APEC ENERGY OVERVIEW 2014

Prepared by

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FOREWORD

The sustainable development and use of energy resources continues to be at the forefront of energy policy in APEC. Facilitating economic growth and securing adequate energy supply, while also taking into account the global responsibility for reducing greenhouse gas emissions, has resulted in a focus on energy efficiency and carbon emission reduction.

APEC economies continue to develop plans and measures to improve energy efficiency across all sectors of the economy. Most economies have followed-through on previously committed action plans to improve energy efficiency; embarked on efficiency awareness raising campaigns; promoted good energy management practices and facilitated investment in energy efficiency.

In a statement made in November 2011 at the APEC Ministerial Meeting in Honolulu, Hawaii, the APEC Ministers aspired to meet a new APEC-wide regional goal of reducing the energy intensity of the APEC economies by at least 45 percent by 2035, using 2005 as a base year. This came after reviewing data analysed by the APEC Energy Working Group (EWG) which indicated that APEC is on the path to significantly exceed its previous energy intensity goal. The 45% reduction is an aggregate goal, which recognizes that economies' rates of improvement may vary for many reasons.

In addition to this, at the APEC Energy Ministers Meeting in Beijing, China on September 2014, the Ministers reaffirmed the UN 'Sustainable Energy for All' initiative. They instructed the EWG through the Expert Group on New and Renewable Energy Technologies (EGNRET) to develop the road map for the aspirational goal of doubling the share of renewables in the APEC energy mix, including in power generation by 2030. As part of this Ministerial reaffirmation, the Asia Pacific Energy Research Centre (APERC) as well as EGNRET and Expert Group on Energy Data and Analysis (EGEDA) collaborated for facilitating discussions on this issue at EWG. The APEC Renewable Energy Share Doubling Goal will need to address either APEC energy security, reduction of carbon dioxide (CO2) or sustainable development and ensure goal setting is consistent with that of the APEC Energy Intensity Reduction Goal.

Sustainable energy development can be achieved by employing highly effective government policies and by broadening 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 those related to policy updates, upstream development, energy efficiency, low carbon energy, and environmental protection.

We hope that this report helps to deepen mutual understanding among APEC economies on energy issues in 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
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 comprises of six states and two territories. The population of just under than 23 million lives mostly in major cities or regional centres along the eastern and south-eastern seaboards. Australia has maintained robust economic growth for the last 23 years, averaging 3.4% over the period 1960–2014 (ABS, 2014). In 2012, Australia's GDP reached USD 911.8 billion (USD 2010 PPP), a 3.6% increase from 2011 (EDMC, 2014). It is the only developed economy in APEC to have recorded no annual recessions during the last 23 years (ATC, 2014).

Australia has abundant, high-quality energy resources that are likely to last for many decades at current rates of production. The Australian energy industry is a significant contributor to the economy (ABS, 2014).

In 2012-13, Australia's energy production increased by 9.4% compared to 19 318 petajoules or 461 404 ktoe (BREE, 2014a). Australia produces energy for both domestic consumption and export. Net energy exports grew by 15.0% and accounted for 68.0% of domestic energy production in 2012-13 (BREE, 2014a).

Australia produces uranium for export only, while all other energy production supplies both domestic and international markets. Australia's energy production increased at an average annual rate of 2.3% in the ten years to 2012–13 (BREE, 2014a).

In 2012–13, coal accounted for 59.2% of Australia's primary energy production, in energy content terms, followed by uranium (21.9%) and gas (12.6%) (BREE, 2014a). Crude oil and LPG represented a further 4.6% of total energy production in energy content terms, and renewables 1.7% (BREE, 2014a). Relative to 2012–13, Australian export earnings from energy and mineral commodities increased by 12.0% in 2013-14 to AUD 195 billion (OCE, 2014).

Australia is the world's eighth-largest energy producer, accounting for around 2.4% of world energy production the second largest exporter of coal and a major exporter of uranium and liquefied natural gas (LNG) (BREE, 2014b). Given Australia's large energy resources and geographical proximity to burgeoning markets in the Asia–Pacific region, it is capable of meeting a significant proportion of the world's growing energy demand, as well as its own domestic needs.

Table 1: Key data and economic profile, 2012

Key data[a]		Energy reserves[b]	
Area (million sq. km)	7.7	Oil (billion barrels)	3.8
Population (million)	22.7	Gas (billion cubic metres)	3738.4
GDP (USD (2010) billion at PPP)	911.8	Coal (million tonnes*)	105 246
GDP (USD (2010) per capita at PPP)	40 124	Uranium (kilotonnes U)	3 471.5

Sources: a. (EDMC, 2014). b. (GA, 2014); *recoverable economically demonstrated resources of black and brown coal

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2012–13 Australia's total primary energy supply was 19 318 petajoules or 461 404 ktoe (BREE, 2014a). Around 59.2% of supply came from coal, 4.6% from crude oil and LPG, 12.6% from gas, 21.9% from uranium and the remaining 1.7% from renewables (BREE, 2014a).

Australia accounts for around 9.0% of the world's black coal production and is the fourth largest producer behind the United States, Russia and China respectively (BREE, 2014b). Australian coking and steaming coals are high in energy content and are relatively low in sulphur, ash and other contaminants. Coal is Australia's second largest commodity export, earning AUD 40.0 billion in 2013-14 followed by LNG (AUD 16.3 billion) and crude oil (AUD 11.1 billion) (BREE, 2014b). It is also an important component of domestic energy supply, accounting for approximately 64.0% of total electricity generation in 2012-13 (OCE, 2014).

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 of Australia's conventional gas comes from three basins: the Carnarvon Basin offshore Western Australia, the Gippsland Basin offshore Victoria and the onshore Cooper–Eromanga Basin that straddles the South Australian and Queensland boundary (GA, 2014). While gas production remained relatively stable in 2013-14 (62.8 billion cubic metres), the start-up of Pluto LNG in April 2012 had resulted in around 5 billion cubic metres of additional gas production in 2012–13 (BREE, 2014b).

Production of coal-seam gas (CSG), which is produced only in New South Wales and Queensland, has expanded rapidly from a share of 3.0% of total gas production in 2004-05 to 12.0% in 2012–13 (BREE, 2014b). CSG production is likely to continue to grow, and a number of projects are under development.

Australia is a net importer of crude oil and condensate, but a net exporter of liquefied petroleum gas (LPG) (BREE, 2014b). Australia's crude oil and condensate production declined by 12.0% in 2012-13 largely due to scheduled production outages (BREE, 2014b). Australia's oil production is likely to decline (BREE, 2014b).

In 2012-13, 249 075 gigawatt-hours (GWh) of electricity was generated, mostly from coal (64.0%) (BREE, 2014b). Given its abundance, coal is likely to remain the most commonly used fuel in electricity generation. However, a large number of wind energy projects, are planned or underway, and are expected to account for an increasing proportion of total electricity generation over the medium to long term.

FINAL ENERGY CONSUMPTION

Australia's total net energy consumption in 2012–13 fell to 5 884 PJ (or 140 537 ktoe) from 5 915 PJ in 2011-12 (BREE, 2014a). In 2012–13 the electricity generation sector was the largest energy consuming sector at 27.6% of Australia's total net energy consumption. The transport sector was the next largest at 26.3%, and then the manufacturing sector at 21.7% (BREE, 2014a). This is followed by the mining (8.3%), residential (7.7%), commercial (5.2%), other (1.1%) and construction (0.4%) sectors (BREE, 2014a). By energy source, petroleum products accounted for 37.7% of consumption in 2012–13, coal 33.1%, gas 23.6% and renewables 5.6% (BREE, 2014a). Gas has increased due to greater uptake by the electricity generation sector and growth in industrial use (BREE, 2014a). The share of renewable energy consumption increased in 2012-13 by 12.0% with growth in solar, wind, hydro and biomass, and decline in biogas and biofuel use (BREE 2014a).

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	296 246	Industry sector	23 263	Total	236 339
Net imports and other	–179 201	Transport sector	30 119	Thermal	214 114
Total PES	122 858	Other sectors	24 170	Hydro	14 026
Coal	48 193	Total FEC	77 551	Nuclear	–
Oil	41 380	Coal	2 985	Geothermal	–
Gas	27 028	Oil	40 047	Others	8 199
Other	6 258	Gas	13 007		
		Electricity and other	21 511		

Source: (EDMC, 2014).

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

ENERGY INTENSITY ANALYSIS

Australia is contributing to the APEC's aspirational goal of a 45.0% energy intensity reduction by 2015 from 2005 levels. Over the last 30 years Australia's energy intensity has generally improved in Australia as depicted in Figure 1 (BREE, 2014a). In 2012-13, energy intensity declined by nearly 3.0%. According to BREE analysis, changes in energy consumption are broken down into the activity effect, which uses changes in the output or level of activity; the structural effect, which uses changes in the composition of activity; and the efficiency effect, which relies on changes in energy intensity. The APEC Energy Statistics' analysis found an improvement in final energy demand of 1.8% from 2011 levels.

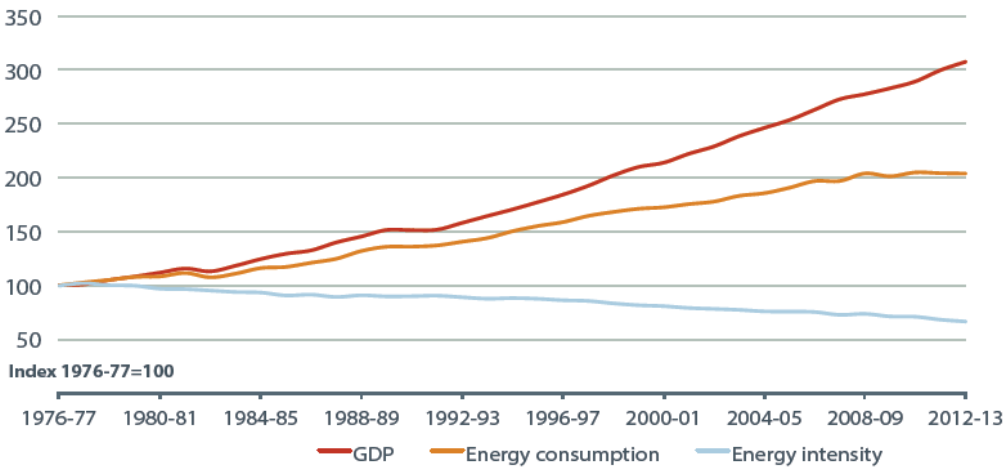
Australia's energy intensity improvements are likely due to improvements in energy efficiency from advances in technology and industry structures shifting towards less energy-intensive sectors such as commercial and services.

Table 3: Energy Intensity Analysis, 2012

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	139.7	140.7	0.7
Final Energy Demand	88.0	86.4	-1.8
Industry	25.8	25.4	-1.7
Transportation	34.0	34.2	0.5
Others	28.2	26.9	-4.5

Source: (EDMC, 2014).

Figure 1: Australian Energy Intensity.



Source: (BREE, 2014a).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

Australia's system of government has three tiers: the Federal Government; the six State Governments and two territory governments; and the local governments. Either the federal government or the state/territory governments rather than private individuals own Australian energy resources. None of the tiers of government are engaged in commercial exploration or development. The Australian Federal 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'). Each state government oversees she approvals process for unconventional gas exploration for their jurisdiction, with the Australian Government, under the Federal Department of the Environment, considering aspects of 'national environmental significance' under the Environment Protection and Biodiversity Conservation Act 1999. In this process, each state/territory assesses applications from proponents looking to explore in their area, and then declines or grants access. Similarly, the state/territory carries out the assessment of safety requirements and environmental regulations for the coal industry in their respective jurisdictions.

The Federal Australian Department of Industry and Science oversees resources and energy matters at a federal level. This includes energy security, international engagement, energy efficiency programs, and energy markets.

The Australian Government has committed to a set of signature economy-wide reforms to respond to rising business and household costs, including a new Energy White Paper. The Energy White Paper will outline a coherent, integrated and efficient regulatory and policy framework, stimulating sustainable growth, building community confidence in environmental safeguards and growing investment in the energy sector. See also the 'Notable energy developments' section. It is due for publication in 2015.

In December 2013, the COAG Energy Council replaced the Council of Australian Governments' (COAG) Standing Council on Energy and Resources (SCER). The role of the Council is to provide a forum for collaboration between jurisdictions on 'matters of national significance' requiring joint action by the Commonwealth, State and Territory Governments, including developing and implementing an integrated and coherent energy and mineral resources policy. The Energy Council is responsible for the remits of the former SCER, Ministerial Council on Energy (MCE) and former Ministerial Council on Mineral and Petroleum Resources (Industry, 2014a). The Australian Minister for Industry and Science chairs it.

The Council's work covers the following broad themes:

- Overarching responsibility and policy leadership for Australian gas and electricity markets;
- Promotion of energy efficiency and energy productivity in Australia;
- Australian electricity, gas and petroleum product energy security;
- Cooperation between Commonwealth, State and Territory Governments; and
- Facilitating the economic and competitive development of Australia's mineral and energy resources.

ENERGY SECURITY

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

Using the same definition of energy security, the second NESA in 2011 found that energy security did not depend on Australian energy independence, or the ability to be self-sufficient. Australia's overall energy

security should remain adequate and reliable. Increasingly both the level of new investment going forward and the price of energy, which are both materially influenced by global trends, shaped it. Work has commenced on the third NESA, with release planned for 2015. The updated NESA webpage link is: www.industry.gov.au/Energy/EnergySecurity/nesa/Pages/default.aspx.

UPSTREAM ENERGY DEVELOPMENT

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

- The efficient commercial development of its energy resources should be promoted to provide the highest-value return for the community;
- Energy resource development should be safe and sustainable, and consistent with all relevant environmental and health and safety standards and obligations;
- The development of Australia's energy resources should contribute to its ongoing domestic energy security;
- The development of its energy resources should enhance Australia's international competitiveness; and
- The energy resource development framework should interface appropriately and effectively with other relevant markets or regulatory frameworks to support efficient investment in upstream development and downstream supply capacity.

The Australian Government does not undertake or finance energy resource exploration or development. In the offshore petroleum sector, the Australian government relies on an annual acreage release of vacant offshore acreage to create opportunities for investment. The release, distributed worldwide, is a comprehensive package that includes geological details of the acreage, bidding requirements and investment considerations for each release area on offer. The onshore petroleum sector is managed by the relevant State/Territory jurisdictions.

ENERGY MARKETS

MARKET REFORMS

Energy market reform is a priority issue for COAG (Industry, 2014b). To date reforms have included creating the National Electricity Market, and supporting legislation and an Australian Gas Market Development Plan. Details on recent market reforms are available on the COAG Energy Council website: www.scer.gov.au/ (COAG, 2014).

ELECTRICITY AND GAS MARKETS

The National Electricity Market (NEM) was established in 1998 to allow the inter-jurisdictional flow of electricity between the Australian Capital Territory, New South Wales, Queensland, South Australia and Victoria (Tasmania joined the NEM in 2005). The NEM is not connected to Western Australia and the 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 is 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.

Australia's gas markets are projected to undergo major changes in the period to 2030, with the development of new unconventional gas resources seeing an expected tripling of domestic gas production over this period in response to strong international and steady domestic demand growth. On 3 January 2014, in response to concerns about the dynamics of the eastern Australian gas market as it makes this transition, the Australian Government released the Eastern Australian Domestic Gas Market Study. The objective of this study was to inform policy makers of the demand supply situation in the eastern Australian gas market and barriers to domestic gas supply over the period 2012–23, as well as canvassing opportunities to improve market efficiency. The Australian Government's response to the eastern

Australian gas market and supply issues will be included as part of the Australian Government's Energy White Paper (Industry, 2014c).

A key component of the 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), the 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 (AEMO, 2014).

The AEMO's functions include operating 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 establishing a short-term trading market for gas from 2010 (AEMO, 2014).

The AEMO is also responsible for improving the operation of Australia's energy markets. It prepares and publishes a 20-year National Transmission Network Development Plan, which provides more information to market participants and potential investors. In addition, it publishes the Statement of Opportunities regarding electricity and the new Gas Market Statement of Opportunities, both of which forecast long-term supply and demand. It also maintains Australia's gas market Bulletin Board (AEMO, 2014).

The AEMO oversees Australia's energy market governance in cooperation with the Australian Energy Market Commission (AEMC), as the rule-making body, and the Australian Energy Regulator (AER), as the regulating body. The COAG Energy Council, comprising energy and resources ministers from all Australian governments, is responsible for energy policy and the legislative frameworks under which AEMO, AEMC and AER operate.

A review of the governance arrangements of these three energy institutions is scheduled to begin in early 2015. This review will consider the performance of current governance arrangements for energy markets and provide advice to the COAG Energy Council on potential areas of improvement to the institutions and their oversight by the COAG Energy Council. More information including the Terms of Reference for the Review is available at www.scer.govspace.gov.au/workstreams/energy-market-reform/review-of-governance-arrangements.

FISCAL REGIME AND INVESTMENT

FEDERAL CORPORATE INCOME TAX

The corporate taxation treatment of companies operating in the energy sector is generally the same as the treatment of corporations in all other industries. Corporations earning an income in Australia are subject to corporate income tax, which is imposed at a rate of 30.0%. Project ring fencing does not apply, and profits and losses of one project can be used to offset those of another project, subject to common ownership criteria.

Certain expenditures incurred by energy companies, such as exploration expenditure and royalty payments, are immediately deductible for corporate income tax purposes. Other indirect taxes, such as payroll tax, fringe benefits tax, fuel excise and land taxes may apply.

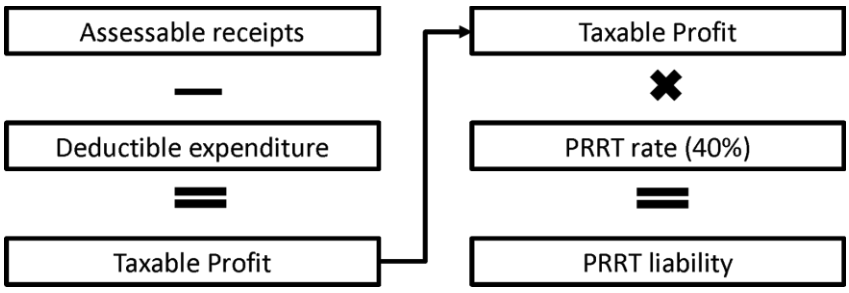
FEDERAL PETROLEUM RESOURCE RENT TAX

The Petroleum Resource Rent Tax (PRRT) is a Federal profits-based tax payable on the upstream profits of a petroleum project. The PRRT has been in operation in Australia since 1 July 1986. Previously applied solely to operations in offshore Australia, the PRRT was extended to apply to all onshore and offshore projects operating in Australia from 1 July 2012 (ATO, 2014a).

Unlike royalty and excise regimes, the PRRT applies to the profits derived from a petroleum project and not the volume or value of the petroleum produced. To ensure that only the economic rent generated from a petroleum project is captured by the PRRT, deductions are provided for all allowable expenditure (together with indexation of carry forward losses). Furthermore, where other layers of resource taxes are applicable (such as State and Territory royalties and Federal crude oil excise), these expenditures are creditable against the liabilities of PRRT projects. This ensures that petroleum projects are not subject to double taxation (ATO, 2014a).

PRRT applies at a rate of 40.0% to taxable profit derived in a financial year from a petroleum project. Taxable profit is calculated by deducting eligible project expenses from the assessable revenues derived from the project. As the PRRT is a project-based tax, losses may not generally be offset against other project income. The exception is exploration expenditure, which is transferable to other petroleum projects, subject to a number of conditions. PRRT payments are deductible for income tax purposes, and a PRRT liability is calculated as per Figure 2 below (ATO, 2014a).

Figure 2: Calculating a PRRT Liability



ROYALTIES

Royalties are generally levied by the States and are an alternate mechanism to charge for resource extraction. 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 petroleum, the state and Northern Territory governments collect royalties for onshore production. The rate is generally between 10.0% and 12.5% of the net wellhead value of production depending on whether it is from a primary or secondary production licence, or a combination.

For offshore production (excluding petroleum), 60.0% of the royalties are directed to the state or territory government and the remaining 40.0% to the Australian government.

FEDERAL CRUDE OIL EXCISE

Excise arrangements apply to eligible crude oil and condensate production from the North West Shelf project area and onshore areas (including coastal waters). Excise is levied on the price of all sales made in a producing region, at rates based on the timing of the discovery and/or the date of development. The first 30 000 barrels of cumulative production from each field is exempt from crude oil excise.

EXPLORATION DEVELOPMENT INCENTIVE (EDI)

Effective from 1 July 2014, the Australian Government introduced the EDI to encourage investment in small exploration companies undertaking 'greenfields' mineral exploration in Australia. The scheme is available to junior minerals explorers incurring eligible 'greenfields' exploration expenditure in Australia.

Where a mining company does not have sufficient income to utilise exploration deductions, the EDI provides a mechanism for Australian resident shareholders to deduct the expense of mining exploration against their taxable income. The EDI does not apply to exploration for quarry materials, petroleum exploration (including exploration for natural gas from coal seams and shale oil), or geothermal energy resources.

RESEARCH AND DEVELOPMENT TAX INCENTIVE

The Research and Development tax offset has been in effect since 1 July 2011. The two core components of the package are:

- A 45.0% refundable tax offset for companies with a turnover of less than AUD 20 million per year;
- A 40.0% non-refundable tax offset for aggregate turnover equal to or greater than AUD 20 million per year.

JOINT PETROLEUM DEVELOPMENT AREA

Petroleum produced within the Joint Petroleum Development Area (JPDA) is subject to fiscal terms outlined in a Production Sharing Contract (PSC). PSCs are agreements between the parties to a petroleum extraction facility and the Australian and East Timorese governments regarding the percentage of production each party will receive after the participating parties have recovered a specified amount of costs and expenses. Government revenues from petroleum extracted within the JPDA are shared 90.0% to Timor-Leste and 10.0% to Australia.

MINERALS RESOURCE RENT TAX (MRRT)

The MRRT regime previously applied to iron ore and coal mining in Australia from 1 July 2012. However, the Australian Government repealed the MRRT in September 2014, and so from 1 October 2014 MRRT liable entities will not accrue further liabilities. (ATO, 2014b).

INVESTMENT

The Australian energy sector faces challenges in attracting investment over the next decade, although Australia's practical investment needs over this period will depend on long-term demand trends. The AEMO's 2014 National Transmission Development Plan (NTNDP) forecasts between AUD 9.1 and 17.7 billion for electricity transmission investment assets will be required over the next 20 years (AEMO, 2014).

ENERGY EFFICIENCY

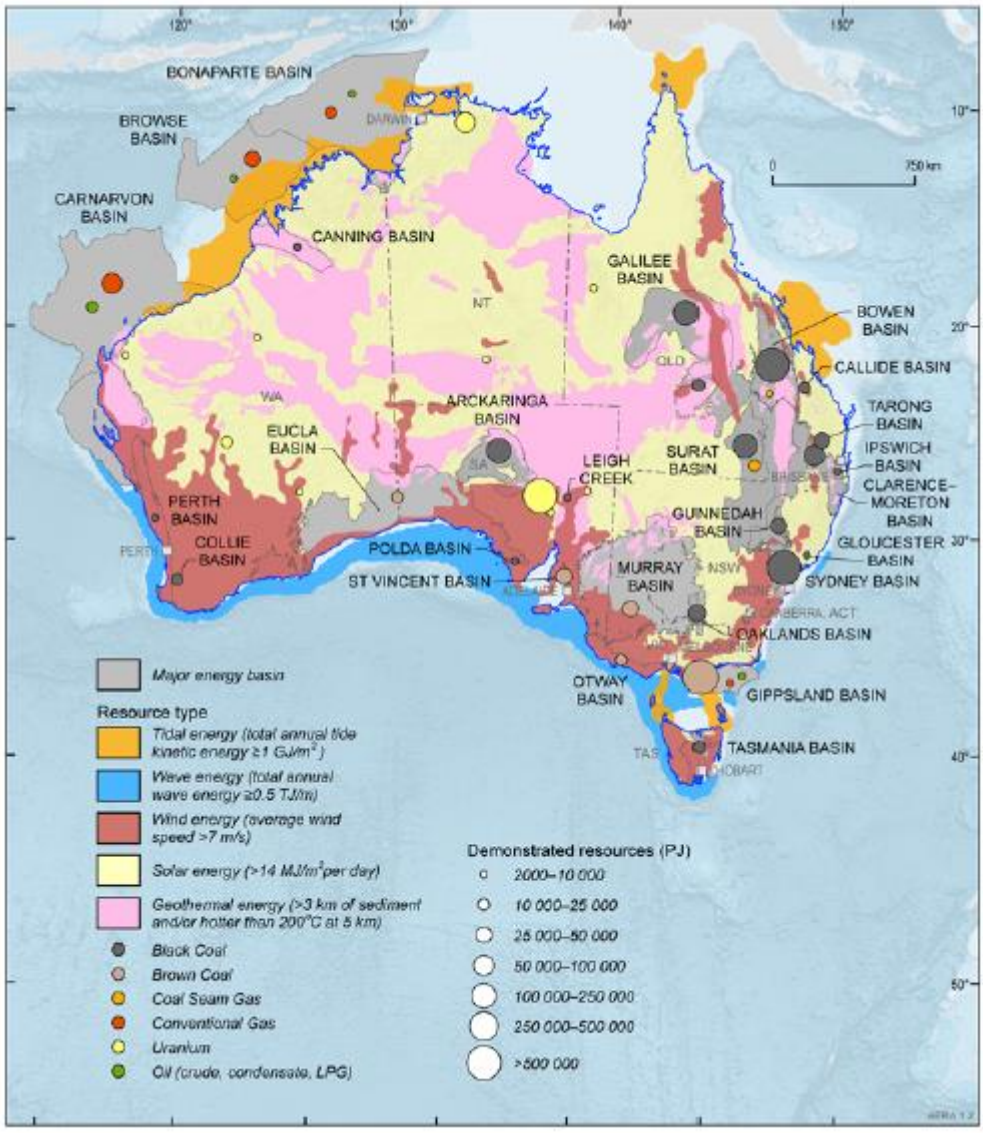
Australia has a number of programs and regulatory measures that promote energy efficiency. The National Strategy for Energy Efficiency (NSEE), released in July 2009, is an overarching programme of work for promoting energy efficiency in Australia. The NSEE is a coordinated approach to accelerating energy efficiency efforts that help households and businesses reduce their energy costs and prepare for the emissions reduction measures and targets.

The NSEE incorporates and builds on measures already agreed on by COAG and the SCER through the National Framework for Energy Efficiency (NFEE). All NFEE projects and activities form part of the NSEE, which is now the responsibility of the COAG Energy Council. 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, industry innovation, advice and education. The NSEE addresses barriers that prevent the optimal uptake of energy efficient opportunities, such as information failures.

RENEWABLE ENERGY

Australia has abundant and diverse clean energy resources with significant potential for future development as shown in Figure 3 (take from 4 of the AER). Solar PV use increased by 49.2% in 2012-13 along with a 3.9% increase in solar hot water from 2011-12 (BREE, 2014a). Wind-powered electricity generation increased by 19.9% in 2012-13 relative to 2011–12 levels (BREE, 2014a). Hydro also increased significantly at 29.7% in 2012-13 relative to 2012-11 levels, due to 'increased water inflows in south eastern Australia as well as improved relative costs of hydro under the carbon price' (BREE, 2014a).

Figure 3: Map of Distribution of Australia's energy resources



Source: (GA, 2014).

The Renewable Energy (Electricity) Amendment Act 2009 and the Renewable Energy (Electricity) (Charge) Amendment Act 2010 were passed in September 2009 and June 2010, respectively. The Renewable Energy (Electricity) Amendment Act 2009 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 (Environment 2014a).

In June 2010, the Australian Government passed further legislation to split the expanded RET into two parts. Effective 1 January 2011, the enhanced RET includes the Small-scale Renewable Energy Scheme (SRES) and the Large-scale Renewable Energy Target (LRET). This enhanced RET aims for at least 20.0% (or around 60 000 GWh) of electricity supply to be provided from renewable sources by 2020. This includes a target of 45 000 GWh of new renewable electricity generation, on top of the 15 000 GWh of existing renewable. The LRET would deliver the majority of the 2020 target (41 000 GWh). The uncapped SRES provides a subsidy to small-scale technologies, such as residential solar panels and solar hot water systems.

The Australian Government undertook a review of the RET. The Expert Panel has completed its review and provided a report to the Government, which is available at: www.retreview.dpmc.gov.au/. The Australian Government is seeking to reform the RET to allow sustainable in renewable energy use and create a more stable environment for long-term investment.

The Australian Renewable Energy Agency (ARENA) is an independent agency established by the Australian Government on 1 July 2012. It has AUD 2.5 billion out to 2022 to fund renewable energy projects (solar, bioenergy, marine geothermal and enabling technologies) and support research and development, commercialisation and early deployment activities, along with activities that capture and share knowledge. The two objectives of ARENA are to improve the competitiveness of renewable energy technologies and to increase the supply of renewable energy in Australia. The Australian Centre for Renewable Energy and the Australian Solar Institute has been incorporated into ARENA. By June 2014 ARENA had committed $1.2 billion in support of more than 200 projects, studies fellowships and scholarships, which have a total value of $3.5 billion.

ARENA's independent decision-making board, also referred to as the 'Board', consists of up to seven members appointed by the Minister for Industry and Science and has a CEO appointed by the Minister for Industry and Science, on the recommendation of the Board. Membership of the Board reflects the skills required to meet the objectives of ARENA. For more information see: www.arena.gov.au.

There is no Australia-wide feed-in tariff scheme to support small-scale renewable technologies. Most state and territory governments implemented jurisdictional feed-in tariff arrangements for small-scale renewable technologies, but all of these schemes have now been amended or closed.

In December 2014 Australia reached 4GW of installed solar, representing a four-fold increase from installed capacity in 2011. The majority of this capacity is small-scale rooftop systems. Over two million households have installed solar PV or solar hot water systems in Australia with penetration levels over 20.0% in some areas.

Over the long term, renewables consumption will increase by approximately 0.9% to 2049-50 and renewables in electricity generation will grow by 1.5% to 2049-50 (BREE, 2014d). Renewables generation will grow to 20.0% of the percentage share of electricity generation by 2049-50, with 10.0% from wind energy (BREE, 2014d).

ENERGY TECHNOLOGY AND RESEARCH AND DEVELOPMENT

In the Australian science system, the bulk of basic research is conducted in the university sector. Funding delivery occurs through organisations including the Australian Research Council, which has established a range of competitive grants schemes. The Commonwealth Scientific and Industrial Research Organisation's (CSIRO) Energy Flagships program provides a focus for energy research and development in Australia, and ARENA supports research and development into renewable energy through funding and knowledge sharing.

NUCLEAR

Australia does not have any commercial nuclear reactors.

CLIMATE CHANGE

The Australian Government is committed to reducing Australia's greenhouse gas emissions by 5.0% below 2000 levels by 2020. The Emissions Reduction Fund (ERF) is the government's program to meet this target. Legislation for the ERF passed parliament on 31 October 2014 (Environment, 2014b).

The ERF has a capped funding allocation of $2.55 billion. The fund has three main components: crediting emissions reductions, purchasing emissions reductions, and safeguarding emissions reductions (CER, 2014). The emissions reduction fund enables the Government to 'purchase lowest cost abatement (in the form of Australian carbon credit units) from a wide range of sources' (CER, 2014). The Clean Energy Regulator (CER) will administer the fund.

The carbon tax was repealed by Parliament with effect from 1 July 2014 (Environment, 2014c).

NOTABLE ENERGY DEVELOPMENTS

ENERGY WHITE PAPER 2015

On 5 December 2013 the Australian Government released the terms of reference for the Energy White Paper and the Issues Paper was released on 17 December 2013. The Issues Paper provided an overview of the energy issues facing Australia. They included: energy supply security, regulatory reform and the role of government, growth and investment, trade and international relations, workforce productivity, driving energy productivity, and alternative and emerging energy sources and technology.

A Green Paper was released on 23 September 2014 which presented a clear set of policy goals across four priority areas: pursuing a focus on deregulation; promoting competition; creating more certainty and competition in gas markets; and improving economic, environmental and security outcomes. The Energy White Paper will be released in 2015. The Energy White Paper will set out an integrated and coherent Australian Government position on energy policy and will consider the supply and use of Australia's energy resources to deliver security of supply, increases in new energy sources to ease demand~~/~~ and supply constraints, regulatory reform to put downward pressure on prices, and improved energy productivity. Downward pressure on prices will help relieve cost-of-living pressures and improve business competitiveness. For more information see: www.ewp.industry.gov.au.

G20-INTERNATIONAL ENERGY FORUM GAS MARKETS DIALOGUE

In November 2014 Australia and Mexico co-chaired the G20-International Energy Forum (IEF) Gas Markets Dialogue. It was the first G20IEF and it aimed to bring together gas industry experts from business, government, and international and regional organisations to enhance collaboration and to identify practical ways to improve how gas markets function. The dialogue centred around three themes: increasing market transparency; encouraging investment in gas infrastructure; and exchanging information about Australia's the region's approaches to increasing gas market resilience and security.

G20 ENERGY EFFICIENCY ACTION PLAN

As President of the G20 in 2014, Australia led the development of the G20 Energy Efficiency Action Plan. The G20 Energy Efficiency Action Plan was endorsed by G20 Leaders at the November G20 summit and provides a significant step for improving energy efficiency globally through international cooperation.

The G20 Energy Efficiency Action Plan documents six work streams where G20 members and guests will work together to improve energy efficiency. Each G20 member and guest has nominated which work streams they will participate in from the Action Plan. These work streams will be progressed through the International Partnership for Energy Efficiency Cooperation (IPEEC) and other international organisations such as the IEA, throughout 2015. The G20 has also tasked IPEEC to report on the progress of these activities to the G20 at the end of 2015.

The plan is available for download here:

www.g20.org/sites/default/files/g20_resources/library/g20_energy_efficiency_action_plan.pdf.

OFFSHORE PETROLEUM RESOURCES MANAGEMENTS REVIEW

In 2014 the Australian Government Department of Industry commenced a high-level strategic review of the offshore petroleum frameworks governing oil and gas resource management in Commonwealth waters. The Offshore Petroleum Resource Management aims to refine the regulatory and administrative frameworks that support timely and efficient commercial investment, exploration and development. A consultation paper was released in November 2014, an interim report is planned for late March 2015, and a final report is scheduled for release mid-2015.

The Terms of Reference for the Review is available for download at: www.industry.gov.au/resource/UpstreamPetroleum/Pages/Offshore-Petroleum-Resources-Management-Review.aspx.

NEW ENERGY PROJECTS

Australia's production and infrastructure capacity will be expanded in the future through the completion of new projects. BREE's *Electricity Generation Major Projects* provides a list of major electricity generation facilities under development, including renewable and non-renewable sources. It is available for download at: www.bree.gov.au/publications/major-electricity-generation-projects.

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USEFUL LINKS

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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 Industry and Science—www.industry.gov.au

Office of the Chief Economist — http://www.industry.gov.au/industry/Office-of-the-Chief-Economist/Pages/default.aspx

Clean Energy Regulator—www.cleanenergyregulator.gov.au

Commonwealth Law—www.comlaw.gov.au

Energy White Paper—www.ewp.industry.gov.au

BRUNEI DARUSSALAM

INTRODUCTION

Brunei Darussalam, which means 'Brunei the Abode of Peace', is strategically located on the north-west coast of the island of Borneo. It covers a total land area of around 5 765 square kilometres and has 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 the economy 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; and its capital, Bandar Seri Begawan, is located in the Brunei-Muara District. Brunei Darussalam is a small economy with great potential. In 2013, it had a population of around 406 200. It is characterised by a mixture of foreign and domestic entrepreneurship, government regulation, welfare programs and traditional village economies.

Brunei Darussalam's GDP in 2013 was USD 29.0 billion (at 2010 USD PPP). Notwithstanding the change in PPP base year from 2005 to 2011, the economy is still enjoying a very high GDP per capita at USD 70 284 in 2013 as compared to other Southeast Asian economies (EDMC, 2014). The oil and gas sector continue to be the economy's main source of revenue and constitutes more than 60.0% of Brunei Darussalam's GDP. To further sustain and strengthen the oil and gas industry, the government is actively strengthening oil and gas upstream and downstream activities as well as energy services (EDPMO, 2015).

Table 1: Key data and economic profile, 2013

Key data		Energy reserves	
Area (sq. km)[a]	5 765	Oil (billion barrels)[c]	1.1
Population (thousand)[a]	406.0	Gas (billion cubic metres)[c]	3 000
GDP (USD (2010) billion at PPP)[b]	29.0	Coal (million tonnes)[c]	–
GDP (USD (2010) per capita at PPP)[b]	70 284	Uranium (kilotonnes U)	–

Sources: a. (DEPD, 2013); b. (EDMC, 2014); c. (BP, 2014).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

The total primary energy supply of Brunei Darussalam in 2012 was 3 406 kilotonnes of oil equivalent (ktoe). Natural gas represented about 78.0% of the total primary energy supply and oil 22.0%. Oil and gas production reached 20 016 ktoe in 2012. As a major oil and gas exporter, Brunei Darussalam exported 82.0% of its oil and gas production in 2012 (EDMC, 2014).

Crude oil production and condensate in 2013 was 135 thousand barrels per day, the majority of which was exported (93.0%). The export destinations for Brunei Darussalam's oil and condensate in 2013 were Australia (15.3%); Indonesia (11.1%); India (16.2%); Republic of Korea (17.7%); and Vietnam (11.4%). Gas production was around 33.9 million cubic metres a day, most of which was exported as liquefied natural gas (LNG) to the major markets of Japan and South Korea (EDPMO, 2015).

Brunei Darussalam's total installed electricity generation capacity from both public utilities and industries reached 916.7 megawatts (MW) in 2012 (DEPD, 2013, p.45). In the same year, total electricity generated was 3 931 GWh, with almost all of the electricity generated being supplied by natural gas (EDMC, 2014).

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	20 016	Industrial sector	203	Total	3 931
Net imports and other	-16 488	Transport sector	451	Thermal	3 929
Total PES	3 406	Other sectors	314	Hydro	–
Coal	–	Total FEC	968	Nuclear	–
Oil	750	Coal	–	Geothermal	–
Gas	2 656	Oil	666	Others	2
Others	–	Gas	26		
		Electricity and other	276		

Source: (EDMC, 2014).

FINAL ENERGY CONSUMPTION

Brunei Darussalam's total final energy consumption in 2012 reached 968 ktoe. The transport sector topped the economy's energy demand at 451 ktoe or 46.6% of the total amount. The other sectors (residential, commercial and non-energy) consumed 32.4% of the total energy used and the industrial sector 21.0%. In terms of energy source, oil accounted for 68.8% of final consumption, followed by electricity and other (28.5%) and gas (2.7%). Natural gas accounted for 99% of the fuel type used to generate electricity, 0.96% was generated by diesel fuel and 0.04% from solar system (EDMC, 2014).

ENERGY INTENSITY ANALYSIS

Brunei Darussalam is contributing to the APEC overall aspirational goal of a 45.0% intensity reduction by 2035 (2005 as base year). In 2012, primary intensity was 117.6 tonnes of oil equivalent per million USD or an improvement of less than 1.0% over the last year's primary intensity. Meanwhile, the economy's final energy intensity reached 33.4 toe/million USD, with the transportation sector accounting for the biggest at 15.7 toe/million USD in view of the economy's increasing energy requirement in the said sector (Table 3).

Table 3: Energy Intensity Analysis, 2012

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	117.7	117.6	-0.1
Final Energy Demand	31.9	33.4	4.7
Industry	6.2	7.0	12.1
Transportation	15.0	15.6	3.7
Others	10.6	10.8	1.9

Source: (EDMC, 2014).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

Energy continues to be the core pillar of Brunei Darussalam's economy and the oil and gas industry is main driver for its economic growth (EDPMO, 2013). In 1981, the Oil Conservation Policy was introduced after oil production peaked at 261 000 barrels per day in 1979. The policy aimed to extend the life of the economy's oil reserves. As a result, oil production gradually declined to around 150 barrels per day in 1989. In November 1990, the government reviewed the policy and removed the production ceiling,

resulting in production of 219 barrels per day by 2006. By 2011, crude oil and condensate production averaged 165 barrels per day. In 2000, the Brunei Natural Gas Policy (Production and Utilisation) was introduced. The policy aimed to maintain gas production at 2000 levels in order 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 electric power generation.

In January 2002, the Brunei National Petroleum Company Private Limited (PetroleumBRUNEI) was empowered to manage Brunei Darussalam's commercial interests in the oil and gas sector. PetroleumBRUNEI has been granted all mineral rights in nine petroleum exploration blocks, nominee shareholder status in the Brunei Methanol Company Private Limited, and one of its subsidiaries, PB Logistics, is a shareholder in Brunei Methanol Tanker (BMT).

On 24 May 2005, His Majesty the Sultan and Yang Di-Pertuan of Brunei Darussalam created the position of the Minister of Energy at the Prime Minister's Office and with it, the Energy Division at the Prime Minister's Office. The Energy Division was responsible for formulating the economy's energy policy as well as presiding over matters related to energy. The Petroleum Unit, which oversaw the development of Brunei Darussalam's natural gas and oil sector, and the Department of Electrical Services, which is tasked with managing and developing its electricity sector, also come under the purview of the Minister of Energy at the Prime Minister's Office. In 2011, the Energy Division and the Petroleum Unit merged to become the Energy Department, Prime Minister's Office.

Brunei Darussalam has implemented a series of five year economic development plans known as the National Development Plan. Currently, the tenth National Development Plan (RKN 2012-2017) is in force. This is the second five-year plan under the long-term development plan, Vision Brunei 2035, which states that the economy's major goals for the next three decades are economic diversification and strengthening of the oil and gas sector. The latter is to be achieved by expanding the economy's oil and gas reserves through on-going exploration in both existing and new areas.

In March 2014, the Energy Department, Prime Minister's Office launched Brunei Darussalam's first Energy White Paper that sets out a framework for strategic actions that ensures a more sustainable energy sector for Brunei Darussalam.

ENERGY SECURITY

Recognising the need to enhance energy security and sustainability, improve energy efficiency and accelerate deployment of renewable energy and clean energy supply for Brunei Darussalam, the economy works to strengthen partnership among all its stakeholders.

Brunei Darussalam is an active member of the Association of South-East Asian Nations (ASEAN). It likewise supports the implementation of strategies relating to energy security, diversification of supply, energy efficiency and conservation among the regions. The economy is working actively with the association towards the achievement of the targets set under the ASEAN Plan of Action on Energy Cooperation 2010–15 (the Action Plan), which include among others the ASEAN Power Grid (APG) and the Trans-ASEAN Gas Pipeline (TAGP) projects.

The energy sector of Brunei Darussalam plays a vital role in the realisation of its National plan or known as the Wawasan Brunei 2035. Energy will continue to serve as the major catalyst in the economy's investment, education and infrastructure development (EDPMO, 2013). Brunei Darussalam's 2014 Energy White Paper indicated three strategic goals in addressing the growth of the energy sector (Ibid), namely:

- Strengthen and grow oil and gas upstream and downstream activities;
- Ensure safe, secure, reliable and efficient supply and use of energy; and
- Maximise economic spin-off from the energy industry–boost local content and secure high participation by the local workforce.

In order to assure the achievement of these strategic goals, 10 key performance indicators (KPIs) were developed under these. These KPIs will help address the needs across the energy sector to achieve the targets set under each strategic goal.

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 exclusive economic zone. Most of the existing oil and gas production is located in scattered sites around 70 kilometres offshore. While its oil and gas reserves are expected to last for at least several decades, a few areas onshore and offshore have been opened up for exploration.

As also indicated in the Energy White Paper, the upstream development is one of the strategic goals in Brunei Darussalam Vision 2035 where the economy put forth great efforts in view of its increasing challenges. The economy's energy resources traced its roots back from its first oil discovery in early 19th century, which spurred development in other sectors of the economy. Now, with its currents oil and gas combine production of around 372 000 barrels of oil equivalent per day (Ibid), the economy will continue to boost its upstream production by maximising the potential of its mature fields and venturing into further exploration and development activities. Specifically, Brunei Darussalam will undertake several initiatives to stimulate production, such as the following:

- Rejuvenate existing fields;
- Maximise economic recovery from newly discovered fields;
- Review potential solutions for the development of small and unconnected fields; and
- Upstream international ventures.

DOWNSTREAM ENERGY DEVELOPMENT

The biggest contributor to the existing downstream industry in Brunei Darussalam comes from methanol produced from the economy's abundant natural gas resources as feedstock. According to Brunei Darussalam Vision 2035, the industry is targeting to contribute about BND 300 million to the economy annually, which would mean increasing the economic output from the downstream processing to satisfy the growing demand especially for the supply of emerging markets. To accommodate these growing needs, the Brunei Economic Development Board (BEDB) initiated the development of specialised industrial parks such as the Sungai Liang Industrial Park (SPARK) for petrochemicals and other downstream oil and gas activities.

The government will provide appropriate support and incentives in order to attract more investors to venture into developing and diversifying additional downstream opportunities such as gas-based petrochemicals, crude and condensate based petrochemicals. A priority initiative entitled the "Evaluate Feasibility of Downstream Derivatives" was likewise established as part of the downstream energy development to ensure the achieving of the target. Enabling such activity under this initiative could function as a possible extension of the petrochemical chain to include ethylene and propylene building blocks.

ENERGY MARKETS

The government regulates the energy market in Brunei Darussalam. In view of the maturing energy markets especially in the oil and gas industry, the government is now considering whether to adopt a comprehensive policy and regulatory framework to support the strategic objectives set out for the energy sector. The Energy Department of the Prime Minister's Office (EDPMO) has initially identified four key regulatory policies and frameworks, which include among others, instituting a regulatory body to monitor the local content requirement in the bidding process for contracts from operators. The Local Business Development (LBD) Framework was enforced to ensure that there is a fair and level playing field in the market.

The Government regulates the energy market in Brunei Darussalam. The Government will continue to provide a subsidy for petroleum products, such as gasoline, diesel and LPG, in order to fix and stabilise the pump prices at the retail stations regardless the level of oil prices in the international market. This is to ensure welfare and benefits of the member economy government.

ELECTRICITY MARKET

The Department of Electrical Services, established in 1921, fulfils the regulatory functions for the power sector. Its mission includes the management and development of the electricity sector. There are two

electrical utilities in Brunei Darussalam, the Department of Electrical Services (DES) and the Berakas Power Management Company Private Limited (BPMC). BPMC is owned by the Brunei Investment Agency and operates as a private company that reports to a board of directors. Brunei Darussalam's electricity generation is almost entirely natural gas fired. The only exceptions are the diesel power station at Belingus and the 1.2 MW Tenaga Suria Brunei (TSB) photovoltaic demonstration plant. The transmission system consists of three grids operated by the two electrical utilities.

ENERGY EFFICIENCY

Brunei Darussalam is actively promoting energy efficiency and conservation in various sectors in the economy. Relevant government agencies collaborate in evaluating legislative, financial and fiscal policy measures that promote energy efficiency and low-energy intensive industries. These industries likewise play a role in the energy conservation efforts of the government, which include, among others, the identification of technical levers that reduce energy usage over time. Meanwhile, individual consumption behaviour likewise shifts towards energy efficiency that includes making choices on high-energy efficient appliances.

The EDPMO is now in the process of enacting a regulatory framework on Energy Efficiency and Conservation (EEC) through the economy's National EEC Committee. This committee serves as the body that coordinates EEC efforts with various stakeholders at a high-level and oversees the implementation the EEC Plan of Actions on four major sectors namely residential, commercial, industry and transportation (EDPMO, 2013). The Brunei National Energy Research Institute (BNERI) established in 2012 that serves as the economy's research arm and think tank for energy, likewise continues to conduct study on energy efficiency and conservation.

RENEWABLE ENERGY

One of the KPI's under the second key strategic goals of the economy, renewable energy development in Brunei Darussalam has four major priority initiatives, namely:

- Introduce renewable energy policy and regulatory frameworks;
- Scale-up market deployment of solar PV and promote waste-to-energy technologies;
- Raise awareness and promote human capacity development; and
- Support research, development and demonstration (RD&D) and technology
- Transfer.

Solar energy is by far the most promising renewable energy, given the economy's exposure to equatorial sunshine. In July 2010, the economy commissioned a 1.2 MW solar power plant known as Tenaga Suria Brunei (TSB). TSB is connected to the national power grid and is designed to produce 1344 Mwh of electricity annually, saving 340 kilolitres of crude oil and avoiding 940 tonnes of CO2 emissions annually. The actual electricity recorded in 2010 was 808 Mwh, i.e. saving an equivalent 205 kilolitres of crude oil and avoiding 566 tonnes of CO2 emissions into the atmosphere.

The economy recently completed a waste-to-energy assessment study, which estimated that municipal solid waste production could be developed with a capacity of between 10 to 15 MW.

NUCLEAR

Brunei Darussalam does not have a nuclear energy industry.

CLIMATE CHANGE

Brunei Darussalam recognises the importance of its economic growth on energy security and environmental sustainability. Environmental policy directions are embedded in the Vision Brunei 2035. These include:

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

Brunei Darussalam acceded to the United Nations Framework Convention on Climate Change (UNFCCC, 2012) in 2007 and subsequently to its Kyoto Protocol in 2009. It also associated itself with the Copenhagen Accord in 2009. At the 18th session of the Conference of the Parties (COP18) to the UNFCC, it pledged to continue integrating environmental dimensions into its national development projects. Some of the proposed steps include (UNFCCC, 2012):

- Introducing Environmental Impact Assessment (EIA) in the planning and implementation of projects;
- Optimising land use by introducing vertical development in national housing schemes;
- Conserving carbon sink resources by maintaining 50.0% of total land area under forest cover and apportioning a percentage of built-up areas as green areas;
- Promoting environmentally sound technology and products;
- Enhancing awareness of environmentally friendly lifestyles and resource efficiency;
- Promoting green building initiatives; and
- Increasing the utilisation of renewable energy to reach 10.0% of the energy mix by 2030.

NOTABLE ENERGY DEVELOPMENTS

ENERGY INFRASTRUCTURE PROJECTS

The government of Brunei Darussalam seeks to maximise the potential of the economy's oil and gas resources and to take advantage of its strategic location for trading. One of the key initiatives under the Vision Brunei 2035 is to designate industry 'cluster-specific' sites with supporting infrastructure and facilities. The first site, established in 2007, was the Sungai Liang Industrial Park (SPARK), designed specifically for downstream petrochemical processing activities. The first petrochemical plant constructed at the site, a methanol production plant, was successfully commissioned in April 2010.

A second industrial site is being developed at Pulau Muara Besar (PMB) for oil field support services, such as an Integrated Marine Supply Base (IMSB), fabrication yard and further downstream activities (BEDB, 2012). The anchoring project will be a USD 2.5 billion oil refinery and aromatics cracker project to be developed by the Zheijiang Hengyi Group Co. Ltd. The project is expected to begin operations in 2018, with a production capacity of approximately 175 000 barrels per day. The first phase will consist of the production of petroleum products such as gasoline, diesel and jet A-fuel, as well as paraxylene and benzene, which is used mainly in textile production (BEDB, 2012). The feedstock for this plant will be crude oil and condensate.

In the power sector, a Memorandum of Understanding was signed between the Brunei Government, Brunei LNG and Brunei Shell Petroleum Company to expand the Lumut Co-Generation Power Station to an installed capacity of 246 MW, an increase of 66 MW. This will meet the growing energy demand for the next 15 years and beyond based on the expected increase in the number of households and industrial activities. The new expanded plant will boost an improved efficiency of greater than 60.0% through the application of combined heat and power integration or cogeneration (EWG, 2012).

BRUNEI NATIONAL ENERGY RESEARCH INSTITUTE (BNERI)

Brunei Darussalam's newly established energy research centre, the Brunei National Energy Research Institute (BNERI), is now fully operational. This centre aims to be an international centre of excellence in energy and will focus on developing innovative solutions for using fossil fuels, for energy efficiency and conservation, and for renewable energy.

THE US-ASIA PACIFIC COMPREHENSIVE ENERGY PARTNERSHIP (USACEP)

At the seventh East Asia Summit (EAS) in 2012, President Obama of the United States, in partnership with His Majesty the Sultan and Yang Di-Pertuan of Brunei Darussalam and President Susilo Bambang Yudhoyono of Indonesia, announced the formation of the U.S.-Asia Pacific Comprehensive Partnership (USACEP). The United States has made up to USD 6 billion available for the financing of this venture.

Under the auspices of USACEP, a new Renewable and Alternative Power Generation (RAPG) Work Stream was established as part of the EAS Energy Cooperation. The main aim of this RAPG Work Stream is to spur new renewable energy collaboration and cooperation in the EAS region. The RAPG projects will coexist and complement current renewable energy activities within ASEAN and Dialogue Partners so as to elevate the role of renewable energy in the region. The project areas cover solar photovoltaic, wind and hydro.

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USEFUL LINKS

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

Brunei LNG Sdn Bhd— http://www.bruneilng.com/home.asp

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

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

Prime Minister's Office, 2013—www.energy.gov.bn/Pages/default.aspx

CANADA

INTRODUCTION

Canada is the second largest economy in land area, behind Russia, in the APEC region and the world. Its border with the United States of America (USA) is the longest international border in the world. The population, of more than 34 million, lives predominantly in the southern cities close in proximity to the USA. Out of the 13 provinces and territories, approximately three-quarters of the population resides in the provinces of Ontario (38.6%), Quebec (23.3%) and British Columbia (13.1%) (Statistics Canada, 2014). Canada is an economically robust nation with a gross domestic product (GDP) of USD 1 417.45, which is the 8th largest in the APEC region and grew by 1.71% from 2011. However, GDP per capita experienced a slightly lower growth of 0.5%, amounting to USD 40 785 in 2012.

Canada is endowed with rich and diversified natural resources, making it the fifth largest energy producer in the world behind China, the USA, Russia and Saudi Arabia and the fourth largest in the APEC region. The development of Canada's rich resources positively impacts the economy, directly contributing to 9.5% of total Canadian GDP in 2012 (NEB, 2014a). Canada's total primary energy supply was an estimated 251.1 Mtoe in 2012, relative to 207.8 Mtoe of final energy consumption (EDMC, 2014), making the nation a net exporter and well positioned to supply growing world energy demand.

The economy is well known for its rich supply of indigenous energy resources, with abundant reserves of oil, natural gas, coal, and uranium. Fossil energy reserves consist of the third largest proven oil reserves behind Venezuela and Saudi Arabia, and a smaller yet critical share of the world's proven gas reserves. Canada draws on its vast oil and gas reserves estimated at 172.5 billion barrels and 2 024.7 billion cubic meters, respectively. Of the 172.5 billion barrels of oil reserves, 97.0% can be recovered from unconventional oil sands, situated predominantly in the province of Alberta and partly in Saskatchewan. Canada has a large coal endowment with 8 700 million tonnes of proven resources of coal-in-place actively mined in western provinces and Atlantic Canada. Of that amount, 6 600 million tonnes are deemed recoverable using existing technology under current and expected local economic conditions (NRCan, 2014a). Just as competitive, Canada's uranium reserves are the fourth largest in the world, at 494 kilotonnes of uranium metal located in the Athabasca Basin of northern Saskatchewan. The Athabasca Basin is considered the world's largest deposit of high-grade uranium with grades up to 20.0% uranium, 100 times greater than the world average (NRCan, 2014b).

Table 1: Key Data and Economic Profile, 2012

Key data[a,b]		Energy reserves[c]	
Area (million sq. km)	10.0	Oil (billion barrels)	172.5
Population (million)	34.8	Conventional (billion barrels)	5.3
		Oil sands (billion barrels)	167.2
GDP (USD (2010) billion at PPP)	1 417.5	Gas (billion cubic metres)	2 024.7
GDP (USD (2010) per capita at PPP)	40 785	Coal (million tonnes)	8 700
		Uranium (kilotonnes U)	494

Source: a. (CAPP, 2014a); b. (EDMC, 2014); c. (NRCan, 2014a) and (NRCan, 2014b).

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Canada's domestic energy production reached 419.7 Mtoe in 2012 dominated by fossil fuel production accounting for approximately 83.0%. Fossil fuel production can be separated into: oil (185.6 Mtoe; 44.0%), natural gas (129.9 Mtoe; 30.9%), and coal (33.5 Mtoe; 7.9%). The remainder of production consists of: hydropower (32.7 Mtoe; 7.8%), nuclear (24.7 Mtoe; 5.9%), and new and renewable sources (13.2 Mtoe; 3.1%) (EDMC, 2014). On a regional basis, Alberta accounts for 64.6% of Canada's primary energy production, followed distantly by British Columbia (14.4%), Saskatchewan (8.4%), Quebec (4.1%), and Ontario (2.7%) (NRCan, 2013a).

Canada is a net exporter of most energy commodities, and stands out as the largest foreign supplier of energy to the USA. Just as the USA relies on Canada for much of its energy needs, Canada too is dependent on the USA as its largest export market. Canada exported a large proportion of its production. Primary energy supply in 2012 totalled 251.5 Mtoe, equivalent to 59.9% of its production. While primary energy supply declined by 0.7% from 2011, net exports rose considerably by 7.7%. Canada has experienced steady export growth between 2000 and 2012 at 2.3% yearly, despite the economic downturn experienced between 2008 and 2010. This continued growth reflects Canada's ability to take advantage of its natural resource endowment to meet domestic consumption while growing its role as an energy exporting economy.

Factors affecting the pace of both conventional and unconventional energy production include: skilled labour shortages, water availability, environmental regulations, rising costs for labour, refining/upgrading, pipeline constraints, and natural gas shortages. The labour issue will be further intensified by the challenge of building new community infrastructure in remote areas in which oil and gas is produced such as Fort McMurray and surrounding areas in Northern Alberta (NRCan, 2014c).

Table 2: Energy Supply and Consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	419 660	Industry sector	58 980	Total	634 400
Net imports and other	-168 710	Transport sector	60 800	Thermal	147 300
Total PES	251 120	Other sectors	88 050	Hydro	380 600
Coal	18 360	Total FEC	207 830	Nuclear	94 900
Oil	82 460	Coal	3 060	Other	11 600
Gas	83 480	Oil	94 560		
Other	66 630	Gas	56 230		
		Electricity and other	53 980		

Source: (EDMC, 2014).

CRUDE OIL

Canada is currently the fifth largest oil producer in the world and production has been on the rise for the past two decades. In 2012, Canada's production of crude oil was 185.6 Mtoe, an increase of approximately 7.7% from 2011 (EDMC, 2014). Oil sands operations have been responsible for most of the growth experienced in production in recent years, which have grown 192.0% since the year 2000 (CAPP, 2014b). The recent growth in production has been driven by bitumen and upgraded synthetic crude oil produced from the oil sands, with oil sands output surpassing conventional production for the first time in 2010 (NRCan, 2014c).

Canada's crude oil production is geographically dispersed, but comes from three principle sources: the resources in the broader Western Sedimentary Basin, offshore Atlantic Canada, and the oil sands. The crude oil production is within the following Western Canadian Sedimentary Basin provinces: Alberta (50.6%), Saskatchewan (42.3%), Manitoba (4.4%), and British Columbia (1.7%) (CAPP, 2014c). The largest production outside of the Western Canadian Sedimentary Basin occurs Atlantic offshore in the Jeanne d'Arc Basin and Hibernia field representing 15.0% of production (CAPP, 2014c). Oil Sands, located in Athabasca oil fields in Alberta, are a solid, extra-heavy type of crude oil composed of a mixture of natural bitumen, sand, water and clay. Production from oil sands in Canada has grown consistently since first production in 1967. It reached 1 802 000 barrels per day in 2012 when Canada's conventional oil production was only 1 458 000 billion barrels per day, accounting for about 55.0% of Canada's total oil production of 3 259 000 billion barrels per day in that year (CANSIM, 2014b).

For geographic and economic reasons, oil is exported from the west and Atlantic offshore, and imported in eastern and central regions. On balance however, Canada remains a large and growing oil exporter experiencing 8.1% increase in exports between 2011 and 2012 (CANSIM, 2014). The Canadian oil industry is heavily impacted by the USA, as Canada is the largest exporter of crude oil to the USA. The bulk of Canadian crude oil exports (128.2 Mtoe; 97.0%) are sent to the USA, accounting for one-third of the USA imports (EDMC, 2014).

GAS

Canada holds a relatively small share of the world's proven natural reserves, yet it is the fifth largest producer of natural gas. In 2012, natural gas production reached 129.9 Mtoe, a decline of 1.9% from 2011, a trend that has been on going since 2006 when gas production peaked (BP, 2014). This continued decline is attributable to numerous factors including: conventional reserve depletion, increasing capital and labour costs, the residual impact of the economic downturn, and most dramatically by the USA's rapid expansion of its shale gas resources. As a result of the American shale gas boom, net natural gas exports from Canada have been declining. This trend continued in 2012 as Canada exported 73.5 Mtoe of gas to the USA, its only gas market, compared to 76.8 Mtoe in 2011 (EMDC, 2014).

While conventional natural gas experiences reserve depletion, technological advances and rapid investment in the Western Canadian Sedimentary Basin have renewed growth potential from shale gas, tight gas, and coal bed methane. Shale gas is emerging as the new low-cost source of natural gas in North America resulting in greater investments and research to develop plays. In Canada, potential and producing shale gas resources are found in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, and Nova Scotia. Most of the current drilling and production activities are occurring in northeast British Columbia in the Montney and Horn River shale basins (NRCan, 2012a).

COAL

Annual coal production has remained relatively steady since 1990. In 2012, Canada produced 33.5 Mtoe of coal (EDMC, 2014). Of total production, thermal coal attributed to 53.3% of production in comparison to 46.7% attributed to metallurgical coal. There were 21 coal mines operating in Canada at the end of 2012 (NRCan, 2012b). British Columbia and Alberta hosted 18 of these mines and were the two highest producing provinces, together accounting for more than 85.0% of Canada's coal production (NRCan, 2012b).

Coal exports are vital to the Canadian coal industry as 52.0% of production, approximately 20.8 Mtoe of coal, was exported in 2012 (EDMC, 2014). While Canada is a mid-size coal producer, it is a significant exporter of metallurgical coal, which accounts for about 90.0% of Canada's coal exports (EDMC, 2014). Canada exports coal to a variety of countries, however Asia is Canada's primary export market, accounting for 81.0% its exports (NRCan, 2012b). Canada also exports coal to a number of European countries, the USA, Mexico and Latin American countries.

URANIUM

Canada is among the three leading producers of uranium along with Kazakhstan and Australia, collectively accounting for roughly 64.0% of total global output in 2012 (WNA, 2014a). With nearly 15.5% of global uranium production, Canada's output totalled nearly 24.7 Mtoe or 10 612 tonnes of U3O8 in 2012 (EDMC, 2014) (WNA, 2014a). Total production increased by 1.3% from 2011 (EDMC, 2014) (WNA, 2014a). Canada's uranium production is mostly located in Northern Saskatchewan with the MacArthur River mine producing approximately 84.0% of Canada's annual uranium production (WNA, 2014b).

NEW AND RENEWABLE

Canada has substantial renewable energy resources including moving water, wind, biomass, solar, geothermal, and ocean energy. In 2012, non-fossil energy production consisting of renewable energy (not including nuclear) accounted for 45.3 Mtoe, which is equal to about 18.3% of the economy's total primary energy, an increase of 1.7% from 2011 (IEA, 2014). Of the total renewable energy production share, the majority share is hydro energy at 70.9% (32.7 Mtoe) (IEA, 2014). Non-hydro renewable energy sources are growing quickly in Canada, but their share in Canada's total primary energy supply remains small at 5.3% (NRCan, 2014d).

FINAL ENERGY CONSUMPTION

Compared to other industrialised countries, Canada is relatively energy intensive and largely fuelled by petroleum, natural gas and hydroelectricity. On average, the Canadian population has high-energy demands, both to meet their high living standards but also due to the prevalence of cold temperatures, the long distances between major cities, and the energy-intensive industries driving the economy. A combination of these factors led to Canada's total final energy consumption in 2012 to be 207.8 Mtoe, making Canada the world's seventh largest energy consumer and the fifth largest in the APEC region (EDMC, 2014).

Given Canada's low population density, a final per capita energy consumption level in 2012 was nearly 6.0 tonnes of oil equivalent, the highest among the APEC economies. Canada's per capita energy

consumption was far ahead of other large developed APEC economies, namely the USA (4.6 toe), Australia (3.5 toe), Russia (3.1 toe), the Republic of Korea (3.3 tonnes of oil equivalent) and Japan (2.4 toe) (EDMC, 2014).

Canadian energy consumption is driven by the transport sector (60.8 Mtoe; 29.3%) followed by the industry sector (58.9 Mtoe; 28.3%) (EDMC, 2014). This follows a similar trend since 2009, when the transport sector overtook industry consumption. Both sectors' consumption have remained relatively stable since 2010 in absolute terms. Excluding the share of the non-energy sector of final energy consumption (26.1 Mtoe; 12.6%), the remaining consumption can be accounted for by the following sectors: residential (31.7 Mtoe; 15.2%), commerce and public services (25.6 Mtoe; 12.3%) and agriculture (4.7 Mtoe; 2.3%) (EDMC, 2014).

Given Canada's endowment of natural resources, naturally direct fossil fuels accounts for the largest share of Canada's total final energy consumption: petroleum products (94.6 Mtoe; 45.5%), gas (56.3 Mtoe; 27.1%) and coal (3.1 Mtoe; 1.5%) (EDMC, 2014). While oil and gas consumption has been increasing since 2000, coal consumption has declined at a yearly rate of 1.0% (EDMC, 2014). Coal consumption has been declining due to various reasons, particularly environmental ones, resulting in government policies to limit the use of coal. Following the direct fossil fuel energy consumption, electricity and renewable energy consumption is the next largest source of energy consumption at 53.4 Mtoe, 25.7% (EDMC, 2014). This sector experienced a decline of 2.6% from 2011, which may be partly explained by the reduction of coal in electricity generation.

POWER GENERATION

Canada generated 616 terawatt-hours (TWh) of electricity in 2012, a decrease of approximately 0.3% from the previous year (618 TWh) (CANSIM, 2014). This decline is largely driven by the rapid decline in thermal power generation at a rate of 6.8% from 2011, a trend on going since 2000 at yearly declines of 2.3% on average. In 2012, hydropower plants were the largest contributor to Canada electricity at 61.2% of total electricity generation in Canada, followed by thermal generation (coal, natural gas and petroleum) at 21.0% and nuclear at 14.5% (NRCan, 2014). Comparatively, the share of renewables, other than hydro, of total electricity generation is relatively small at 3.3%, but is growing steadily.

The share of renewable electricity production (including hydroelectricity) has been on the rise since 2000 in Canada. New regulations limiting the use of coal, low natural gas prices, and the rapidly decreasing cost of renewable energy is making the electricity sector increasingly 'greener' (NEB, 2014b). Canada is the APEC regions second largest and the world's third largest hydroelectricity producer after China and Brazil, accounting for 61.2% of Canada's electricity production in 2012 (CANSIM, 2014a). Canada's rich water resources, particularly in eastern Canada, allow it to rely on hydropower. If nuclear power is added to renewable power generation, 79.0% of Canada's electricity generation did not emit greenhouse gases in 2012 (CANSIM, 2014a).

The electricity networks of Canada and the USA are highly integrated, resulting in the USA being a net importer of electricity. In 2012, Canada exported 4.98 Mtoe of electricity to the USA while importing 0.9 Mtoe, making Canada APEC's largest and the world's third largest exporter of electricity after France and Germany (IEA, 2013) (EDMC, 2014). The bulk of electricity trade with the USA takes place between the provinces of Québec, Ontario, Manitoba, and British Columbia (NEB, 2014b). The excess supply of hydro and nuclear resulted in Canadian net exports to reach a 10-year high. This explains the significant increase in net exports of electricity compared to 2011 when Canada exported 4.4 Mtoe of electricity (EDMC, 2014).

ENERGY INTENSITY ANALYSIS

Canada's industrial structure, vast geography, and cold climate make it a highly energy-intensive economy in the APEC region. In 2012, Canada had the third largest primary supply energy intensity, behind Russia and China at 177 tonnes of oil equivalent per million USD (EDMC, 2014). Canada's energy intensity reflects its role as a significant energy producer and exporter. Among other factors, energy intensity is influenced also by efficiency improvements achieved from technology, which the Canadian Government is committed to through the Office of Energy Efficiency (OEE) (NRCan, 2014e).

Canada has successfully reduced its energy intensity over the past few decades. Since 2011, primary energy intensity has fallen by 2.5%, whereas final energy demand intensity reduced by 0.9% (EDMC, 2014). A significant share of the decline is driven by the industrial sector, which experienced a reduction of

11.5% since 2005. Increasing energy efficiency and reducing energy intensity has been a policy goal for the Government of Canada, mandated by the OEE, as a way to mitigate climate change and conserve energy, further discussed in the energy efficiency section.

Table 3: Energy Intensity Analysis

Energy	Energy Intensity (tonnes of oil equivalent per Million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	181.6	177.1	-2.5
Final Energy Demand	148.0	146.6	-0.9
Industry	41.9	41.6	-0.7
Transportation	42.9	42.9	0.0
Others	63.2	62.1	-1.7

Source: (EDMC, 2014).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

Canada has a federal government, ten provincial governments, and three territories, which all have a role in shaping the energy policy in Canada. Canada's energy policy at all levels is market-based to determine supply, demand, price, and trade. The fundamental principles that are important pillars to energy policy include: the respect for jurisdictional power granted under the Constitution Act of 1867, and targeted intervention in the market process to achieve specific policy objectives (e.g., pipeline regulation) through regulation and other means (NEB, 2014b) (GOC, 2014a).

Under Sections 91 and 92 of the Constitution, provinces are the owners of ground resources and mineral rights within provincial boundaries, excluding the resources located in aboriginal lands, and frontier lands (i.e. national parks, and international waters) (NEB, 2014b) (GOC, 2014b). The provincial governments have the primary responsibility for shaping policies in their jurisdiction, making energy policy variable from jurisdiction to jurisdiction. Unlike the provinces, the territories do not own the ground resources, but do share partial management responsibility. In addition to frontier lands, the federal government is responsible for uranium resources/power, interprovincial/international trade and commerce, trans-boundary environmental impacts, interprovincial work (e.g. pipelines), and policies in the national interest (economic development, health and safety, and energy security) (NEB, 2014b) (GOC, 2014c).

At the federal level, energy policy is layered and a number of government agencies are involved in the development and implementation of energy policy under the federal jurisdiction. The Natural Resources Canada (NRCan) is the federal department that is mandated to develop 'policies and programs that enhance the contribution of the natural resources sector to the economy and improve the quality of life for all Canadians' (NRCan, 2014). The National Energy Board (NEB) is an independent federal regulator responsible for pipelines, energy development and trade issues in the Canadian public interest. Other important government agencies include: Environment Canada, Fisheries and Oceans Canada, Aboriginal Affairs and Northern Development Canada, and Department of Foreign Affairs, Trade and Development Canada.

ELECTRICITY MARKETS

The structure of the Canadian electricity markets gives the provinces and territories jurisdiction over generation, transmission and distribution of electricity within their boundaries, including restructuring initiatives and electricity prices. In turn, the federal government is responsible for electricity exports, international and designated inter-provincial power lines, and nuclear safety, which is especially important since the economy-wide market is interconnected at many points with the United States to form a larger grid (NEB, 2014c).

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. While some of these utilities are privately owned, many are Crown corporations owned by the provincial governments and, although independent power producers also exist, they are rarely in direct competition with a Crown

corporation. Exceptions include the provinces of 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 levels and the mechanisms by which they are set. Provinces with an abundant supply of hydro-electricity generally have the lowest prices. In most provinces, the regulator sets the prices according to a formula that determines the cost of generation plus a reasonable rate of return. While 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, 2013).

Institutional arrangements have been made to improve the reliability of the electricity power system. The United States Energy Policy Act 2005 called for the creation of an Electric Reliability Organisation (ERO) to address concerns about the reliability of the North American grid that had been prompted by the 2003 blackout. In July 2006, the Federal Energy Regulatory Commission of the United States (FERC) certified the North American Electric Reliability Corporation (NERC) as the ERO, authorising the NERC to enforce reliability standards on the owners, operators and users of the bulk power system in both Canada and the United States (FERC, 2014). The Canadian and United States governments also established the Bilateral Electric Reliability Oversight Group as a forum in which the United States Department of Energy, the FERC, the NRCan and the provincial energy ministries can discuss issues of mutual concern (FERC, 2014).

ENERGY MARKET

OIL AND NATURAL GAS

Wellhead oil and natural gas prices in Canada have been fully deregulated since the conclusion of the Western Accord and the Agreement on Natural Gas Markets and Prices between the Canadian federal government and the Canadian energy-producing provinces in 1985. The latter 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 (NEB, 1996). Oil and gas pipeline networks continue to be regulated as natural monopolies.

The participation of international oil companies, both private and state-owned in Canada's oil and gas sector has risen rapidly. These investments may be driven by a number of factors including economic and political motivations, or to gain technological expertise that can be applied to conventional and unconventional resources elsewhere. Federally, the Investment Canada Act stipulates that any large investment greater than CAD 325 million in Canada must be a net benefit to Canada (Industry Canada, 2014).

COAL

Canada has abundant coal resources with the largest known reserves located in the western provinces, which are also Canada's principal producers. Coupled with the provincial level law and regulations, 35 federal acts and regulations relate to the mining industry (CAC, 2012).

Among the many existing regulations, a new regulation will be adopted starting July 2015 that will place a performance standard to new coal-fired electricity. This will further reduce the coal consumption in Canada, but not necessarily the production of coal. The Regulation, adopted under the Canadian Environmental Protection Act 1999, is a performance standard that sets an emissions intensity level of Natural Gas Combined Cycle (NGCC) technology, a high-efficiency type of natural gas generation, fixed at 420 tonnes per GWh (GOC, 2014d). It also contains a caveat to encourage new technology for GHG reductions, where units that incorporate CCS technology can apply to receive a temporary exemption from the performance standard until December 31, 2024 (GOC, 2014d).

ENERGY EFFICIENCY

Energy efficiency is the joint responsibility of the federal and provincial governments, but their role and responsibilities vary and target different aspects of efficiency. Each province has ministries responsible for administering energy and environment policies and programs, including energy efficiency programs. Examples of energy efficiency programs include energy-efficient building codes, equipment standards, and consumer rebates. The foundation of all provincial policies rests upon the federal Energy Efficiency Act 1992, which was amended in 2009 to expand its scope and effectiveness (GOC, 2014e). This Act provides for the creation and enforcement of regulations on the energy efficiency of products, and supports the replacement of the least efficient products with high-efficient, cost-effective ones.

The Energy Efficiency Act 1992 and related efficiency issues is administered at the federal level by the NRCan through its Office of Energy Efficiency (OEE), with the vision to improve the utilisation of energy by 'leading Canadians to energy efficiency at home, at work and on the road' (NRCan, 2014e). The OEE delivers the ecoENERGY Efficiency program to improve energy efficiency for a cleaner environment and reduced greenhouse gas emissions (GHG), while saving Canadians money and making the most of Canada's natural resources (NRCan, 2014g). Between 2011 and 2016, the ecoENERGY Efficiency is investing 195 million CAD to improve energy efficiency in all end-use sectors, making the housing, building and equipment stock more energy-efficient, energy performance more visible, and industry and vehicle operations more efficient. The ecoENERGY efficiency program addresses the following components of efficiency:

- ecoENERGY Efficiency for Buildings provides information and benchmarking tools to improve building energy performance of new and existing buildings;
- ecoENERGY Efficiency for Housing encourages the construction and retrofit of low-rise residential housing, making the stock more energy-efficient;
- ecoENERGY Efficiency for Equipment Standards and Labelling introduces or raises energy efficiency standards for a wide range of products and promotes energy-efficient products through the ENERGY STAR® initiative in Canada;
- ecoENERGY Efficiency for Industry aids the adoption of an energy management standard and accelerates energy-saving investments and the exchange of best practices information within Canada's industrial sector; and
- ecoENERGY Efficiency for Vehicles provides both individual Canadians and Canada's commercial/institutional fleet sector with decision-making tools for buying and operating their vehicles to reduce fuel consumption. It also promotes vehicle efficiency by introducing improved vehicle fuel consumption labels and a light-duty tire information system (NRCan, 2014g).

In addition to the 195 million CAD invested into the efficiency program, the Government is investing in alternative fuels and biofuels in order to diversify its energy sources. From 2011 to 2016 the federal government has committed 3 million CAD to support alternative fuels used in the transport sector (NRCan, 2014g). Federally, there is CAD 1.5 billion of funding available between 2008 and 2017 to support the production of renewable alternatives to gasoline and diesel for the development of a competitive domestic industry (NRCan, 2014g).

RENEWABLE ENERGY

Given its large landmass and diversified geography, Canada has an abundance of renewable resources that can be used to produce energy. Canada is world leader in the production and use of renewable energy, with 18.3% of its primary energy supply from renewable energy resources (EDMC, 2014). At a federal level, Natural Resources Canada's research centre, CanmetENERGY, is the leader in clean energy research and development. The federal government supports renewable energy through funding it provides to CanmetEnergy, which develops research, development and demonstration activities that would ultimately accelerate renewable technology towards commercialisation and self-sustainability (NRCan, 2014f). Through the research centre, the government funds and drives hydro energy, wind energy, solar energy, bioenergy, geothermal energy and tidal energy.

Moving water is the most important source of renewable energy in Canada, accounting for 61.2% of Canada's electricity generation in 2012(NRCan, 2014d). In 2013, Canada had 533 hydroelectric stations, with more than 75.7 thousand megawatts of installed capacity (CANSIM, 2014a). Surrounded by oceans, Canada has access to a significant energy source that can be used to produce energy from ocean waves and tides. Canada has one of the few tidal power plants in the world, located in Nova Scotia generating 20 megawatts of electricity and has two wave and tidal current technology demonstration projects in British Columbia and Nova Scotia. In British Columbia, the wave energy device has capacity of 100 kilowatts. The 4-megawatt project in Nova Scotia will be the first deployment of commercial-scale tidal turbines in Canada. (NRCan, 2014d). Wind is the second most important renewable energy source in Canada, accounting for 1.8% of electricity generation (NRCan, 2014d). Canada has vast areas with large potential for wind resources making expansion of wind-generated power very economical. Installed wind power capacity has expanded rapidly in the recent years and is forecasted to grow at a rapid pace given the government initiatives in place supporting its growth (NRCan, 2014d). In 2013, Canada had almost 4 400 wind turbines in operation in 187 wind farms, with a total installed capacity of 7 801MW (CanWEA, 2015).

Solar energy has also experienced continuous growth both in thermal and photovoltaic power. Thermal power has grown at an annual average rate of 9.5% since 2000, reaching a capacity of 819MW. Solar photovoltaic power experienced an exponential growth during the 2008-2011 period with an annual growth rate of 147.3%, reaching installed capacity of 1 210MW (IEA, 2014).

With its large landmass filled with active forests and agricultural industries, Canada has access to large and diversified biomass resource for energy production. In 2013, bioenergy is the second most important form of renewable energy with biofuels and renewable waste representing 4.9% of Canada's total primary energy (NRCan, 2014d). Canada has 61 bioenergy power plants with a total installed capacity of 1 580MW. Most of this capacity is built around the use of wood biomass, spent pulping liquor, and landfill gas. Biofuels is also a growing form of bioenergy in Canada, accounting for 2.0% of world ethanol production and 1.0% of world biodiesel production (NRCan, 2014d). The federal government alongside the provinces has introduced regulations on renewable content that will further increase future production and use of biofuels. The Government of Canada has developed a comprehensive renewable fuels strategy consisting of four elements:

- Renewable Fuels Regulation establishing a minimum renewable fuel content of 5.0% renewable content based on gasoline pool, and 2.0% renewable content in diesel and heating oil;
- A commitment of CAD 200 million over four years to the ecoAgriculture Biofuel Capital Imitative to support farmer participation in the industry;
- A commitment of CAD 1.5 billion over 9 years to the ecoENRGY for Biofuels program to support domestic production; and
- Commitment of CAD 500 million to the NextGen BioFuels FundTM to support next-generation technologies from non-conventional feedstock (NRCan, 2014d).

Geothermal power has not experienced similar momentum as solar, wind and biomass. As the highest temperature geothermal resources are located in British Columbia, Northwest Territories, Yukon, and Alberta; there are a number of heat and power generation projects being considered with the demonstration projects under way in Western Canada, including the South Meager project in British Columbia, the most advanced geothermal power plant in Canada. In 2010, there were over 95 000 ground-source heat pumps, but no large-scale geothermal stations (NRCan, 2014d). CanmetENERGY has been financially supporting the demonstration projects in British Columbia, Northwest Territories, Yukon, and Alberta. These demonstration projects are not commercially viable.

NUCLEAR POWER

Nuclear energy is an important component of Canada's dynamic energy mix. In 2012 nuclear energy accounted for 14.5% (89.5 TWh) of electricity generation in Canada (EDMC, 2014), with nearly 50.0% located in the Province of Ontario. Canadian nuclear power generation is concentrated in the provinces of Ontario (houses 20 reactors) and New Brunswick (houses one reactor) (NRCan, 2014j). In 2012, Gentilly 2, the Province of Québec's only nuclear plant, was decommissioned following Hydro-Québec's (the provincial energy utility provider) decision not to proceed with refurbishment due to the high cost (Canadian Nuclear Association, 2014).

Unlike other energy sources, nuclear energy falls within federal jurisdiction. Within its bounds, the federal government is responsible for all regulation of nuclear materials and activities along with supporting research and development (R&D). Concerned with nuclear activities impact on health, safety, security and the environment, the federal government has put in place a comprehensive nuclear legislation framework, which is comprised of the Nuclear Safety and Control Act 1997, the Nuclear Energy Act 1985, the Nuclear Fuel Waste Act 2002 and the Nuclear Liability Act 1985 (NRCan, 2014j). While these regulations provide the framework for how nuclear energy will develop in Canada, it is administered through a layered organisational approach. The organisations that play a role in the administration of the legislation include:

- **Natural Resources Canada (including Energy and Nuclear Energy division):** Responsible for developing 'policies and programs which enhance the economic and environmental well-being of Canadians. The Department provides advice on energy policy, as well as, institutional, legislative, and financial frameworks for the nuclear industry';
- **Canadian Nuclear Safety Commission**: An independent agency of the Government of Canada tasked with 'regulating the use of nuclear energy and materials to protect health, safety, security and

the environment and to respect Canada's international commitments on the peaceful use of nuclear energy';

- **Atomic Energy of Canada Limited:** This Crown Corporation is the premier nuclear and science organisation mandated to 'develop peaceful applications of nuclear energy. It has two distinct roles, namely a public policy role and a commercial role'; and
- **The Department of Foreign Affairs, Trade and Development Canada, Health Canada, Transport Canada, and Industry Canada (including National Research Council):** These federal departments are not directly involved in nuclear legislation or policy development, but do administer certain aspects of nuclear energy including: security, health, safety, research and trade (NRCan, 2014j).

While the federal government is the central body regulating nuclear energy, the decision to invest in nuclear power plants for electricity generation rests with the provinces (in concert with relevant provincial energy utilities) (NRCan, 2014j). Given the current context and each provincial electricity outlook, no new nuclear capacity is projected but existing operational plants will undergo refurbishments.

The Canadian Government is committed to address climate change in a meaningful manner while ensuring the Canadian economy remains competitive (GOC, 2014f). Climate change is a complex issue making Canada's approach multifaceted and layered at the provincial, federal and international levels. All these levels work in collaboration to ensure policies, regulations and initiatives are aligned and work in concert.

PROVINCIAL

Provinces/territories hold the jurisdictional authority to regulate natural resources, therefore play an integral role in climate policies as energy production and consumption contribute significantly to Canada's greenhouse gases (GHG). Each province has an extensive list of policies, regulations and initiatives to manage climate change and reduce GHG emissions. The major regulations and programs that focus on reducing direct GHG's include:

- **Alberta**: Passed the Specified Gas Emitters Regulation 2007, which requires facilities emitting more than 100 000 tonnes of greenhouse gas to reduce emissions by 12.0%. Among other options, companies may choose to pay CAD 15 per tonne for every ton over their target if they do not physically reduce their emission levels (Province of Alberta, 2014).
- **British Colombia**: A revenue neutral carbon tax applied to the purchase or use of fuels within the province at a current rate of CAD 30 per tonnes of CO_2 equivalent (British Columbia Ministry of Finance, 2014).
- **Nova Scotia:** The Greenhouse Gas Emissions Regulations 2009 places a cap on electricity sector emissions from all facilities with targets established to 2030 (Nova Scotia, 2013).
- **Ontario:** As of April 2014 the province no longer uses coal to generate electricity and the Government has proposed regulation to ensure no future coal-burning generation on the electricity grid (Ontario, 2014). The Government also introduced the Green Energy and Green Economy Act 2009, which implemented a feed-in-tariff that promotes and facilitates the connection of renewable generating facilities (Ontario Power Authority, 2014).
- **Quebec:** Established a GHG emission cap-and-trade system along with placing a small levy on fuel and fossil fuels (Quebec, 2012).

FEDERAL

Energy production and consumption contribute significantly to Canada's greenhouse gas (GHG) and air pollutant emissions. Canadian government policies are aimed at promoting energy efficiency and cleaner technologies, boosting renewable energy supplies and reducing GHG emissions. Since 2006, the Federal Government has invested more than CAD 10 billion to reduce GHG emissions and build a more sustainable environment through investments in green infrastructure, energy efficiency, clean energy technologies and the production of cleaner energy (Environment Canada, 2013a).

The Federal Government is regulating greenhouse gas (GHG) emissions through a sector-by-sector approach, with regulations already in place in two of the largest emission sectors: electricity and transportation.

- **Electricity Sector:** Canadian government announced in 2012 stricter regulations concerning coal-based electricity generation, with new standards applicable for new and old power plants that have reached the end of their economic life. The standards, which will be in force by July 2015, are expected to result in a cumulative reduction in GHG emissions of about 214 megatonnes in the first 21 years (Environment, 2013a).
- **Transportation Sector:** proposed final regulation in the transportation sector will ensure that 2025 passenger vehicles and light trucks will emit about 50.0% less GHGs than 2008 models and emissions from 2018 model-year heavy duty vehicles will be reduced by up to 23.0% (Environment, 2013a). The transportation regulations were developed to align with U.S. Environmental Protection Agency (EPA) standards in order to collaboratively work towards a common North American standard (Environment, 2013a).

Despite the provinces having jurisdiction over natural resources, when it comes to climate change, the federal government has constitutional authority to regulate emissions under Section 91 of the constitution. This creates a dichotomy between the two institutional powers in terms of regulating emissions coming from natural resource production. The federal government has indicated the next step of the Canadian climate change plan is to regulate the remaining major sources of emissions including the oil and gas sector (Environment, 2013a). The federal government has been in negotiations with industry and all provincial governments since 2012.

INTERNATIONAL

Climate action taken by the provinces and federal government of Canada is partially driven by the commitments made at the international arena. Canada is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC). In 2009, Canada signed onto the Copenhagen Accord and committed to reduce GHG emissions to 17.0% below 2005 levels by 2020 (Environment Canada, 2013b). Canada has continued its engagement in the UNFCCC negotiations to support the establishment of a fair and comprehensive global climate change regime since the end of the Doha round of negotiations under the UNFCCC in December 2012. This was endorsed again through the Cancun Agreement. Along with the UNFCCC, Canada commenced the 2009 Clean Energy Dialogue with the USA with the intention of developing a possible future cap-and-trade system, and development and deployment of clean energy technologies in a regionally focused effort.

NOTABLE ENERGY DEVELOPMENTS

LNG TERMINAL PROJECTS

A dramatic shift occurred in the North American liquefied natural gas (LNG) market over the past decade. In the early 2000's, mounting concerns over the decreasing conventional supplies of domestic natural gas gave way to uncertain forecasts, ultimately resulting in an investment boom to build LNG import facilities (NRCan, 2014h). One such investment included the Canaport LNG terminal in Saint John, New Brunswick, which began gas-importing operations in 2009, and has remained Canada's only operating LNG facility (regasification) since.

However, despite these early concerns, natural gas resource and production in Canada and the USA surged given the technological advancements made in unconventional natural gas production. Greater supply from shale gas and tight gas formations outpaced the growth in natural gas demand, which ultimately paved a path for the USA to become increasingly self-sufficient with respect to natural gas. Given this significant shift in the USA, Canadian exports to the USA may experience decline.

Canada is looking to diversify its market by exporting LNG to overseas markets and creating LNG export terminals to do so. The West coast of Canada has experienced an overwhelming number of proposed LNG facilities to address growing demands of the Asia Pacific region, but these projects involve long lead times to obtain approvals, establish markets and construct facilities (NEB, 2014b). For Canada, along with many other export countries, the window of opportunity to capitalise on its LNG export potential is quite narrow given the strong competition around the world that aims to profit from these investments (NEB, 2014b).

Currently, Canada does not have any operational export facilities. However, as of November 2014, seventeen proposed LNG export facilities have entered the regulatory review process. Most of these projects are located in the province of British Columbia near Kitimat and Prince Rupert, and most will

require new infrastructure to bring both gas and electricity to the facilities (NEB, 2014b). None of these projects have entered the construction phase. Final investment decisions will be influenced by factors including construction costs, pricing arrangements and competition for other existing or potential LNG exporters (NEB, 2014b).

Once in operation, the LNG terminal generally falls under provincial regulations. However, LNG terminal proposals require numerous federal and provincial environmental assessments and permits. Among other federal requirements, a permit from the National Energy Board (NEB) is required to export LNG from Canada. The NEB ensures that the proposed volume of gas exports does not exceed the surplus needed to meet estimated domestic demand (NRCan, 2014h). As of November 2014, the NEB has issued nine long-term export licenses to the proposed Canadian facilities. No application has yet been rejected, thirteen remain under review (of which five are for Steelhead LNG and three for Cedar LNG) and one has been deemed incomplete (Goldboro LNG).

PIPELINE DEVELOPMENTS

The success of Canada's landlocked oil economy, based in Alberta, Saskatchewan, and Manitoba, relies on its ability to reach markets. While the industry is experiencing growth in production from oil sands and new light oil prospects, its location is less than ideal. The distance is too far from the major refining hub in the USA Gulf Coast and ocean ports that would provide access to the expanding overseas market. The Government and industry are working together to find options to access markets, new LNG terminals on Canada's west coast, and numerous pipeline proposals are in the regulatory process or have recently received approval in addition to the frequently discussed TransCanada Keystone XL.

ABORIGINAL ENGAGEMENT

The participation of Aboriginal people is a critical factor in Canada's ability to capture the benefits of energy resource development. Aboriginal peoples are especially well positioned as many of the existing or proposed energy resources and infrastructure projects are located near their communities. In Canada's resources development sector, Aboriginal consultation has been a strong component of energy projects and will continue to be in the future.

In recent years, the Government of Canada has adopted initiatives to enhance the engagement of Aboriginal communities and to ensure that resources development are done in partnership with Aboriginal peoples, in a way that protects the local environment, and is respectful of Aboriginal and treaty rights. As part of this policy, Aboriginal consultations are integrated into assessment and regulatory processes and consultation protocols or agreements with Aboriginal groups are established for project reviews. In 2012, the Government of Canada introduced Responsible Resource Development. In addition to its objective to create jobs, growth and long-term prosperity, the plan highlights the aim to establish open consultation with Aboriginal partners, strong partnerships throughout natural resource development, and to provide considerable employment and profit opportunities for the Aboriginal communities (GOC, 2014g)

As many of the proposed energy infrastructure projects on the West Coast of Canada pass through or near Aboriginal communities, the federal government works closely with the Government of British Columbia (BC), and BC First Nations to establish a tripartite forum that will provide an opportunity to share information identify common interests and align efforts on issues relating to the development of energy infrastructure and natural resources. The Government has created the Major Projects Management Office West (MPMO) that serves as a single window for the Government of Canada to coordinate activities on energy infrastructure development with BC First Nations and industry in BC and Alberta.

ARCTIC AND OFFSHORE ENERGY

Since the 1950s, exploration and study by the oil and gas industry, and the Canadian Geological Survey has indicated strong potential for petroleum discoveries in the north. However, the cost of developing the fields and getting to the market were quite large; given the low oil prices of the previous decades, and transportation bottlenecks made discoveries uneconomical to bring to market (NRCan, 2007). However, there is a renewed interest in vast oil and gas potential provided high oil and gas prices, and the promise of new pipeline systems. The potential of the offshore continental shelf is considered quite high with 19 significant discover licenses issued for the Arctic islands and 60 licenses in the Mackenzie Delta/Beaufort Sea region (NEB, 2014b). Discoveries in these regions exceed one billion barrels of oil and ten trillion cubic feet of gas.

Canada's oil and gas industry in the North, including offshore drilling in the Arctic, is regulated by the NEB, as set out in the Canada Oil and Gas Operations Act (COGOA) and the Canada Petroleum

Resources Act (CPRA) and National Energy Board Act whereas Canada's Atlantic offshore oil and gas industry is regulated by the Canada-Nova Scotia Offshore Petroleum Board and the Canada-Newfoundland and Labrador Offshore Petroleum Board. It is important to note that a 1972 Federal Moratorium restricts offshore field development off the Pacific coast of Canada, where there are an estimated 9.8 billion barrels of recoverable resources (NRCan, 2013b).

In order to enhance responsible resource development, the Canadian Minister of Natural Resources introduced legislation in early 2014 that would bring changes to Canada's offshore oil and gas regime. The Energy Safety and Security Act contains amendments to the Canada Oil and Gas Operations Act 1985 and the Canada Petroleum Resources Act 1985, along with the federal Accord Acts for offshore Nova Scotia and Newfoundland and Labrador (NRCan, 2014i). The proposed changes focus on four main areas — prevention, response, accountability and transparency — and they help to further strengthen safety and security to prevent incidents and ensure swift response in the unlikely event of a spill.

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Canadian Nuclear Association—www.cna.ca

Environment Canada—www.ec.gc.ca

National Energy Board—www.neb.gc.ca

Natural Resources Canada—www.nrcan-rncan.gc.ca

Statistics Canada—www.statcan.ca

Transport Canada—www.tc.gc.ca

CHILE

INTRODUCTION

Chile joined APEC in November 2004 and is one of the two South American member economies. Located in South America, it shares borders with Peru to the north, Bolivia to the north-east and Argentina to the west. Its coastline runs along the Pacific Ocean for 6 435 kilometres with an average of 175 kilometres wide and a land area of 756 102 square kilometres. Administratively, Chile is divided into 15 regions headed by regional governors (Intendente) appointed by the President and divided into 54 provinces. In 2012 the economy's population was above 17 million with an 87.0% of the population living in urban areas (INE, 2013). Given the size and shape of its territory and its number of inhabitants, Chile's general population density is almost 23 inhabitants per square kilometre in 2012 on average, although in such metropolitan areas as Santiago and Valparaíso it is much higher, having respectively as much as 455 and 110 people per square kilometre (INE, 2013).

Chile's economic growth is based in solid macroeconomic fundamentals, such as fiscal responsibility, an independent central bank and a floating exchange rate. Chile has more than doubled its GDP per capita from USD 8 728 in 1990 to USD 19 973 in 2012 (PPP in USD). It is one of the fastest growing economies in South America. In 2012, Chile's GDP reached USD 348 billion (USD constant 2010 at PPP), which represents an increase of 5.8% from 2011 levels, led by retail sales (8.4%) and construction (8.1%). In terms of Chile's GDP composition, 96.0% is divided between services (61.0%) and industry (35.0%), where mining (15.0%) is considered a service. Almost 98.0% of the total exports were under trade agreements with 60 economies with which include: the European Union, Mercosur (a regional trade group comprised of Argentina, Brazil, Paraguay, Uruguay and Venezuela), India, China, Japan, Korea, Mexico and the United States. Copper is a main factor in the Chilean economy accounted alone for nearly 92.0% of the mining exports and 41.0% of total exports (BCL, 2012). The evolution of foreign direct investment (FDI) is closely related to the evolution of mining investment, in that sense, FDI increased in 32.0% to USD 30 billion during 2012 due the higher investment flows in mining (UNCTAD, 2013).

Despite the diverse geography and abundant natural resources, the territory is very limited in fossil fuel resources, making Chile a net energy importer for which one of its mainstay priorities revolves around a steady energy supply.

Table 1: Key data and economic profile, 2012

Key data[a]		Energy reserves[b]	
Area (sq. km)	756 102	Oil (million cubic metres)	1.9
Population (million)	17.5	Gas (million cubic metres)	9.0
GDP (USD (2010) billion at PPP)	348.8	Coal (million tonnes)	171.0
GDP (USD (2010) per capita at PPP)	19 973	Uranium (kilotonnes U)[c]	3.7

Source: a. (EDMC, 2014); b. (MEN, EIA, 2014); c. (CChEN, 2013).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

According to EDMC (2014), Chile's total primary energy supply (TPES) has increased in 10.7% from 2011 to 2012 to reach 37 213 ktoe. Approximately 42.0% of this energy volume was supplied in the form of crude oil and its by-products, 16.5% as coal, 11.5% as natural gas and the remaining 23.4% as other sources, particularly biomass and hydropower. Given its limited endowment of hydrocarbons Chile is a net importer of primary energy, especially of fossil fuels. Its net primary energy imports represents 70.0% of the TPES, having reduced 1.5% from 2011 to reach nearly 26 000 ktoe in 2012. Despite its small contribution to TPES, Chile's energy output from non-fossil sources have increased in 43.0% from 2011 to 2012, being explained by the important increase in biomass used by auto-producers of energy.

In regards to fossil energy resources, Chile's proved crude oil reserves amounted to 15 million barrels by the end of 2012, with most of it located in the southern Magallanes region. In the light of the low domestic production, nearly all of Chile's crude oil supply of 15 609 ktoe in 2012 came from imports that also included by-products such as diesel, gasoline and LPG (EDMC, 2014). As for natural gas, Chile's demand was 4 286 ktoe, met by three-quarters of imports and the rest by domestic production in 2012 (EDMC, 2014). Chile's domestic coal production is mainly located in the region of Magallanes with a total recoverable coal reserves estimated in 170 million tonnes, but as of 2012, domestic production accounted for less than 4.0% of the total supply (EDMC, 2014).

Owing to Chile's abundance of renewable energy resources, in particular of water resources, their contribution to TPES is high, totalling 11 198 ktoe and representing near 85.0% of the economy's total domestic energy production in 2012 (EDMC, 2014). Chile's primary supply of non-fossil energy in 2012 was mainly made up of biomass and hydropower.

In 2013, Chile's total net installed electricity capacity was 17 741 MW, representing an increase of 476 MW (2.8%) from 2012, with thermal power plants representing 65.0% of the total capacity (self-suppliers included), and the remainder contributed by mainly hydro power with a 33.0%. It is important to mention about the drastic change in the participation of Hydro and Thermal sources since 2006 when hydro was 54.0% and thermal 46.0% of the total electricity capacity.

The National Electric System (SEN in Spanish) in Chile is organised around the following systems[1]:

- Northern Grid (SING): 3 760 MW, 99.0% thermal (51.0% coal and 38.0% natural gas);
- Central Interconnected System (SIC): 13 826 (MW), 54.0% thermal (33.0% coal and 18.0% natural gas) and 43.0% hydro;
- Aysen Grid: 50 MW, 51.0% thermal (100% diesel) and 45.0% hydro;
- Magallanes Grid: 99 MW, 100.0% thermal (85.0% natural gas and 15.0% diesel); and
- Los Lagos Grid: 6.2 MW, 88.0% thermal (100.0% diesel) and 12.0% hydro.

FINAL ENERGY CONSUMPTION

During 2012, Chile's total final energy consumption was 24 954 ktoe, representing almost the same values of the previous year.

Energy demand was fairly balanced between industry (39.3%), residential, commercial and public—jointly grouped as 'other'—(29.6%) and transport (29.8%) sectors.

By energy source, more than half of Chile's final energy demand was met by petroleum products (50.4%), primarily consumed in the transport and industrial sectors, followed by electricity and other sources (43.0%), natural gas (5.8%) and a marginal share of coal. Oil, gas and coal consumptions decreased 1.2%, 27.0% and 41.0% respectively, while electricity consumption rose 7.4% (EDMC, 2014).

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	13 053	Industry sector	9 069	Total	64 897
Net imports and other	24 957	Transport sector	7 461	Thermal	44 330
Total PES	37 213	Other sectors	8 423	Hydro	20 158
Coal	6 094	Total FEC	24 954	Nuclear	-
Oil	15 609	Coal	192	Others	409
Gas	4 286	Oil	12 589		
Hydro	1 734	Gas	1 441		

Others	9 490	Electricity and other	10 732		

Source: (EDMC, 2014).

ENERGY INTENSITY ANALYSIS

Energy intensity has been declining since 2005 showing a better and efficient use of energy sources. Chile's primary energy supply in 2012 was 106.7 tonnes of oil equivalent per million USD, up 5.0% from 101.5 in 2011. The energy intensity for the final energy demand improved, declining by 5.0% to 71.5 toe/million USD in 2012 from 75.7 tonnes of oil equivalent per million USD in 2011. Broken down by sector the transport and others sectors declined by 3.0%, while the energy intensity of the industry sector declined by 10.0%.

Table 3: Energy Intensity analysis

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	101.5	106.7	5.0
Final Energy Demand	75.7	71.5	-5.0
Industry	28.8	26.0	-10.0
Transportation	22.0	21.4	-3.0
Others	24.9	24.2	-3.0

Source: (EDMC, 2014).

ENERGY POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

Chile has embarked on the development of an economy based on international trade and the rules of the free market since the 1980s, when the economy started to grow significantly. From that time to 2012, Chile has more than doubled its income per capita and has been one of the fastest-growing economies in Latin America. In addition, it provides a supportive business environment for foreign investments with streamlined administrative processes and simplified tax payments. Chile is ranked 34 among 183 economies in the report *Doing Business 2014*.

Chile is an open market economy, highly integrated to world. Its participation in free trade agreements increase its options to reach a sustainable development based on further trade opportunities, looking to reduce its dependency of mineral exports and trade products with a higher value added.

In line with these foundations, Chile's energy policy is based on the development of a free market economy and oriented towards enhancing its economic efficiency and energy security by reducing its vulnerability to supply shocks and high dependence on imports.

The Chilean Parliament approved the creation of a Ministry of Energy in November 2009 and in February 2010 the new Ministry of Energy started operations. 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. In 2014, the Chilean government through its Ministry of Energy (MEN in Spanish) released the national Energy Agenda to guide the economy's long-term energy policy.

The goals and purposes of the Energy Agenda can be summarised as follows:

- Reduce the electricity marginal cost by 30.0% in the Central Interconnected Grid (SIC);
- Reduce the prices of the electricity supply bids by 25.0%;

- Lift existing barriers for Non-Conventional Renewable Energies to increase the participation of renewal energies up to 45.0% of the new electric generation capacity by 2025;
- Foster the efficient use of energy as an energy resource, establishing a 20.0% savings goal by the year 2025, considering the expected energy consumption growth in the economy as of that date.
- Set up a fuel price stabilisation system to reduce the volatility of internal fuel prices;
- Turn ENAP (National Oil Company) into a main actor in the energy challenges of the member economy government; and
- Develop by 2015 a long-term Energy Policy that will be validated by the Chilean citizens.

FISCAL REGIME AND ENERGY PRICES

Since 2001, Chile's fiscal policy is guided by the rule of the cyclically adjusted balance, also known as the Structural Balance Rule. This policy looks to keep medium term equilibrium in the fiscal accounts, adjusting the government incomes by the economic cycle and approving the government spending according to this income. The 2006 Fiscal Responsibility Law introduced new rules on the investment of accumulating assets. In addition, it covers central government agencies, but not the central bank, public non-financial enterprises, the military sector, or municipalities.

In Chile, prices for petroleum-based fuels are set by international market conditions and across all stages of the value chain, including retail sales at service stations. However, specific excise taxes (IEC in Spanish) are charged on transport fuels (gasoline, diesel, liquid petroleum gas (LPG) and compressed natural gas (CNG)). In February 2011, the government introduced the Consumers' Protection System for Volatility in International Oil Prices (SIPCO) to reduce uncertainty about domestic prices for oil products. This system was replaced on July 2014 by a new mechanism called the Fuel Price's Stabilisation Mechanism (MEPCO in Spanish), which changes the previous SIPCO mechanism by reducing the price's band and setting a limit on the weekly variation of fuel prices in no more than five Chilean Pesos per liter per week. Finally, the SIPCO converts the oil international price in local currency to assess the value of the final price protection to the consumer.

Under this system, a price band is determined around the average price between the historical and future pricesof a fuel; if the price of the fuel rises or falls outside this band, the excise tax is adjusted to counteract the price change. Thus, significant variations in price are absorbed into the IEC excise tax system and consumer risk is minimised.

ENERGY MARKETS

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. Private companies wholly serve the electricity market, while the government remains as regulator, policy-maker and technical consultant in such efforts to identify the requirements to meet the projected demand growth. The Ministry of Energy is the main regulator of the electricity industry in Chile, which is supported by the National Energy Commission (*Comisión Nacional de Energía*, or CNE) and the Superintendence of Electricity and Fuels (*Superintendencia de Electricidad y Combustibles*, or SEC).

The Energy Agenda of May 2014 presents seven fundamental issues to reach a reliable, sustainable and inclusive energy development at reasonable prices:

- A new role for the State;
- Reduction of energy prices, with higher competition, efficiency and diversification of the energy market;
- Development of own energy resources;
- Connectivity for energy development;
- An efficient sector managing consumption;
- Boost for investment in energy infrastructure; and
- Citizen involvement and territorial regulation.

ENERGY EFFICIENCY

Energy efficiency is among Chile's priorities as it works toward achieving its key goal of enhancing its energy security. As per the ENE issued in 2012, the government's approach in recent years has been focused on increasing the electricity generation from nonconventional renewable energy sources, with efforts also encompassing the stabilisation of demand growth through energy efficiency efforts.

In terms of energy efficiency, the Ministry of Energy is responsible for the development of policies and guidelines, including the promotion and enhancement of economy-wide efficient energy use as a means of contributing to the achievement of this goal. Furthermore, in pursuing these objectives, the Ministry of Energy entrusts them to the Chilean Energy Efficiency Agency, which is responsible for implementing many of these policies by promoting, disseminating and implementing dedicated programs; opening new markets and exploring opportunities in the field of energy efficiency; and developing energy efficiency marks to recognise and reward leading energy-efficiency companies. The current goal is to foster the efficient use of energy as an energy resource, establishing a 20.0% savings goal by the year 2025, considering the expected energy consumption growth in the economy as of that date.

RENEWABLE ENERGY

In April 2008, Law 20.257 (Law of Non-Conventional Renewable Energy) was enacted, which was added to previous modifications of the Electricity Law introduced through Law 19.940 (2004) and Law 20.018 (2005). It establishes the requirement that electricity companies include a percentage of non-conventional renewable energy (renewable energy excluding large hydropower plants, NCRE) as a share of the total energy sold.

Specifically, the law requires that between 2010 and 2014 5.0% of the total annual withdrawals of electricity generators that obtain energy from electric systems with an installed capacity greater than 200 MW be guaranteed to come from non-conventional renewable sources. Beginning in 2015, the required level of non-conventional energy sources rises by 0.5% annually to reach 10.0% of the total energy production by 2024. Since 2005, the Ministry of Energy has implemented, through the CORFO, a mechanism used to finance feasibility studies for NCRE projects for up to 40.0% of the total study with a UF 1 000 cap. (Approx. USD 40 000.00)

In October 2013, the government of Chile enacted Law 20.698 to promote the expansion of renewable energy, which doubles the goal previously set by Law 20.257 and specifies that 20.0% of the electricity sold by 2025 must come from non-conventional renewable energies. In addition, it introduces the obligation of the Ministry of Energy to conduct annual public procurement of energy blocks generated from non-conventional renewable energy, which will serve to fulfill the required NCRE quotas. This occurs only if it is foreseen that the market will not meet the requirement by itself.

At the end of September 2014, Chile's energy matrix has an installed capacity of 1 803 MW of NCRE, with Wind and Biomass representing 41.0% and 26.0%, respectively. In the same way, there are an additional 14 280 MW in new projects with approved Environmental Permission and 5 035 MW under environmental evaluation.

Chile's Economic Development Agency (CORFO) is administratively dependent on the Ministry of Economy and its mission is to promote the economy's economic development by supporting production companies. CORFO handles subsidies for studies at the pre-investment stage and long-term credits for financing consortiums to develop biofuel projects and solar energy pilot projects.

NUCLEAR

In 1964, Chile created its Commission on Nuclear Energy (*Comisión Chilena de Energía Nuclear*, or CCHEN) to address problems related to the production, acquisition, transfer, transport and peaceful uses of atomic energy. Also, the Commission on Nuclear Energy is in charge of the operation and regulation of the two reactors located in the Santiago metropolitan region, which have been used for investigation and civil purposes. In 2007, the Nuclear Power Working Group was created to assess the potential advantages and risks associated with the use of nuclear energy for power generation. Its duties are as follows:

- Technical and legal advisor to the government on nuclear issues related to energy and radiations;
- Research and development in peaceful uses of nuclear energy;
- Regulate, control and supervision of nuclear facilities; and

- Technology transfer and its applications.

In the National Energy Strategy 2012–2030 the Chilean government announced that it had decided that it would not make any decisions regarding the use of nuclear energy to generate electricity.

CLIMATE CHANGE

Chile is a signatory to the United Nations Framework Convention on Climate Change (1995) and ratified the Kyoto Protocol in 2002. In December 2008, Chile published the National Action Plan on Climate Change 2008–12. This action plan assigns institutional responsibilities for adapting, mitigating and strengthening Chile's response to climate change (CONAMA, 2008). According to the results of vulnerability studies of the Environmental Ministry of Chile, the effects of the climate change can summarised as follows:

- Decrease in precipitation in some regions up to 75.0%, temperature increase up to 1.5% and a decrease in the caudal rate to 77.0% in some regions.
- The vast majority of species have reduced their distributions.
- Regions, which are predominately small properties with low levels of technological access, show the greatest vulnerability to climate change.

While Chile's contribution to global carbon emissions is very low, at around 0.2% of the global carbon dioxide emitted in 2010 (UNStats, 2013) its territory is highly vulnerable to the effects of climate change. Glacial melting, shifts in rainfall patterns, expanding deserts, and the greater frequency of El Niño weather patterns will have an impact on the economy's water supply, food production, tourism industry and migration, as well as on its socio-economic development and energy security. In this regard, 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, and where adaptation would be required.

In July 2014, the Plan for the Adaptation to Climate Change in Biodiversity was approved. This plan contains 50 measures that aim to reduce and mitigate the effects of the climate change on the biodiversity.

NOTABLE ENERGY DEVELOPMENTS

The new Energy Agenda increases the role of the government not only as a regulator but also as an active participant in the energy market through ENAP. The government aims to protect the final consumer of energy and create effective competition in the market. In the case of market distortions, the government will use public policies, regulations, and even direct participation in the market through ENAP.

Under the new Energy Agenda of May 2014, the Chilean government proposes short- and long-term goals. The short-term policy horizons goals lay out the terms for the standards, policies and regulations with the intention of securing the technical feasibility and sustainability of the energy matrix by 2025. The medium- and long-term policy goals cover the strategic and technological aspects defining the energy matrix to be intensified by 2050.

This new Energy Agenda proposes a participative role of the society that involves public sector, industry, academy, civil society, regions and citizens to approve the new long-term "Energy Policy". This policy will identify the matrix, standards, guidelines and regulations required to guarantee its sustainability and feasibility through year 2050. Additionally, this Energy Agenda, proposes energy security as a permanent process to establish an organisational and operative structure for ex-ante preparation to face energy emergency situations.

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USEFUL LINKS

Chilean Commission of Energy (CNE)—http://www.cne.cl

Chilean Energy Efficiency Agency (AChEE)—http://www.acee.cl

Chilean Energy Efficiency Agency—www.acee.cl

Economic Load Dispatch Centre Norte Grande Interconnected System—www.cdec-sing.cl

Economic Load Dispatch Centre of Central Interconnected System—www.cdec-sic.cl

Government of Chile—www.gobiernodechile.cl

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

Ministry of Energy—www.minenergia.cl

Ministry of Environment—www.mma.gob.cl

National Centre for Innovation and Development of Sustainable Energy (CIFES)—www.cifes.cl

National Energy Commission (CNE)—www.cne.cl

National Institute of Statistics (INE)—www.ine.cl

National Oil Company (ENAP)—www.enap.cl

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

Superintendence of Electricity and Fuel (SEC)—www.sec.cl

Chilean Energy Efficiency Agency—www.acee.cl

Economic Load Dispatch Centre Norte Grande Interconnected System—www.cdec-sing.cl

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

Superintendence of Electricity and Fuel (SEC)—www.sec.cl

CHINA

INTRODUCTION

China is one of the world's most important emerging economies. It is located in north-east Asia and is bordered by the East China Sea, the Yellow Sea and the South China Sea. Its population of 1.4 billion is roughly one-fifth of the world's population. It has a land area of about 9.6 million square kilometres, with diverse landscapes consisting of mountains, plateaus, plains, deserts and river basins. Its total maritime area is 4.7 million square kilometres, and the length of its coastline reaches 32 thousand kilometres (NBS, 2012).

After reforming and opening up its economy in 1978, China entered a new period of high-speed growth. Its entry to the World Trade Organisation in 2001 further contributed to its prosperity in the first 10 years of the twenty-first century. China's proportion of total imports and exports in the world increased from 4.0% in 2001 to 10.1% in 2012 (WTO, 2013). In 2010, China overtook Japan to become the world's second-largest economy, ranking after the United States. Its gross domestic product (GDP) was 13 236 billion (USD 2010 at PPP), with the primary, secondary and tertiary industries accounting for 10.0%, 43.9% and 46.1%, respectively (EDMC, 2014; NBS, 2013).

Due to its huge population and booming economy, China plays an increasingly important role in the world's energy markets. Some statistics have reported that China was the world's largest energy consumer in 2013 and accounted for 22.4% of global primary energy consumption in 2013 (BP 2014). However, its per capita primary energy supply, at 2.0 tonnes of oil equivalent (toe) in 2012, is far lower than that of many developed economies and below the world's average. It has almost one-fourth of the per capita energy consumption of the United States (EDMC, 2014).

China is rich in energy resources, particularly coal. According to recent estimates, China had recoverable coal reserves of around 114.5 billion tonnes, proven oil reserves of 18.1 billion barrels and proven natural gas reserves of 3.3 trillion cubic metres (tcm) at the end of 2013 (BP, 2014). In addition, China has 400 gigawatts (GW) of economic 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.

The reserves per capita of coal, oil and gas are all well below the worldwide average levels. The limitations of its energy reserves per capita force China to conserve its resources. From 1978 to 2012, the average annual growth rate of primary energy consumption in China was 5.6% and the average annual growth rate of GDP was 15.9% (NBS, 2013). China essentially achieved its goal of a quadrupling of GDP supported by only a doubling of energy consumption.

Table 1: Key data and economic profile, 2012

Key data[a]		Energy reserves[b]	
Area (million sq. km)	9.6	Oil (billion barrels)	18 100
Population (million)	1 350.7	Gas (billion cubic metres)	3 300
GDP (USD (2010) billion at PPP)	14 249.0	Coal (million tonnes)	114.5
GDP (USD (2010) per capita at PPP)	10 549	Uranium (kilotonnes U)	18 100

Source: a. (EDMC, 2014); b. (BP, 2014).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

China's primary energy supply has expanded sharply since 2001, driven mainly by rapid economic growth, especially in energy consumption by heavy industry. In 2012, the total primary energy supply increased 5.2% compared with 2011, reaching 2 668 Mtoe, including net imports and other. Of this, coal was the dominant source, accounting for 73.2%, followed by oil (17.8%), gas (5.1%) and other (3.9%) (EDMC, 2014).

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	2 289 163	Industry sector	932 042	Total	4 987 553
Net imports and other	467 639	Transport sector	202 742	Thermal	3 892 814
Total PES	2 668 356	Other sectors	417 673	Hydro	872 107
Coal	1 954 417	Total FEC	1 552 458	Nuclear	97 394
Oil	474 526	Coal	597 464	Geothermal	125 238
Gas	136 498	Oil	437 282	Others	4 987 553
Other	102 915	Gas	92 414		
		Electricity and other	425 297		

Source: (EDMC, 2014).

China has provided significant political and financial support for the development of its abundant indigenous coal reserves to ensure the security of its energy supply. In 2012, China's total energy production reached 2 289 Mtoe, of which coal accounted for 81.7%, followed by oil (9.1%), gas (4.4%) and other (4.9%) (EDMC, 2014). Since 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. However, with lean oil and gas resources, the share of coal in total domestic energy production is still at a comparatively high level. In 2013, coal production reached 1 840 Mtoe, 1.2% higher than the previous year. Total coal consumption reached 1 925 Mtoe, 4.0% higher than the previous year and 50.3% of global coal consumption in 2013 (BP, 2014).

In 2013, China's domestic crude oil production reach 208.1 million tonnes, rising 0.6% compared to 2012. At the same time, crude oil imports reached 283 million tonnes. Since 1993, China has been a net oil and oil product importer, and net oil and oil product imports increased to 311.5 million tonnes in 2012. Total oil consumption reached 507.4 million tonnes, 3.8% higher than the previous year and 12.1% of global oil consumption in 2013 (BP, 2014).

China's proven gas reserves and gas production have expanded rapidly. Gas reserves have grown from 1400 billion cubic metres (bcm) in 2001 to 3300 bcm in 2013. Since 2003, gas production in China has grown 12.8% a year, on average, to reach 117.1 bcm in 2013 (BP 2014). The expansion of natural gas pipelines has also been rapid (NBS 2013). At the same time, China imported 24.5 bcm of liquid natural gas (LNG) and 27.4 bcm of pipeline gas in 2013. Total gas consumption reached 161.6 bcm, 10.8% higher than the previous year and 4.8% of global gas consumption in 2013 (BP, 2014).

China has been the world's second-largest economy in terms of electric power generation capacity since 1996. Its electric power industry experienced a serious oversupply problem in the late 1990s, due largely to lower demand after the closure of inefficient state-owned industrial units, which were major consumers of electricity. Subsequently, however, a power supply shortage developed because of rapid economic expansion after 2001. Between 2001 and 2005, installed generation capacity increased steadily at an annual average rate of 9.8%; since 2005, installed generation capacity has increased steadily at an annual average rate of 13.6%. In 2010, installed generation capacity reached 962 GW, an increase of 10.1% compared with 2009 (EDMC, 2013).

The power supply structure diversifying, with wind power and nuclear energy generation increasing rapidly. In 2012, total power generation in China was 4 987.6 terawatt hours (TWh). Thermal power accounted for 78.1% (3 892.8 TWh) of total generation, hydropower 17.5% (872.1 TWh), nuclear energy 2.0% (97.39 TWh) and other 2.5% (125.2 TWh) (EDMC, 2014).

FINAL ENERGY CONSUMPTION

Final energy consumption in China reached 1552.5 Mtoe in 2012, 6.9% higher than in the previous year. The industrial sector was the largest consumer, accounting for 60.0% of total final energy consumption, followed by the transport sector (13.1%) and other sectors, including residential, commercial and agriculture, totalling 26.9% (EDMC, 2014).

Power generation increased 12.0% to 4 987.6 TWh in 2012, compared to the previous year (EDMC, 2014). Demand rate growth was, as in previous years, based mainly on increased consumption in the commercial and public services, residential, transport and industrial sectors. In 2012, the industrial sector

accounted for the majority of electric power consumption (68.6% or 243.33 Mtoe), followed by the residential, commercial and public services sector (29.1% or 103.26 Mtoe, including non-specified), and transport (2.2% or 7.9 Mtoe). In terms of growth, electric power consumption in the residential, commercial and public services sector in 2012 increased by 10.26% compared with the previous year, the transportation sector by 7.89%, and the industry sector by 5.3% (EDMC, 2014).

Coal consumption, excluding coal consumption to generate electricity, was 597 Mtoe in 2012 (EDMC 2014). The electric power generation sector was the biggest coal consumer, followed by the metallurgical sector, the building materials sector, the chemical sector and other. Coal consumption in the residential, commercial and agriculture sectors showed little growth.

In 2012, total final oil consumption was 437 Mtoe. The transportation sector was the largest oil-consuming sector, accounting for 40.9% of total final oil consumption, or 178.4 Mtoe. The industrial sector was the second largest in terms of consumption and accounted for 21.9% of total oil consumption or 95.4 Mtoe (EDMC, 2014).

The market for gas is moving to the north and east of China with the completion of the Shaanxi–Beijing and West–East gas pipelines. With the larger-scale utilisation of gas, residential and commercial and public service consumption grew from 5.19 Mtoe in 2000 to 31.7 Mtoe in 2012. However, the industrial sector was still the largest sector in total final gas consumption, accounting for 40.9% or 37.9 Mtoe (EDMC, 2014).

Based on changes in its electricity mix and energy consumption in end-use, China is optimising its primary energy structure, and the proportion of low-carbon energy has increased significantly. In 2012, the proportion of coal used was 66.6% (compared to 76.2% in 1990), the proportion of oil and natural gas used rose from 18.7% in 1990 to 24.0%, and hydropower, nuclear energy and wind power rose from 5.1% in 1990 to 9.4% (NBS, 2013).

ENERGY INTENSITY ANALYSIS

China has reduced energy intensity in the last two decades. The intensity of primary energy and final energy demand in 2012 have been cut by 50.4% and 61.5% respectively compared to 1990, the biggest among the APEC economies. However, the energy intensity is still very high and there is quite a lot of room to improve (EDMC, 2014).

In 2011, China eliminated more than 3 GW of small thermal power plants and 24 million tonnes of backward cement production capacity (MEP, 2012). With all these efforts, the intensity of final energy demand decreased 1.2% year-to-year in the industry sector. However, due to the booming economy and transportation needs, car purchases are high, which result in increased energy intensity of transportation sector.

Table 3: Energy Intensity, 2012

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	191.6	187.3	-2.3
Final Energy Demand	109.7	109.0	-0.7
Industry	66.2	65.4	-1.2
Transportation	13.8	14.2	3.2
Others	29.8	29.3	-1.5

Sources: EDMC (2014).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

China's energy consumption is growing 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. China aims to be a low carbon economy. The structural transformation of energy is

key to economic restructuring, which is also 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.

In March 2011, the National People's Congress approved the Twelfth Five-Year Plan for National Economic and Social Development (the Twelfth Five-Year Plan). The plan aims to:

- prioritise domestic resources; encourage diverse patterns of development; protect the environment;
- increase international cooperation for mutual benefit;
- adjust and optimise the energy structure; and
- construct a modern energy industry with the merits of safety stability, economy and cleanliness.

It also publishes energy targets including increasing non-fossil fuels in total primary energy consumption to 11.4%, and reducing the energy consumption per unit of GDP by 16.0% and carbon dioxide emissions per unit of GDP by 17.0% by 2015, compared to 2010.

ORGANISATION

The National Energy Committee is a high-level body that coordinates overall energy policies. The committee, chaired by the Premier, is in charge of drawing up China's energy strategy and deliberating on major issues in energy security. In March 2013, the State Electricity Regulatory Commission (SERC) merged into the National Energy Administration (NEA), under the administration of the National Development and Reform Commission (NDRC). The NEA currently is composed of 12 departments, with an authorised staff size of 240 civil servants. It is responsible for developing and implementing energy industry planning, and industrial policies and standards. In addition, it is in charge of administering the energy sector, including coal, oil, and natural gas, other forms of power such as nuclear energy, and new and renewable sources of energy. It has also assumed responsibility for the Office of the National Energy Committee. Some departments within the NDRC also contribute to energy conservation and climate change policy development.

In 2009, China established the National Energy Conservation Centre directly under the NDRC to provide technical support to the government in implementing energy efficiency and conservation management initiatives. Its main duties include energy efficiency and conservation policy research; the assessment of fixed asset investment projects; information dissemination; the promotion of technologies, products and new mechanisms; label management; and international cooperation in the field of energy conservation.

LAW

The laws relating to energy in China include, the Coal Law, the Electricity Law, the Renewable Energy Law, the Energy Conservation Law and the Environmental Protection Law. A comprehensive legal basis for the energy sector, the Energy Law, is currently under consideration. The Standing Committee of the National People's Congress endorsed the amended version of the Renewable Energy Law on 26 December 2009. It came into effect on 1 April 2010. It more clearly defines the responsibilities of the power grid and power generation enterprises and emphasises the completely secure purchase of power from renewable energy sources and the establishment of a development fund for renewable energy. The amendment provides that power grid companies will receive all of the revenue generated from the surcharge on retail power tariffs, and it sets a minimum target for renewable electricity that grid companies must buy from renewable energy projects (Qiu and Li, 2012).

The Oil and Natural Gas Pipeline Protection Law, endorsed on 25 June 2010 and came into effect on 1 October 2010, requires that oil and pipeline companies take safety measures while constructing pipelines. This includes ensuring the quality of construction materials, conducting regular patrols of pipelines and promptly eliminating any hazards.

The State Council approved the Regulation on Electricity on 15 February 2005 and became effective on 1 May 2005. This regulation clarifies the content and responsibilities of electricity regulation.

The State Council approved the Regulation on the Administration of Urban Gas on 19 November 2010 and it came into effect on 1 March 2011. This regulation clarified the responsibilities and duties of gas operators, unified gas market management into a regular channel, and set the basis for local governments' activities.

ENERGY SECURITY

'More coal, less oil and gas' characterises China's energy resources. The most efficient use of available resources is the guiding principle for the economy. China has also strengthened the security of its oil supply through building and supporting bilateral cooperation with new trading partners and through the globalisation of its oil and gas assets. China is trending toward energy diversification to secure its energy base.

To increase oil supply security Chinese companies are encouraged to develop upstream investment activities abroad, through cooperation with international and/or local companies. The China–Russia crude oil pipeline, completed in September 2010, transports 150 mt of crude oil per year from 2011 to 2030. On 10 September 2010, construction began on domestic engineering of the China–Myanmar oil and gas pipeline in Yunnan province. In 2009, the first phase of China's SPR projects was completed and in operation. In 2010, a second round of SPR projects began construction, and a third round of SPR locations went through the site selection process. In 2014, China's SPR capacity has reached 12.4 mt (NEA, 2014b). According to the China Petroleum and Chemical Industry Federation (CPCIF), with the addition of the second and third rounds, China's SPR capacity will reach 350 million barrels by the end of 2015 (CPCIF 2011).

In order to secure the energy supply, the NDRC and the Ministry of Finance established a strategic coal reserve base in major coal production areas and import ports in 2011. The first round of reserves with capacity of 5 mt. China will continue to look for new locations for a second round of strategic coal reserves with another 10 mt capacity (CEN, 2011).

ELECTRICITY MARKET

In addition to the abovementioned laws, the following laws apply to the electricity market: the Electricity Law, the Energy Conservation Law, the Renewable Energy Law, the Regulations on Electric Power Supply and Consumption, and the Basic Operating Rules for the Electric Power Market.

The State Electricity Regulatory Commission (SERC), formed in 2003, administers the electricity sector, along with the NDRC and the NEA. The SERC merged into the NEA in March 2013. This is a significant change for China's power industry as the restructuring has eliminated duplicated functions and responsibilities between the original NEA and the SERC, and endowed the new NEA with greater administrative and regulatory power over the energy sector.

In 2014, China's total installed power generation capacity reached 5550 TWh, a 3.6% increase from the previous year, giving it the second largest capacity in the world. (CEC, 2015).

In 2011, thermal power plants, particularly coal-fired power plants, were under pressure both from the move towards carbon reduction and from operational deficits. The southern provinces experienced the worst power shortages since 2004. This situation was caused by the contradiction that existed between coal-fired power plants and the price for supplying coal, which resulted in a 'the more power generated, the greater the deficit' dilemma for existing coal-fired power plants. In order to solve this problem, the NDRC announced the decommissioning of coal-fired power plants with a capacity of less than 100 MW by the end of 2011, and proposed a mechanism for creating a linkage between the price of electricity and coal prices. In 2011, China adjusted the tariff for electricity three times. The last adjustment, at the end of 2011, was more comprehensive, and included CNY 0.008/kWh in subsidies. In this regard, while price adjustments may ease the losses incurred by thermal power enterprises, reliance on temporary administrative adjustments makes it impossible to solve the problems of China's electric power system (CEN, 2011).

Some coal production enterprises have gradually expanded their business into the thermal power industry. This has led coal-fired power plants growth continued growth and rising coal prices to bring greater revenue for the coal industry. This also creates impacts efforts to reduce carbon emissions. However, the integration of power generation companies with coal production companies can also help avoid the risk of coal price fluctuations and enhance the stability of the electricity supply (CEN, 2011).

On December 2011, China completed the power grid network connecting Qinghai and Tibet—the Qinghai-Tibet power grid project. It has a total length of 1 038 km and includes DC transmission lines and two ±400 kV converter stations. It also supports the construction of the Xining-Mountain-Hercynian-Golmud 750 kV power transmission project and a 220 kV power grid project in Tibet. It integrates the Tibet Power Grid into China's grid and completes China's comprehensive grid network system (CEN, 2011).

ENERGY MARKET

Actively promoting energy market reform and uniformly allocating resources to accelerate development are among China's major concerns. The Government of China announced that the entire range of projects included in the National Energy Plan would be open to private investment, except those prohibited by laws and regulations. In 2010, the State Council issued 'Several Opinions of the State Council on Encouraging and Guiding the Healthy Development of Private Investment,' which encourages private capital to participate in the exploration and development of energy resources, oil and gas pipeline network construction, power plant construction, coal processing, energy conversion, the refining industry and a comprehensive, new renewable energy industry.

China has stressed that reform is a strong driving force in accelerating the transformation and diversification of energy. China intends to continue pushing firmly ahead to reform the energy field, strengthen top-level design and overall planning, accelerate the establishment of institutional mechanisms for the development of energy technology, improve the environment for energy development, and promote a revolution in energy production and application to secure the economy's energy supply in line with demand (Reuters, 2012).

COAL MARKET

Coal is the major primary energy source for China, contributing about 70.0%, and this is likely to remain the case for the near future. Due to efforts by the State Council and enforcement of policies regarding coal industry development during the period of the Eleventh Five-Year Plan (2006-2010), the coal industry has made quite promising progress (CEN, 2011).

In March 2012, the NEA announced its Twelfth Five-Year Plan for Coal Industry Development and set an overall target for annual coal production to reach 3.9 bt by 2015. The Plan calls for the industry to:

- Continue to push for the formation of large coal companies that will contribute to more than 60.0% of production in China.
- Continue to improve the safety of coal production, reducing deaths per million tonnes of production by more than 28.0% in 2015 compared to 2010.
- Adjust the balance between production and demand, strengthen the railway and shipping transportation system, reduce the long-distance road transportation of coal, and establish an emergency coal reserve system, improving emergency response capabilities.
- Strengthen the development of coal bed methane by creating 36 sites with annual production of coal bed methane in excess of 100 million cubic metres. Encourage the application of coal bed methane in district power generation and for household use through the construction of a district pipeline network.

On 21 October 2010, the State Council announced the Instructions for Accelerating Coal Mine Enterprise Mergers and Restructuring, prepared by the NDRC. Some commentators believe that mutual ties between a coal enterprise and its relevant upstream and downstream industries will be a trend and that the integration of coal production and related industries will be an important characteristic of future large coal companies (CEN, 2010).

Since 2011 the central government requested that large coal and power enterprises establish coal reserves in the major collection and distribution centres, consumption regions and key transport hubs, so as to be able to respond to supply disruptions or serious shortage of coal due to natural disasters or other emergencies. The central government grants a subsidy to the stakeholders for their costs in relation to the reserves and instructs them to use the reserves when it is necessary.

According to the strategic plan for energy development (2014-2020), the consumption of coal will be less than 4.2 billion tonnes by 2020. The government plans to expand 14 large coal bases, with an output that will occupy 95.0% market share in China (SCC, 2014a).

The February 2011 'Thermal Power Plant Air Pollutant Emission Standards' (second edition), requires all new thermal power plants from 2012 to meet tougher emissions standards for sulphur dioxide, nitrogen oxides and particulate matter. From 1 July 2014 these standards also applied to existing power plants. (CEN, 2011).

OIL MARKET

In December 2008, China instituted an oil product tax and price reform plan. 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 State Council approved the programme and it took effect on 1 January 2009. The reform aims to standardise government fees and charges by gradually abolishing 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 government approval of road charges on secondary loans. The reform also raises the gasoline consumption tax from CNY 0.2 a litre to CNY 1 a litre for gasoline and from CNY 0.1 to CNY 0.8 for diesel, with similarly increased unit taxes on other oil products. For gasoline and diesel oil, the aim is to implement a fixed-amount consumption tax rather than an *ad valorem* tax.

The government mandates or guides prices for oil products depending on the product type. When the average oil price in international markets varies by greater than 4.0% for more than 22 consecutive working days, the government may adjust domestic oil product prices accordingly. From December 2008 to March 2013, the government adjusted the oil price 25 times, where it rose 15 times and fell 10 times. In March 2013, the NDRC revised the oil pricing mechanism to reflect global price movements. The new plan shortened the 22-working day price review period to a 10-working day period and removed the 4.0% fluctuation limit, which means the government will adjust domestic oil product prices based on international market fluctuations every 10 working days (CEN, 2013).

On 25 March 2006, the State Council decided to collect a Special Oil Gain Levy from oil companies that obtain excess income from sales of domestically produced crude oil when the crude oil price exceeds a certain level. The cut-off point is USD 40 per barrel and the levy rate is progressive, with five categories ranging from 20.0% to 40.0%.

On 9 May 2008 the National Standardisation Technical Committee for the Oil and Natural Gas Industry standardised China's oil and natural gas industry and it entered a new stage of development. The committee is 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.

On 1 November 2010, the first crude oil pipeline between China and Russia began its trial run. This pipeline transports 15 mt of crude oil a year from 1 January 2011, for a period of 20 years, up to a maximum of 30 mt a year (CEN, 2010).

In 2010, the first round of economy-wide strategic petroleum reserve projects successfully completed collections. China aims to have 100 days of net imports by 2020 or approximately 570 million barrels and currently has just under 30 days of net imports. (Bloomberg News, 2014). China constructed a number of commercial petroleum reserve bases with a capacity of up to 26.5 million cubic metres. In December 2015 China had 20 underground gas storage units with a total storage capacity of 4.2 billion cubic metres (bcm) (CN, 2015)..

The 'Ocean Oil 981', also known as Haiyan Shiyou 981, Ocean Petroleum 981 and HD-981, began operation in 2012 in the South China Sea. It is the sixth generation of China's first independently designed 3 000 metre deep-water semi-submersible drilling platform and is used to perform deep-water drilling for the China National Offshore Oil Company (CNOOC) (CEN, 2011).

In 2011 China started the refined oil electronic trading platform at the Beijing Petroleum Exchange, along with another trading platform in Xiamen (CEN, 2011). In March 2013, the NDRC announced a new pricing system to reflect fluctuations in global oil prices. The new system shortened the current 22-day adjustment period to 10 days and removed the 4.0% limit, making it a more market-based mechanism that could better reflect production costs and energy shortages.

NATURAL GAS MARKET

China's energy industry is rapidly expanding its natural gas market. This includes production, transmission and application of natural gas. On 14 October 2012, China released the new Natural Gas Utilisation Policy (2012 Gas Policy). The 2012 Gas Policy addressed some important issues such as balancing gas supply and demand, promoting economical and efficient use, intensifying the pricing reform and classifying gas users (NDRC 2012).

China's five-year plan (2011–2015) for shale gas development, aims for 6.5 bcm/year of shale gas production by 2015, the equivalent to 2.0–3.0% of projected Chinese gas production in 2015, and 60~100 bcm/year of shale gas production by 2020. Geological conditions are complex in China posing greater technical and investment challenges. In order to secure more natural gas supply through domestic shale gas, China and the United States signed a working plan of action on shale gas resources during the second round of their strategic and economic dialogue in May 2010. They agreed that, based on the US's

experience in unconventional natural gas development and in accordance with relevant Chinese laws and regulations, both sides will strengthen cooperation in shale gas resource evaluation and exploration and in the development of technology and related policies.

According to the strategic plan for energy development (2014-2020), the usage of gas is encouraged and the efficiency is to be improved so that gas could occupy more than 10.0% of the total primary energy consumption in China by 2020 (SCC, 2014a).

China's reforms cover energy investment, government regulation, market adjustment and managing state-owned energy companies. The economy encourages investment diversification in the energy sector, offers autonomy to businesses and seeks to attract foreign capital and advanced technology to China's energy industry.

The Chinese energy tax regime includes resource taxes, royalties, mineral resources compensation, consumption taxes and other levies. Since 1 October 1984, China collected a resource tax on oil, natural gas and coal. In 1994, the levying scope expanded to the volume of production as well as the circumstances of the various resources. In September 2011, the State Council amended the Provisional Regulations on Resource Taxes. From 1 November 2011, the assessment base for resource taxes on crude oil and natural gas changed from production amount to sales value, with the tax rate ranging from 5%–10%. It singles out coking coal and rare earth ores from coal and nonferrous metal ore resources, respectively. Correspondingly, it also raises the tax rates were to CNY 8–20 per tonne and CNY 0.4–60 per tonne, respectively.

The collection of royalties is limited to offshore and onshore oil and gas exploitation and with the option to pay in kind. Since 1989, production of up to 1 mt of crude oil in offshore exploitation has royalties levied at a rate of 2.5%–4%. Similarly, production of up to 2 bcm of natural gas has royalties levied at a rate of 1%–3%. For onshore exploitation, the collection of royalties has depended on the annual production of each oil field or gas field since 1990. The rate ranges from 1%–12.5% for production of up to 50 000 tonnes of crude oil and 100 million cubic metres of natural gas. Since 1 April 1994, China has levied mineral resources compensation on mining operators. The rates differ between mineral resources, ranging from 0.5%–4%. There are 13 kinds of energy-related products, including gasoline and diesel that incur a consumption tax.

On 29 March 2010, the Sichuan–East China gas production and related transmission pipeline came into operation. This included Puguang gas field exploration and development, acidic gas processing and matching long-distance pipelines. At present, the Puguang gas field has an annual production capacity of 10.5 bcm of natural gas mixture, with plans to purify 4 bcm of natural gas. The pipeline is 2 170 kilometres long and will carry 12 bcm of natural gas to eastern China and the regions along the line (CEN, 2010).

On 1 June 2010, a Notification on the Increase of the Benchmark Price of Domestic Onshore Natural Gas issued by the NDRC went into effect. This notification aims increase domestic natural gas prices and to publicise related policies about natural gas pricing and supporting measures (CEN, 2010).

On 19 November 2010, the State Council approved the Regulation on the Administration of Urban Gas it came into effect on 1 March 2011.

On 3 December 2010, four ministries jointly issued a notice announcing further expansion of international cooperation on coal bed methane (CBM) exploration (CEN, 2010). In 2013 pilot wells produced 3 bcm and China is aiming to produce 16 bcm in 2014. However, meeting this target is unlikely, given development is still in its early stages (NUS, 2014).

The first stage of the Shanxi Coal Bed Methane Pipeline was completed at the end of 2011 at a length of 354 km. The second and third stages will follow with an additional 1 328 km. This is the longest pipeline for a coal bed methane transportation system in China. It will support the Gasification Shanxi strategy and speed up the development of coal bed methane in China. Construction of a so-called 'five horizontal and three vertical' pipeline network across Shanxi Province is also planned, with a total length of 3 300 km to support 12 bcm of annual gas production by the end of 2015 (CEN, 2011).

ENERGY EFFICIENCY

China's energy consumption per unit of GDP is much higher than the global average. Energy-intensive industries are backward in technology. The share of energy consumption by the secondary industries is too high a percentage of the member economy's total. Four major energy-intensive industries—steel, non-ferrous metals, chemicals, and building materials—account for 40.0% of the total energy consumption. Low energy efficiency results in high-energy consumption for every unit of GDP.

In 2011, the State Council released the Comprehensive Work Plan on Energy Conservation and Emission Reduction during the Twelfth Five-Year Plan Period. This plan proposed the major objectives and key actions in the fields of energy conservation and emission reduction during this period. China aims to establish a 'reverse coercion mechanism' through the dynamic integration of its efforts in lowering the intensity of energy consumption, reducing the total emissions of major pollutants, and rationally controlling total energy consumption. The reverse coercion mechanism helps promote the strategic restructuring of the economy, push forward the optimisation of the industrial structure, and strengthen all aspects of energy utilisation management in industry, construction, transportation and public organisations, as well as in the fields of urban and rural construction and consumption (SCC 2012a).

To promote energy conservation activities in the industry sector, the central government has issued catalogues of advanced and applicable technologies in the fields of energy conservation and emission reduction for key industries such as iron and steel, petrochemicals, non-ferrous metals and building materials. It has established and improved a mandatory standards system of quotas for energy consumption per unit product in key industries and strengthened the energy-saving evaluation and supervision system. It has undertaken key energy-saving projects, including combined heat and power (CHP), recycling of industrial by-product gas, construction of enterprise energy-control centres, and fostering of energy-saving industries, to increase its enterprises' energy utilisation efficiency. The government also encourages energy service companies (ESCOs) through financial and tax incentives. ESCOs provide a total energy efficiency solution (finance, technology, operation, maintenance, etc.) for industrial energy users. From 2005 to 2010, the number of ESCOs increased from 80 to over 800, the number of employees in this sector increased from 16 000 to 180 000, and revenues from the energy service industry grew from CNY 4.7 billion to CNY 84 billion (USD 740 million to 13.2 billion) (APERC, 2012).

In the transport sector, the government is committed to improving public transport, developing intercity rail transportation, and encouraging green commuting. China has implemented some of the world's most advanced fuel economy standards for automobiles and popularised energy-saving and environmentally-friendly vehicles. It is speeding up the elimination of old automobiles, locomotives and ships. Some efforts include optimising the transportation structure and develop green logistics. According to the Development Plan for Energy Saving and New Energy Automobile Industry (2012–2020), China will focus on electrically powered cars (EVs and FCVs) to increase energy efficiency and reduce carbon emissions. It will also push the economy's automobile industry to upgrade its technology and encourage local car manufacturers to speed their efforts in the development of electrically powered vehicles. Production and sales of electrically powered vehicles are expected to total 500 000 units by 2015 and to reach more than 5 million units with a 2 million unit production capacity by 2020. Subsidies and tax exemptions are available for electrically powered vehicles (SCC, 2012b). The construction of supporting facilities, such as electricity charging facilities is also included. More than 2000 charging stations with 400 000 quick chargers for EVs will be provided by 2015. The economy is harmonising charging methods to promote electrical-driven vehicles. Electrically powered car (EVs and FCVs) and hybrid vehicle use is gradually increasing on the domestic market (IEEJ, 2012). Another effort by China is to carry out a vehicle fuel consumption testing and management scheme from March 2011 to enhance and strengthen vehicle energy efficiency management. In this scheme, China published a list of vehicle models that satisfy the fuel consumption standards (CAA, 2011).

The government sets standards for green buildings and implements rating and identification of green buildings. It actively promotes energy-saving renovation of existing buildings, sets quotas for energy consumption by public buildings and publicises their energy efficiency rates. It has set up a management system for the life cycles of buildings and exercises strict control over the demolition of buildings. China has also made and implemented an energy-saving plan for public institutions and strengthened the establishment of a supervisory system for energy conservation in public buildings. It carries forward heat metering and energy efficiency renovations on existing residential heating systems in the northern regions of China, builds energy-saving greenhouses, improves the old heat-supply network, and practices metered heat-supply charging and energy consumption quota management (SCC 2012a).

China also promotes energy conservation among all citizens. The government will intensify efforts in energy saving education and publicity. It has launched a project to promote energy-efficient products such as high-efficiency lighting products and air conditioners, energy-efficient motors by providing government subsidies. The central treasury has appropriated subsidies to support the use of 360 million high-efficiency lighting products, 30 million high-efficiency air conditioners and one million energy-efficient motor vehicles, which have realised an annual energy-saving capacity of 20 billion kWh. The government has established a preferential procurement system for energy-efficient products, released a government procurement list of energy-efficient products and ordered the mandatory procurement of nine kinds of

energy-efficient products, including air conditioners, computers and lighting products. By the end of 2010, the market share of high-efficiency lighting products had reached 67.0%, and that of high-efficiency air conditioners, 70.0%.

China advocates demand side management, pushing enterprises to use efficient products and optimise energy usage. The target is to save more than 40 TWh of electricity and reduce 9 GW in peak demand during 2014-2015 year (SCC, 2014b).

RENEWABLE ENERGY

China announced the Medium- and Long-term Development Plan for Renewable Energy in September 2007. It aims to achieve a 15.0% share for non-fossil fuels (including nuclear energy) in its primary energy consumption mix by 2020. According to the strategic plan for energy development (2014-2020), the capacity of hydro power, wind power and solar power are expected to be around 350GW, 200GW and 100 GW by 2020 respectively, while the usage of geothermal power would save about 40 mt coal equivalents (SCC, 2014a).

In the Twelfth Five-Year Plan for Energy Development, China confirms its ambitious targets for renewable energy. By the end of 2015, installed wind power generation capacity will reach 100 GW, and the capacity of installed solar power plants will be more than 21 GW.

After the enactment of the Renewable Energy Law in 2005, China has doubled its installed capacity every year for renewable energy. In 2010, the thermal power supply accounted for 79.2 of total power generation capacity, hydro for 17.2% and (grid connected) wind power for 1.1%. The Renewable Energy Law, revised in April of 2010, now requires the grid companies to guarantee a minimum amount of renewable electricity to solve the issue of balance between power generation and grid connection.

The generation price for biomass power, solar power and other sources of renewable energy power is a mandated price. On 18 July 2010, the NDRC published a Notification about the Ideal Pricing for Power Generation Using Agriculture and Forestry Biomass, which came into effect on 1 July 2010. The notification requires the implementation of a benchmark electricity price policy for power generation projects using agricultural and forestry biomass. The benchmark electricity price for biomass power is uniform at CNY 0.75 per kWh (including tax). On 24 July 2011, the NDRC published another Notification about the Ideal Pricing for Solar Photovoltaic Power Generation, which came into effect on 1 August 2011. The notification set the benchmark electricity price for solar photovoltaic power at CNY 1.00 or CNY 1.15 per kWh (including tax), depending on the location and commissioning time.

WIND

China's approach in increasing wind power has come to be known as 'Three Gorges on the Land,' a reference to a massive scale of development comparable to that of the Three Gorges Dam. In 2009, China added 13 GW to total capacity, of which 5.5 GW was in Inner Mongolia, and was on par with Germany with the world's second largest installed wind power capacity. The Chinese capacity surpassed the United States in 2010, when the member economy became the world's largest wind power capacity holder (IEA, 2012). In 2014 China installed 61 offshore wind power units with a total capacity of 229.3 MW. In 2014 the Chinese Wind Energy Association released its '2014 China Wind Power Installation Capacity Statistics'. According to China Electricity Council, China has 95.81 GW of wind capacity connected to the grid in December 2014, 657.9 MW of that was offshore wind power (Howe, 2015).

In August 2011, the NEA published a large wind power grid design specification, which put forward clear requirements for wind power unit performance. It will improve grid safety when the grid takes on wind power.

On 31 August 2011, the Shanghai Donghai Bridge offshore wind power plants passed their 240 hours' inspection. It was China's first offshore wind turbine project and has a total capacity of 100 MW (CEN, 2011).

Asia's first flexible DC power transmission demonstration project—the Shanghai Nanhui Wind Farm Flexible DC Transmission Project—was put into operation on 25 July 2011. The project links the Shanghai Nanhui wind farm and the Sulo converter station, with a DC transport capacity of 20 MW at the ± 30 kV level and a transport distance of 8.6 km. It is a completely independent intellectual property of China (CEN, 2011).

SOLAR

In 2014, photovoltaic (PV) cell production in China reached 26.52 million kw, accounting for more than 50.0% of the global market share, of which five local enterprises ranked among the world's top 10 PV cell

manufacturers. The price per PV module fell from CNY 40 per W in 2005 to about CNY 6–7 per W in 2010. The power generation cost has also fallen from CNY 4 per kWh before 2009 to about CNY 1 per kWh in 2010. This marked significant progress in technology development and production capability in China (NEA, 2012).

In December 2014, national grid solar power generation capacity was 26.5 million kw, which is a 67.0% increase (CEC, 2015).

China is also developing a feed-in tariff policy for PV systems to encourage the construction of solar farms in the western region to connect with the local grid system. The Golden Sun Demonstration Project provided financial subsidies for the construction of photovoltaic power generation systems on the demand side. Photovoltaic power generation systems is widely used in areas without any other electricity supply, as well as in solar traffic signals, solar street lights, and in the fields of communications, weather, railways, and petroleum. By the end of 2010, the total installed PV capacity reached 860 000 kW, including large-scale grid-connected photovoltaic power plants generating 450 000 kW and Building Integrated Photovoltaic Systems (BIPVs) generating 260 000 kW (NEA, 2012).

China has established targets for solar power development: 21 GW of solar power capacity (10 GW for solar farms, 1 GW for solar thermal power and 10 GW for distributed solar power) in 2015, and 50 GW (20 GW for solar farms, 3 GW for solar thermal power and 27 GW for distributed solar power) by 2020 (NEA, 2012).

HYDRO

On 27 March 2011 the first privately owned million-kilowatt hydropower station, the Jin'anqiao Hydropower Station with a 2.4 GW capacity, began operations and connected to the grid (CEN, 2011).

In 2014 hydropower installed capacity reached 300 million kw, which is an increase of 7.9% from the previous year. Generating capacity reach 1.07 trillion kwH a 19.7% increase from 2013, due to the Pianku 2013 flood (CEC, 2015).

NUCLEAR

The Medium- and Long-Term Nuclear Energy Development Plan (2005–20), issued in 2007, called for total nuclear energy installed capacity to reach 40 million kW by 2020, and for annual power generation by nuclear energy to reach 260–280 billion kWh. An additional 18 million kW of installed capacity will be under construction at the end of 2020.

China has 24 nuclear power generating units in operation by 2014 and has another 25 units still under construction (WNA, 2015). It has 19.1 GWe of installed nuclear energy capacity, which China plans to expand to 58 GWe by 2020.

Following Japan's Fukushima Daiichi Crisis in early 2011, China reviewed their nuclear plant safety requirements. On 25 October 2012, the Chinese Cabinet approved new safety rules, which prioritises safety and quality in the Chinese regulations (WNA, 2015). The Chinese government has said that it will approve a small number of plants along the coast in accordance with new stricter safety rules. However, none in inland areas during the period of the Twelfth Five-Year Plan (2011-2015) (SCC, 2013).

According to the Energy Development Strategy Action Plan 2014-2020, all new nuclear plants are to meet the strictest safety standard in the world in coastal areas. (SCC, 2014a).

On 21 July 2011, China's first fast neutron reactor—China's experimental fast reactor (CEFR)—had its first critical success operation, a significant breakthrough for the economy's fourth advanced nuclear energy power generation system technology. China has become one of the few economies with fast reactor technology (CEN, 2011).

CLIMATE CHANGE

The 2008 Chinese Government White Paper on China's Policies and Actions for Addressing Climate Change described the economy's climate change policies and actions the economy. The government releases follow-up annual progress reports at the end of every year. Nearly all provinces have province-level programmes to address climate change. China also addresses climate change in its mid-term and long-term planning for economic and social development. In 2006, China set the goal of reducing per unit GDP energy consumption in 2010 by 20.0% from that of 2005. In 2007, China became the first developing member economy to formulate and implement an economy-wide program to address climate change. In 2009, China set a goal to reduce per unit GDP GHGs in 2020 by 40.0%–45.0%, compared to 2005 levels (IOSC, 2011). It also aims to increase non-fossil fuel to 15.0% of the primary energy by 2020 and 20.0% by 2030 (NEA, 2015).

From 2000 to 2010, China's energy use grew 130.0% - a 50.0% increase from the previous decade. China is the world's largest energy consumer and the greatest source of greenhouse gas emissions. China's share of global energy-related CO_2 emissions has increased in just five years from 19.5% in 2005 to 24.7% in 2010 (WB, 2014).

In 2010, China launched an economy-wide 'low-carbon province and low-carbon city' experimental project. The first round of selected localities included five provinces, namely, Guangdong, Hubei, Liaoning, Shaanxi and Yunnan, and eight cities, namely, Tianjin, Chongqing, Hangzhou, Xiamen, Shenzhen, Guiyang, Nanchang and Baoding.

In 2011, the Chinese Government released the Comprehensive Work Plan for Energy Conservation and Emission Reduction during the Twelfth Five-Year Plan period (2011–15) and established overall arrangements for energy conservation, emissions reduction and greenhouse gas emissions control during that period

Since 2013 seven major cities (Beijing, Chongquing, Guangdong province, Hubei province, Shanghai, Shenshen and Tianjin) are testing a pilot cap-and-trade program. On 31 August 2014, China announced that an economy-wide cap-and-trade program will operate from 2016 (CBR, 2014)

As the APEC region's and the world's second largest economy and largest emitter, China's role international climate change negotiations is critical. The economy is a non-annex I party to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. It adheres to the double-track negotiation mechanism of the and the principle of 'common but differentiated responsibilities' in promoting the progress of international climate change negotiations (EE, 2012).

NOTABLE ENERGY DEVELOPMENTS

In late 2014 the United States and China made a Joint Announcement on Climate Change, which establishes an economy-wide target of peaking CO_2 emissions in 2030, however the announcement did not provide a target level (SCC, 2014c). Under the announcement, China intends to increase the share of non-fossil fuels in primary energy consumption to around 20.0% by 2030. President Xi Jinping and President Barack Obama will work together, and with other countries, to adopt a protocol, another legal instrument or an agreed outcome with legal force under the Convention applicable to all Parties at the United Nations Climate Conference in Paris in 2015 (SCC, 2014c).

In June 2014, the 6th Work Conference of Central Government Finance and Economics Leading group was held, focusing on the security of energy. President Xi Jinping attended and emphasised the revolution of energy production and consumption, including:

- promoting the revolution of energy consumption and restraining unreasonable energy consumption;
- promoting the revolution of energy supply and setting up multiple supplying system;
- promoting the revolution of energy technology and pushing the industrial upgrading; promoting the revolution of energy management system and smoothing the way of energy development; and
- enhancing the international energy co-operation and realising energy security under the conditions of open-up policy.

On 28 November 2014, an ultra-large auxiliary platform for workers for offshore oil drilling, named the POSH XANADU, was completed in China and is ready to be handed over to overseas customers. 750 people can live and work on the floatel, the largest of its kind in the world (SCC, 2014d).

On 21 May 2014, China Natural Petroleum Corporation and Gazprom signed an agreement to purchase and transport natural gas from Russia to P.R.C. through the East pipeline. According to the contract, the pipeline will run from 2018, and the final capacity is 28 bcm per year, the value of the contract would be about 400 billion US dollars (NEA, 2014a).

On 20 November 2014, the Sichuan-Tibet grid-connection project came into operation. This project would enhance the reliability of Tibet grid and the total cost is more than 1 billion US dollars (CEN, 2014a). On 23 November 2014, the first unit came into run in Zangmu hydro power plant, the first large-scale hydro power plant in Tibet with 510 MW in capacity totally (CEN, 2014b).

On 27 November 2014, more than 14 GW of renewable energy connected to the grid in Gansu province, which the largest in China in terms of capacity. Currently, the capacities of wind and solar power are around 9.5 GW and 4.6 GW respectively, and is likely to reach 17 GW and 7.5 GW at the end of 2015 (CEN, 2014c).

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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)—www.nea.gov.cn

Standardisation Administration—www.sac.gov.cn

HONG KONG, CHINA

INTRODUCTION

Hong Kong, China is a special administrative region of the People's Republic of China. It is a world class financial, trading and business centre of some 7.1 million people located at the south-eastern tip of China. Hong Kong, China has no natural resources and thus all of its energy demand is imported. The energy sector consists of investor-owned electricity and gas utility services.

In 2012, the per capita GDP of Hong Kong, China was 49 303(USD 2010 at PPP), among the highest of the APEC economies. GDP increased 1.6% in real terms in 2012to 352.8 billion (USD 2010 at PPP). The services sector remained the dominant driving force of overall economic growth, accounting for 90.0% of GDP in 2012 (EDMC, 2014). Hong Kong, China is driven by its financial services, as well as its higher value-added and knowledge-based services. To stay competitive and attain sustainable growth, Hong Kong, China not only needs to restructure and reposition itself in the light of the challenges posed by globalisation, but also due to its 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 by local manufacturers.

With the support of mainland China under CEPA and the Framework Agreement on Hong Kong/Guangdong Co-operation, Hong Kong, China is poised to reinforce and enhance its status as an international centre for financial services, trade and shipping, as well as an advanced global manufacturing and modern services base. The central government has announced the goal of basically achieving liberalising trade in services between the mainland and Hong Kong by the end of the National Twelfth Five-Year Plan period, starting with pilot programs in Guangdong. Hong Kong, China will enhance government-to-government co-operation and economic partnership with provinces and municipalities in the Mainland on all fronts, and maintain ties with its trading partners and related international organisations around the world to expand its markets (Policy Address 2013, 2014).

Table 1: Key data and economic profile, 2012

Key data[a]		Energy reserves[b]	
Area (sq. km)	1 104	Oil (million barrels)	–
Population (million)	7.1	Gas (billion cubic metres)	–
GDP (USD (2010) billion at PPP)	352.9	Coal (million tonnes)	–
GDP (USD (2010) per capita at PPP)	49 303	Uranium (kilotonnes U)	–

Source: (EDMC, 2014).

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. A substantial share of imported energy is converted into secondary energy such as electricity and gas for final consumption. The total primary energy supply in Hong Kong, China was 13.8 Mtoe in 2012, about the same amount as in 2011. Coal maintained the highest share of the total primary energy supply (53.3%), followed by oil (22.6%), gas (18.3%) and other sources (5.8%) (EDMC, 2014).

In 2013, the total installed electricity generating capacity in Hong Kong, China was 12 624 MW (EDMC, 2014). All locally-generated power is thermal fired. Electricity is supplied by CLP Power Hong Kong Limited (CLP Power) and The Hongkong Electric Company, Limited (HKE). CLP Power supplies electricity from its Black Point (2 500 MW), Castle Peak (4 108 MW) and Penny's Bay (300 MW) power stations. Natural gas and coal are the main fuels used for electricity generation at the Black Point and

Castle Peak power stations. CLP Power has arrangements with the China National Offshore Oil Corporation and the PetroChina International Company for gas supplies from the Mainland. HKE's electricity is supplied by the Lamma Power Station, which has a total installed capacity of 3 737 MW. Natural gas used at HKE's power station is mainly imported through a submarine pipeline from the Dapeng liquefied natural gas (LNG) terminal in Guangdong, mainland China. HKE has also operated wind turbines 800 kW since 2006, and a photovoltaic (PV) system (1 MW) since 2010 (PAH, 2013a, 2013b).

While natural gas and liquefied petroleum gas (LPG) are the main types of gaseous fuels used in Hong Kong, China, there is another product available. Town gas, which is manufactured locally using naphtha and natural gas as feedstock, is being distributed by the Hong Kong and China Gas Company Limited (Towngas, 2014).

FINAL ENERGY CONSUMPTION

In 2012, the total final energy consumption in Hong Kong, Chinawas 6 837 ktoe, an increase of 1.6% from the previous year. The other sectors (residential and commercial) accounted for the largest share of energy used at 63.1%, followed by the transport sector (31.8%) and the industry sector (5.1%). By energy source, electricity and others made up 54.7% of end-use consumption, followed by petroleum products (35.4%) (EDMC, 2014).

Town gas and LPG are the main types of fuel gas used in the domestic, commercial and industrial sectors. LPG is also used as fuel for taxis and light buses while natural gas is used for electricity generation and town gas production.

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	67	Industry sector	352	Total[a]	38 750
Net imports and other	28 056	Transport sector	2 175	Thermal	38 750
Total PES	13 823	Other sectors	4 311	Hydro	–
Coal	7 288	Total FEC	6 837	Nuclear	–
Oil	3 234	Coal	–	Geothermal	–
Gas	2 374	Oil	2 418	Others	–
Other	928	Gas	677		
		Electricity and other	3 742		

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

Sources: (EDMC, 2014).

ENERGY INTENSITY ANALYSIS

Hong Kong, China's energy intensity is lowest in terms of primary energy or final energy demand among APEC economies. The primary energy intensity in 2012 is only 39.2 tonnes of oil equivalent per million USD (toe/million USD), compared with the median value of 122.0 toe/million USD in APEC economies, while the final energy demand is only 19.4, compared with the median value of 72.2 tonnes of oil equivalent per million USD (EDMC, 2014).

Hong Kong, China endeavours to develop sustainably and fully supports the APEC's Honolulu Declaration in 2011, seeking to reduce 45.0% of energy intensity by 2035. To step up energy efficiency and conservation, various policies are implemented, such as Mandatory Energy Efficiency Labelling Scheme, Building Energy Efficiency Ordinance, Building Energy Efficiency Funding Schemes and District Cooling System (EMSD, 2013).

Table 3: Energy Intensity Analysis, 2012

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	40.0	39.2	-2.0
Final Energy Demand	19.4	19.4	0.0
Industry	1.0	1.0	-1.6
Transportation	6.2	6.2	-0.8
Others	12.2	12.2	0.6

Source: (EDMC, 2014).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

The Government of Hong Kong, China has pursued four key energy policy objectives: to ensure the energy needs of the community are met safely, efficiently and at reasonable prices, while minimising the environmental impact of electricity generation. The Government also promotes the efficient use and conservation of energy. In combating climate change, reducing greenhouse gas emissions and developing a low-carbon economy, Hong Kong, China's emissions reduction strategy emphases the wider use of cleaner and low-carbon energies and fuels in power generation.

In keeping with the free market economic policy of Hong Kong, China, the Government intervenes only when necessary to safeguard the interests of consumers, ensure public safety and protect the environment. The Government works with the oil companies to maintain strategic reserves of gas, oil and naphtha. It monitors the performances of the power companies through the Scheme of Control Agreements, the present ones signed in 2008, to encourage energy efficiency, quality services and renewable energy use.

Specifically, Hong Kong, China proposes to optimise the fuel mix for power generation. The Government conducted a public consultation on the future fuel mix for electricity generation in Hong Kong in 2014 to solicit the public's views on the subject. Two fuel mix options were put forward for public consultation. They are firstly to import more electricity through purchase from the Mainland power grid, and secondly to use more natural gas for local generation. Both fuel mix options could help us achieve our pledged environmental targets for 2020 in respect of reduction in carbon intensity and air pollutant emissions. That is, to reduce carbon intensity by 50.0-60.0% by 2020 when compared to 2005; and to reduce SO2 emissions by 35.0%-75.0%, NOx by 20.0%-30.0% and respirable suspended particulates (RSP) by 15.0%-40.0% by 2020 when compared to 2010. Hong Kong, China will also endeavour to enhance energy efficiency, promote green buildings, advocate electricity savings, facilitate low-carbon transport, reducing wastes and develop facilities to turn waste into energy (ENB, 2014).

A major target for the economy's energy policy is to reduce its energy intensity by 25.0% by 2030, based on the 2005 level. The key measures are:

- Reduce carbon emissions through the use of clean fuel and improved energy efficiency;
- Promote the energy efficiency of buildings and products;
- Promote renewable energy, including waste-to-energy;
- Seek input from the community to improve energy efficiency; and
- Enhance the management of electricity demand.

ENERGY MARKETS

A memorandum of understanding (MOU) was signed by the Hong Kong, China Government and the National Energy Administration of the People's Republic of China on 28 August 2008. To ensure the prosperity and stability of Hong Kong, the Central Government of China will continue to support energy

co-operation between the Mainland and Hong Kong over the long term, which will include efforts to provide a stable supply of nuclear electricity and natural gas to Hong Kong. The inter-governmental MOU contemplates the delivery of natural gas to Hong Kong, China from three sources:

- Existing and new gas fields planned for development in the South China Sea;
- A second West-to-East Gas Pipeline, bringing gas from Central Asia; and
- A liquefied natural gas (LNG) terminal to be located in Shenzhen, mainland China.

The MOU also contemplates the ongoing supply of nuclear-generated electricity to Hong Kong, China. An extension of the Guangdong Daya Bay Nuclear Power Station joint venture and supply contracts was approved by the Hong Kong, China Government in September 2009. These contracts will enable the continued supply of non-carbon-emitting electricity to Hong Kong, China for a further term of 20 years from 2014 (CLP 2012a, 2012b).

ENERGY EFFICIENCY

Buildings consume about 90.0% of the electricity used in Hong Kong, China. The economy is putting its efforts into conserving building energy as its first priority. Efforts will go into improving public awareness of energy efficiency to drive behavioural changes.

ENERGY DATA

To help monitor the energy situation, Hong Kong, China has developed an energy end-use database. The database provides useful insight into the energy demand situation, including the energy consumption patterns, trends, and usage characteristics of each sector and segment. A basic data set is publicly available on the internet. The Government is able to analyse the current system based on the data and develop policy and strategy revisions for future implementation, while the private sector can use the data to benchmark their own energy efficiency, as they seek improvements in their energy consumption systems (EMSD, 2012d).

BUILDINGS

To strengthen its efforts to improve the effects of building energy conservation, the Government has enhanced the regulatory system for building energy efficiency. The Buildings Energy Efficiency Ordinance was fully implemented on 21 September 2012. The three key requirements of the Ordinance are as follows (EMSD, 2012a):

- The developers or building owners of newly constructed prescribed buildings should ensure that the four key types of building services installations (air conditioning, lighting, electrical, and lift and escalator installation) comply with the design standards of the Building Energy Code (BEC).
- Responsible persons of prescribed buildings (i.e. owners, tenants or occupants, etc.) should ensure that the four key types of building services installations comply with the design standards of the BEC when carrying out 'major retrofitting works'.
- The owners of commercial buildings, including the commercial portions of composite buildings, should carry out an energy audit for the four key types of central building services installations in accordance with the Energy Audit Code (EAC) every 10 years. The first energy audit should be carried out within four years of the commencement of the Ordinance in accordance with the timetable set out in Schedule 5 to that Ordinance.

It is estimated that implementation of the Ordinance will result in a savings of approximately 2.8 billion kWh of electricity and 1.96 million tonnes of carbon dioxide emissions in its first decade. These figures only take into account the savings achieved from new buildings. It is expected that more savings can be achieved from existing buildings when carrying out 'major retrofitting works' and energy audits (EMSD 2012b). The BEC and EAC are being reviewed and will be completed in 2015. It is anticipated that it would contribute more savings in future by tightening of minimum standards.

The Government continues to demonstrate in government buildings state-of-the-art energy efficient designs and building energy conservation technologies. These are based on an environmental performance framework that covers energy efficiency, greenhouse gas reduction, renewable energy application, waste reduction, water management and indoor air quality. In its effort, all newly built government buildings over 10 000 square metres should aim to obtain not lower than the second highest grade under the Hong Kong Building Environmental Assessment Method (BEAM).

In April 2009, the Government promoted a comprehensive target-based green performance framework for new and existing government buildings and set targets for various aspects of environmental performance. It aims to achieve a 5.0% savings on the total electricity used in government buildings from 2009–10 to 2013–14 after discounting activity changes, using electricity consumption in 2007–08 as the baseline.

Also in April 2009, the Government introduced the Buildings Energy Efficiency Funding Schemes, with a total of HKD 450 million to subsidise environmental performance reviews and upgrades for communal areas of residential, commercial and industrial buildings. The Schemes also cover energy/carbon audits and works to upgrade the energy efficiency performance of building services installations. The subsidy can cover up to 50.0% of the expenditure. These funding schemes were closed in April 2012 (EMSD 2012a).

Water-cooled air conditioning systems

Water-cooled air-conditioning systems using fresh water-cooling towers are generally more energy efficient than air-cooled systems. A voluntary Fresh Water Cooling Towers Scheme was launched in 2000 to promote a wider use of fresh water in evaporative cooling towers for air conditioning systems in non-domestic buildings for energy efficiency. At the end of December 2014, 573 installations were completed under the Scheme. It is estimated that these installations could save up to about 372 million kWh of electricity, which is equivalent to the reduction of around 261 000 tonnes of carbon dioxide emissions per annum (EMSD, 2012h).

The Government implements a District Cooling System (DCS) at the Kai Tak Development to supply chilled water to buildings in the new development for centralised air conditioning. The DCS is the first project of its kind implemented by the Government. The core facilities including the plant rooms of the project were completed and the Kai Tak Cruise Terminal Building and a shopping centre under the Hong Kong Housing Authority were provided with chilled water in February 2013 (EMSD, 2012i).

ENERGY CONSUMPTION INDICATORS

In 2011, the Government reviewed and updated 68 groups of energy consumption indicators covering the residential (6 groups), commercial (32 groups) and transport (30 groups) sectors. The energy consumption indicators and benchmarks serve to allow the energy-consuming groups to understand their energy consumption levels and performance with respect to corresponding peers. They help foster the concept of efficient energy consumption and promote general awareness (EMSD, 2012c).

ENERGY EFFICIENCY LABELLING

Hong Kong, China has a voluntary Energy Efficiency Labelling Scheme that covers 22 types of household and office appliances, among which there are 13 types of electrical appliances (refrigerators, washing machines, non-integrated type compact fluorescent lamps, dehumidifiers, electric clothes dryers, room coolers, electric storage water heaters, televisions, electric rice-cookers, electronic ballasts, LED lamps, induction cookers and microwave ovens), seven types of office equipment (photocopiers, fax machines, multifunction devices, printers, LCD monitors, computers and hot/cold bottled water dispensers) and two types of gas appliances including domestic instantaneous gas water heaters and gas cookers. The Scheme was extended to cover petrol passenger cars (EMSD, 2012g).

To further assist the public in choosing energy efficient appliances and to raise public awareness of energy saving, the Government has introduced a Mandatory Energy Efficiency Labelling Scheme (MEELS) through the Energy Efficiency (Labelling of Products) Ordinance, Cap. 598. The MEELS covers five types of products, namely room air conditioners, refrigerating appliances, compact fluorescent lamps, washing machines and dehumidifiers. Under the MEELS, energy labels are required to be shown on the products for supply in Hong Kong, China to inform consumers of their energy efficiency performance (EMSD, 2012f).

TRANSPORT

Land transport accounts for about 17.0% of the total greenhouse gas emissions in the economy, and is the second most significant contributor. In order to reduce carbon emissions from the transportation system, Hong Kong, China, is conducting the following efforts:

EXTEND THE PUBLIC TRANSPORT SYSTEM

An extensive and energy-efficient public transport system in Hong Kong, China is instrumental in helping to maintain its low level of greenhouse gas emissions. Some 90.0% of commuter trips each day are made

via the public transport system. The Government is committed to further expanding and upgrading its public transport infrastructure with emphasis on railways.

PROMOTE CLEANER VEHICLES

To encourage the use of cleaner vehicles, the Government launched tax incentive schemes for environment-friendly petrol private cars from April 2007. Vehicles meeting the energy efficiency and exhaust emissions criteria can have the First Registration Tax (FRT) reduced. The current FRT reduction rate is 45.0%, subject to a cap of HKD 75 000 per car. In addition, the Government actively promotes wider use of electric vehicles. The FRT of electric vehicles is waived till end of March 2017.

PROMOTE ELECTRIC VEHICLES

The Government liaised with the electric vehicle manufacturers and dealers to encourage them to introduce electric vehicles into Hong Kong and as a result leads in electric vehicle use. The Government has been working with the private sector in expanding the electric vehicle charging infrastructure in Hong Kong. There are now more than 1 100 EV charging points for public use including over 150 medium charging points and 31 quick charging points. Funding was provided for franchised bus companies to purchase 36 single-deck electric buses and also six double-deck hybrid buses for trial.

PILOT GREEN TRANSPORT FUND

To encourage the transport sector to test green and innovative transport means and technology, in 2011 the Government set up a HKD 300 million Pilot Green Transport Fund for which the transport sector can apply (Policy Address, 2010).

PROMOTE THE USE OF BIODIESEL AS MOTOR VEHICLE FUEL

In order to facilitate the use of biodiesel in motor vehicles, the Government has adopted a duty-free policy for biodiesel since 2007 and introduced in 2010 a regulatory control for motor vehicle biodiesel to help safeguard its quality and build up drivers' confidence in the fuel.

RENEWABLE ENERGY

Despite geographical and natural constraints in developing wind energy, both power companies (CLP Power and HKE) in the economy have started to explore the feasibility of offshore wind farm projects.

CLP Power is continuing the feasibility study for an offshore wind farm. An offshore meteorological wind mast was installed to collect site environmental data. CLP Power completed the renewable energy power system of about 200kW on Town Island in late 2012. The system now consists of 672 solar panels and two wind turbines supplying renewable energy to the Island.

The renewable energy assets of HKE also performed well, with Lamma Winds generating more than 7 000 MWh of electricity since being commissioned in 2006, offsetting more than 6 000 tons of carbon dioxide emissions. Another 1 MW thin-film photovoltaic (TFPV) solar power system was installed at Lamma Power Station, generating 1 100 MWh annually (PAH 2013c, 2013d, HKEI 2014).

To increase its renewable energy portfolio, HKE plans to install up to 33 offshore wind turbines at a capital cost of about HKD 3 billion with a total generation capacity of around 100 MW, producing 175 GWh of electricity and offsetting 150 000 tons of carbon dioxide emissions annually after completion. In 2012, HKE commenced a wind monitoring station at its offshore wind farm site to collect meteorological and oceanographic data for detailed design purposes (PAH 2012).

In 2007, a landfill gas processing plant at the North East New Territories landfill started operation, with a peak supply of synthetic natural gas (SNG) from landfill gas at 8 000 m^3 per hour. As a result, the consumption of naphtha at the town gas production plant in Tai Po can be reduced by about 10 000 tonnes, reducing carbon dioxide emission up to about 31 600 tonnes in 2014 (Towngas 2014).

The Government has taken the lead in using renewable energy by installing a 350 kW PV system on the roof of the Electrical and Mechanical Services Department headquarters. An 850 kW PV system has been planned by the Drainage Services Department for installation at Siu Ho Wan Sewage Treatment Works, scheduled for completion in mid-2016. The Government also installed large-scale solar water heating devices on government buildings, including swimming pools, to save power in water heating.

In its effort to convert waste to energy and to reduce greenhouse gas emissions, the Government is planning to construct an integrated waste management facility, two organic waste treatment facilities and a sludge treatment facility, expecting them to meet about 1.0% of the total electricity demand by 2020.

NUCLEAR

Currently, CLP Power has contracted to purchase around 70.0% of the electricity generated by the two 984 MW pressurised water reactors at the Guangdong Daya Bay Nuclear Power Station in mainland China to help meet the long-term demand for electricity in its supply area (CLP, 2012a). This meets some 22.0% of the electricity demand in Hong Kong, China. 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 alleviate air pollution and greenhouse gas emissions locally (CLP, 2012b). To make sure that more clean and cost-competitive energy is provided to Hong Kong, an agreement has been reached, whereby Daya Bay will increase its electricity supply to Hong Kong from 70.0% of its output to approximately 80.0% for late 2014 to 2018 (CLP, 2013).

CLIMATE CHANGE

Hong Kong, China is committed to working closely with the international community to combat climate change, and the Government is pursuing measures set out in the Hong Kong's Climate Change Strategy and Action Agenda to reduce the territory's carbon intensity by between 50.0% to 60.0% by 2020, with reference to 2005 level.

The major contributors of greenhouse gases in Hong Kong, China are power generation and the land transport sector, accounting for about two-thirds and one-fifth of the territory's greenhouse gas emissions, respectively. Also, energy consumption in buildings contributes about 90.0% of total electricity consumption. Therefore, the Government is focussing on decarbonising the future fuel mix for power generation, enhancing building energy efficiency and greening the road transport to reduce carbon emissions.

The greenhouse gas emissions reduction measures set out in the Hong Kong's Climate Change Strategy and Action Agenda can be classified as follows:

Maximising energy efficiency*:* In particular, measures to improve energy efficiency in buildings, including reducing the energy demand of air conditioning and other major electrical equipment. Specific measures include:

- Expanding the scope and tightening the requirements of the Building Energy Codes, so that by 2020 major electrical equipment in all new commercial buildings will be up to 50.0% more energy efficient compared with buildings in 2005.
- Expanding the use of district cooling or water-cooled air conditioning, so that by 2020 up to 20.0% of all commercial buildings will have up to 50.0% better refrigeration performance compared with buildings using regular air conditioners.
- Reducing energy demand in new buildings by various means, such as tightening overall thermal transfer value standards and promoting the wider adoption of green roofing, so that by 2020 all new commercial buildings will reduce their energy demand by up to 50.0% compared with new buildings in 2005.
- Improving energy efficiency in commercial buildings through good housekeeping, information technology products and intelligent building environmental management systems, so that by 2020 up to 25.0% of existing commercial buildings will be 15.0% more energy efficient compared with 2005.
- Expanding the scope and tightening the energy efficiency of electrical appliance standards for domestic use, so that by 2020 all appliances sold in the market will be 25.0% more energy efficient compared with those sold in 2005.

Greening road transport*:* Includes measures to promote the use of electric vehicles and to implement energy efficiency standards for vehicles. Specific measures include:

- Expanding access to public transportation, and establishing pedestrian areas and covered walkways, etc., to reduce transport needs.

- Making wider use of motor vehicles running on alternative fuels, so that 30.0% of private cars, and 15.0% of buses and commercial vehicles are hybrid and electric vehicles (EVs) or other vehicles with similar performance by 2020.
    - Implementing importers' average fleet-efficiency standards, so that new vehicles will be 20.0% more energy efficient than the 2005 market average.

Promoting the use of clean fuels for motor vehicles: Measures to promote clean fuels such as biofuels.

Turning waste into energy: Measures to explore the potential of renewable energy. Specific measures include:

- Developing and fully operating one integrated waste management facility, two organic waste treatment facilities, and one sludge treatment facility.
- Fully utilising recovered landfill gas and gas generated from wastewater treatment.

Revamping the fuel mix for electricity generation*:* To increase the use of non-fossil, clean and low-carbon fuels for future electricity generation, having balanced the various objectives of Hong Kong, China's energy policy

NOTABLE ENERGY DEVELOPMENTS

In order to create a more ecologically-friendly environment, the Government has initiated a number of major actions to save energy, reduce carbon emissions and improve waste recovery. Some major actions and achievements are summarised as follows (EPD, 2012a, EMSD 2014):

- The CLP Power and its Mainland counterparts have completed construction of the Second West-East Natural Gas Pipeline (Hong Kong Branch Line) to supply cleaner energy to Hong Kong.
- A mandatory energy efficiency labelling scheme for certain products and building energy efficiency codes for both new and existing buildings were introduced.
- An Environmental Impact Assessment report on the development of a 100 MW offshore wind farm in Hong Kong, China was approved in May 2010.
- The Buildings Energy Efficiency Ordinance was implemented in September 2012, mandating compliance with codes of practice promulgated by the Electrical and Mechanical Services Department concerning the energy efficiency of four types of buildings services.
- High-efficiency equipment (air-conditioning, electrical systems, lifts and escalators, and lighting installations) has been newly installed and energy audits are being conducted.
- The number of electric vehicles in Hong Kong has started to expand with the Government's active promotion. As at end of December 2014, there are 1 551 electric vehicles in use. .
- At the end of December 2014, around 6 400 product models were listed under the Mandatory Energy Efficiency Labelling Scheme.

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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 southeast 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 7.9 million square kilometres, which includes Indonesia's exclusive economic zone. Indonesia's total land area (24.5% of its territory) is about 1.9 million square kilometres. The population was 246.9 million in 2012.

Indonesia had a gross domestic product (GDP) of around USD 2,144 billion and a per capita GDP of USD 8 684 in 2012 (USD 2010 at PPP). Excluding the oil and gas sector, manufacturing industries accounted for the largest component of GDP in 2012 (25.6%), followed by trade, hotels and restaurants (18.0%); agricultural, livestock, forestry and fisheries (12.5%); transportation and communications (10.1%); finance, real estate and business services (9.7%); services (9.3%); mining and quarrying (7.4%); construction (6.6%); and electricity, gas and water supply (0.8%). In 2012, Indonesia attained economic growth of 6.2%, a decrease of 0.3% from 2011 (BPS, 2013).

Domestic 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 2012, oil and gas exports contributed 19.5% and coal exports contributed 13.8% of Indonesia's total exports of about USD 190 billion (BP, 2013). Overall, tax and non-tax revenue from oil, gas and minerals including coal accounted for 30.5% of the Indonesian Government's budget in 2012 (ESDM, 2013a).

Indonesia's proven fossil energy reserves at the end of 2012 consisted of 3.7 billion barrels of oil, 2.9 trillion cubic metres of natural gas and 28.0 billion tonnes (Bt) of coal.

Table 1: Key data and economic profile, 2012

Key data[a]		Energy reserves[b]	
Area (million sq. km)	1.9	Oil (billion barrels)	3.7
Population (million)	246.9	Gas (trillion cubic metres)	2.9
GDP (USD (2010) billion at PPP)	2 143.9	Coal (billion tonnes)	28.0
GDP (USD (2010) per capita at PPP)	8 684	Uranium (kilotonnes U)	-

Source: a. (EDMC, 2014); b. Proven reserves at the end of 2012 (BP, 2014).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2012, Indonesia's total primary energy supply (TPES) was 184 604 kilotonnes of oil equivalent (ktoe) of commercial energy, made up of oil (45.0%), coal (26.2%), natural gas (20.5%) and other energy (mainly hydropower and geothermal) (8.3%), and 44 834 ktoe of biomass. Indonesia is a net exporter of energy, and overall energy exports of crude oil, condensates, natural gas, liquefied natural gas (LNG), petroleum products and coal totalled 228 400 ktoe in 2012. Total energy exports in 2012 slightly increased by 5.0% from 2011 (10,959 ktoe), an increase driven primarily by coal exports.

OIL

In 2012, Indonesia produced 50 330 ktoe of crude oil and condensates; of this, 17 633 ktoe (35%) was exported or decreased by 15% compared to 2011's export. Since oil production has declined significantly over the past decade (in 1997 Indonesia produced 72 474 ktoe of crude oil and condensates), the economy imported 14 672 ktoe of crude oil and 31 182 ktoe of petroleum products in 2012 in order to meet its domestic oil requirements, up 12.2% from total of 41 148 ktoe in 2011 (EDMC 2014).

Most crude oil is produced onshore from two of Indonesia's largest oil fields: the Minas and Duri oil fields in the province of Riau on the eastern coast of central Sumatra. As these fields are considered mature, the Duri oil field in particular has been subject to one of the world's largest enhanced oil recovery efforts.

NATURAL GAS

Indonesia produced 69 435 ktoe of natural gas in 2012, a decrease of 4.6% from the 72 796 ktoe produced in 2011 (EDMC, 2014). Of the total natural gas production, 39.0% was converted to LNG for export shipping. The economy produced 27 077 ktoe of LNG in 2012, a decrease of 16.1% from 32 283 ktoe in 2011. In 2012, Indonesia also exported 10 219 ktoe of natural gas (14.7% of its total natural gas production) through pipelines to Singapore and Malaysia (ESDM, 2013b). Overall, 45.6% 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, with smaller gas reserves offshore from West and East Java. LNG exports from Tangguh, Papua began in 2009 with gas 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 2012, Indonesia produced 226 909 ktoe of coal, an increase of 9.2% from 207 723 ktoe in 2011. Most of Indonesia's coal production in 2012 (178 782 ktoe, or 78.8%) was exported with domestic demand (48 300 ktoe in 2012) being allocated for power generation (64.3%), and industry (35.7%) uses (EDMC, 2014).

About 57.0% of Indonesia's total recoverable coal reserve is lignite, 27.0% is sub-bituminous coal, 14.0% 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. As a result, while Indonesian coal's heating value can range from 5 000 to 7 000 kilocalories per kilogram, it is generally distinguished by its low ash and sulphur content (typically less than 1.0%).

ELECTRICITY

Indonesia had 45 253 MW of electricity generation capacity in 2012, which was owned by the state-owned electricity company (PLN) and independent power producers (IPPs). In 2012, 197 328 GWh of electricity were generated, of which 24.1% was supplied by IPPs and 1.5% was imported from Malaysia. In 2012, several types of power plants produce electricity, namely coal-steam power plants (48.0%), combined gas-steam power plant (20.0%), renewable energy power plants (geothermal, hydro, biomass, solar, and wind) (11.0%), diesel power plants (11.0%), gas power plants (5.0%), gas-steam power plants (3.0%), and oil powered thermal plants (2.0%) (ESDM, 2013b).

FINAL ENERGY CONSUMPTION

The total final energy consumption was 127 168 ktoe in 2012, an increase of 10.1% from 115 504 ktoe in 2011. The share of final energy consumption by sector in 2012 was 41.9% for industry, 35.1% for transport and 23.0% for other sectors. Indonesia's economy is highly dependent on oil; final energy consumption of oil in 2012 was 77 432 ktoe (60.9% of the total final energy consumption) (EDMC, 2014).

Table 2: Key data and economic profile, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production[a]	355 873	Industrial sector	53 279	Total	196 053
Net imports and other	–182 244	Transport sector	44 625	Thermal	173 689
Total PES	184 604	Other sectors	29 264	Hydro	12 799
Coal	48 300	Total FEC	127 168	Nuclear	–
Oil	83 098	Coal	17 240	Others	9 565
Gas	37 760	Oil	77 432		
Others	15 446	Gas	17 532		
		Electricity and Others	14 963		

Source: EDMC (2014); a. Excludes biomass.

ENERGY INTENSITY

In 2012, Indonesia's primary energy intensity was 86.1 tonnes of oil equivalent per USD million, a slight decline of 0.6% from its previous year level. This indicates Indonesia's energy intensity has improved in recent years, but there is still room for the economy to improve its energy efficiency. In terms of final

energy demand, the energy intensity amounted to 59.3 tonnes of oil equivalent per USD million, a 3.6% increase from 2011, which was mostly driven by increasing energy consumption in other sectors.

Table 3: Energy Intensity Analysis

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	86.6	86.1	-0.6
Final Energy Demand	57.3	59.3	3.6
Industry	25.6	24.9	-3.0
Transportation	19.9	20.8	4.6
Others	11.7	13.7	16.5

Source: (EDMC, 2014).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

THE ENERGY LAW

On 10 August 2007, Indonesia enacted the Energy Law (Law No. 30/2007). This law contains 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. It 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 businesses.

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 energy crises and energy emergencies; and
- Provide oversight on the implementation of energy policies that are cross-sectoral.

The President chairs the assembly of DEN members. As an institution, DEN is headed by the minister responsible for energy affairs, and it has 15 members: Seven ministers and high-ranking government officials responsible for the supply, transportation, distribution and use of energy; and eight 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.

After getting approval from the parliament (the DPR), on 17 October 2014 the government issued the new National Energy Policy under the Government Regulation No. 79/2014 to replace the existing National Energy Policy that was established by Presidential Regulation No. 5/2006. This policy is intended to create energy security and resilience through an energy management policy for period of year 2014 to 2050.

The National Energy Master Plan (RUEN) implements the KEN. By law, RUEN is drafted by the government, namely the Ministry of Energy and Mineral Resources, in a process that involves the related ministries and other government institutions, state-owned companies in the energy sector, and regional governments, as well as academia and other energy stakeholders, with due regard to input from the public. In order to give guidance how to drafting the National Energy Master Plan, the Government has just issued the Presidential Regulation No. 1/2014 on 2 January 2014. Under this regulation, RUEN should be prepared based on the National Energy Policy, engagement of the local government, and considering the public opinion and input.

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, which was replaced with Law No. 21/2014), 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 business 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.

In 2004, the Constitutional Court rejected an advanced reform of the electricity sector, which would have established the possibility of direct competition in power generation through Law No. 20/2002 (currently annulled).

THE OIL AND GAS LAW

Indonesia's oil and gas industry is currently undergoing regulatory changes. The industry was reformed in 2001 under the Oil and Gas Law (Law No. 21/2001). The regulatory bodies, known as BP MIGAS and BPH MIGAS, were created to address oil upstream and downstream activities, respectively. Exploration and production activities were conducted based on a fiscal contractual system that relies mainly on production sharing contracts (PSCs) between government and private investors, which may include foreign and domestic companies, as well as the government-owned oil company Pertamina.

However, on 13 November 2012, the Constitutional Court declared that the existence of BP MIGAS was in conflict with the Constitution of 1945 and ordered its dissolution. At the time of this writing, the government is drafting a new Oil and Gas Law that will determine a new industry structure and until this law can be enacted, an Interim Working Unit for Upstream Oil and Gas Business Activities (SKSPMIGAS) has been established under the Ministry of Energy and Mineral Resources (MEMR) to take over all BP Migas roles and responsibilities. Furthermore, on 14 January 2013, the government issued Presidential Regulation Number 9 Year 2013 as the umbrella for the establishment of the working Unit for Upstream Oil and Gas Business Activities (SKKMIGAS) with its tasks in managing the upstream oil and gas business in Indonesia.

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 the promotion of 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 (now handed over to SKKMIGAS) and BPH MIGAS, and mandated the termination of Pertamina's monopoly in upstream oil and gas activities.

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 government enacted new law on 12 January 2009 as Law No. 4/2009 on 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 businesses known as 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 to by both the government and the investor. By instituting permits, the government expects to be better positioned 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 for permit holders to build smelters;

- An obligation for foreign companies to divest shares to the government or to state-owned business and private companies registered in Indonesia;
- Payment of taxes, fees and allocation of profits; and
- Reclamation and post-mining costs.

A set of government regulations with regard to the Mining Law was completed in 2010 and these are now operational.

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, or Izin Usaha Penyediaan Tenaga Listrik (IUPTL). The IUPTL integrates electricity supply, power generation, transmission, distribution or retailing of electricity. Indonesia's electricity systems will retain vertically integrated configurations. However, these will consist of several licensed systems, such as PLN's numerous power systems, provincial government-owned systems (to be established, where necessary), and private sector power systems, each operating within their respective business areas. Licence holders of specific electricity supply types (such as the IPPs, as licence holders in power generation for the supply of electricity to the public) will participate in the vertically integrated systems.

By law, the government and regional governments 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. At the time of writing, there was no ruling as to whether PLN will implement tariff differentiation over its extensive power systems across Indonesia.

As mandated by Law No. 30/2009, MEMR issued three government regulations (GR), namely GR No. 14/2012 on electricity supply businesses activity, GR No. 42/2012 on the buying and selling of electricity across Indonesia's borders, and GR No. 62/2012 on electricity support businesses.

GEOTHERMAL LAW

Geothermal development activities are defined as mining activities under the Geothermal Law No. 27/2003 and according to the Forestry Law, no mining activities are allowed to occur in protected forest areas (protection and conservation forest); as a result, geothermal energy cannot be developed if it is located in protected forest areas. This situation has been one of the major barriers to developing geothermal electricity in Indonesia.

In order to remove the restriction to develop geothermal in protected forest areas, the government has issued the New Geothermal Law No. 21/2014 on 17 September 2014. Under the new law, geothermal development activities are not considered as mining activities after the government has changed the scheme of permitting from 'Geothermal Mining Permit' to 'Geothermal Permit'. This new law has stated that geothermal energy can be developed in production, protection and conservation forests after getting a permit from the Ministry of Forestry under the category of environmental service use permit.

The new regulation also states that the government sets the tariff on geothermal electricity, offering incentives to developers as well as affirming that the Central Government holds the authorisation power to conduct tenders on Geothermal Working Areas (GWA) and then control of the project. The Local Government, on the other hand, is authorised to utilise geothermal for direct use (other than electricity generation).

Geothermal exploration and exploitation are based on awarding licences. The process involves the Central Government offering GWA for competitive bidding to prospective business investors. Public, private and cooperative entities may submit bids on GWA that are being offered. Successful bidders are awarded GWA. The width of the concession areas will be determined based on the capacity of the individual geothermal system. The successful bidders have the right to conduct exploration for five years with two

extensions of up to one year per extension and 30 years for exploitation from the date that a feasibility study has been approved by the government. The government can approve extensions to geothermal resources exploitation permission for an additional 20 years per extension approval. Working areas are subject to tax, land rent, and royalties determined by the government. 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 from 2009, with improvements to tax collection and lower tax rates. The general corporate income tax rate for the 2009 tax year was reduced to a flat rate of 28.0% from the previous maximum progressive rate of 30.0%. Tax rates are to be further reduced to a flat rate of 25.0% in 2010 (ASEAN Affairs, 2008).

OIL AND GAS

The PSC (production sharing contract) 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, 2008). Several types of PSC have since emerged internationally.

Technically, PSCs 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, and the remaining production is available for cost recovery. Some industry analysts view FTP as a royalty (Johnston, 1994). Indonesia has other types of joint contract schemes for oil and gas, such as technical assistance (TACs) and enhanced oil recovery (EOR) contracts. A TAC is a variant cooperation contract or a PSC, and is typically used for established producing areas, so that 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, participants in PSCs, TACs and EOR contracts may also enter into separate agreements known as joint operating agreements (JOA) and joint operating bodies (JOB).

Since 2008, fifth generation PSCs have been introduced. The key differences between the later generation PSCs and earlier generations are as follows:

- Rather than a fixed production historical after-tax share, there has been some flexibility in the production sharing percentage offered;
- PSCs now provide for a domestic market obligation for natural gas;
- BP MIGAS is entitled to FTP of 10.0% of the petroleum production that is not shared with the contractor;
- The profit sharing percentages appearing in the contract are determined on the assumption that the contractor is subject to a dividend tax on after-tax profits under Article 26(4) of the Indonesian Income Tax Law, which is not reduced by any tax treaty;
- Certain pre-signing costs (e.g. for seismic purchases) may be cost recoverable;
- BP MIGAS must approve any changes to the direct or indirect control of the entity; and
- The transfer of the PSC participating interest to non-affiliates is only allowable with BP MIGAS's approval, and where the contractor retains majority interest and operatorship, or three years after the signing of the PSC (PwC, 2012). Note that BP MIGAS has since been handed over to SKKMIGAS

Indonesia revised the terms of the domestic market obligation in 2009. Under Government Regulation No. 55/2009, the contractor must allocate 25.0% of its oil or gas share to the domestic market. In relation to the development of new gas reserves, the government advises the contractor, on request, of the domestic gas supply requirement about a year prior to production. The contractor and prospective domestic buyers 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.

UPSTREAM

In 2012, the Directorate General of Oil and Gas, the Ministry of Energy and Mineral Resources signed 25 new Production Sharing Contract-PSC. Out of this additional number, PSC under control the upstream oil and gas implementing agency—BP MIGAS (before being changed to SKKMIGAS) reached about 308 PSCs at the end of 2012, consisted of 75 oil and gas production, 179 oil and gas exploration and 54 coal bed methane (SKKMIGAS, 2012).

In order to increase production of oil and gas, SKKMIGAS has made the development of national oil and gas in the new field through a number of major projects, namely (SKKMIGAS, 2012):

- Banyu Urip – Mobil Cepu Ltd;
- Indonesia Deepwater Development (IDD) – Chevron Indonesia Company;
- Abadi – INPEX Masela Ltd.;
- Jangkrik dan Jangkrik North East (JNE) – Eni Muara Bakau B.V.;
- Bukit Tua – PC Ketapang II Ltd.;
- Ande-Ande Lumut – AWE (Northwest Natuna) Pte. Ltd.;
- North Duri Development 13 (NDD-13) – PT Chevron Pacific Indonesia;
- Corridor – ConocoPhillips Grissik Ltd.;
- Ruby – PearlOil (Sebuku) Ltd.;
- Kepodang – PC Muriah Ltd.;
- Donggi Senoro – JOB Pertamina-Medco Tomori; and
- Tangguh Train 3 – BP Berau Ltd.

KEROSENE TO LIQUEFIED PETROLEUM GAS CONVERSION PROGRAM

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

In an extension of the program, 4.7 million three-kilogram LPG canisters were distributed in 2010. As of May 2011, some 2.4 million three-kilogram LPG cylinders had been distributed. In 2012, the program expects to distribute 800 000 cylinders with the same characteristics.

COALBED METHANE

Oil and gas laws and regulation also govern coalbed methane. The Directorate General of Oil and Gas has oversight of business activities in coalbed methane gas development. MEMR issues regulations and establishes and offers coal methane gas work areas. The Directorate General of Oil and Gas technically establishes and offers coalbed methane work areas, with due consideration given to BP MIGAS' opinion (since handed over to SKKMIGAS).

Ministerial Regulation No. 36/2008 Regarding Business in Coal Methane Gas regulates coalbed methane development. The regulation covers exclusive rights and business related to coal methane gas; the method of determining and the offering of coal gas methane work areas; use of data and information, equipment and facilities; research, assessment and development of coal gas methane; dispute resolution; ruling on coal methane gas as an associated natural resource; and the utilisation of coalbed 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 businesses (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. The PUP is a contract between the government and a private mining company, where the government is represented by an implementing body yet to be established.

Under the new law, the mining fiscal regime includes corporate tax under the prevailing taxation law, a surtax of 10.0%, 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 for 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 states that existing contracts will be upheld, but the specific scheme for the transition of existing concessions is yet to be formulated.

PUBLIC PRIVATE PARTNERSHIP

With the signing of project documents in late 2011, the Central Java ultra-supercritical coal power plant two 1 000 MW will be the first project realised under the Public Private Partnership (PPP) program by Presidential Regulation No. 67 of the Year 2005 Regarding Government Partnership with Private Entities to Provide Infrastructure. The terms of the PPP include government investments and guarantees on PLN power purchases through a private guarantor established by Presidential Regulation No. 78 of Year 2010, Infrastructure Guarantees in Government Partnership Projects with Business Entities Executed Through Private Infrastructure Guarantors.

Government guarantees for the PPP Central Java power plant project are an advanced step in infrastructure development in Indonesia, since it is considered more transparent and accountable. The PPP scheme to be used for the Central Java power plant project is the Build-Own-Operate-Transfer (BOOT), which has a concession period of 25 years. Commercial operation is expected to commence at the end of 2016.

GEOTHERMAL

In order to promote geothermal development, the government has provided some fiscal incentives for income tax, value added tax, import duty, and withholding income tax for import under the taxation regulations (MoF, 2014), as follows:

- Tax Holiday, exemption of corporate income tax (from five to ten tax years) and after the period of corporate income tax exemption ended, the developers are given reduction 50.0% of corporate income tax due for two tax years;
- Investment Allowance for Geothermal which facilities are given including reduced net income tax for 30.0% of total investment (5.0% a year for six years); accelerated depreciation; income tax rate 10.0% or lower based on tax treaty on dividend paid to non-resident tax payer; and compensation for losses in certain circumstances. However, the developers may only get one of these two incentives, either Tax Holiday or Investment Allowance;
- Exemption of Value Added Tax for import of machinery and equipment, not including spare part;
- Exemption of Import Duty for machinery, goods, and materials for construction and development as long as the machinery, goods, and materials have not been produced in domestic area, have been produced in domestic area yet its specification do not meet the criteria, and have been produced in domestic area yet the quantity is not sufficient; and
- Exemption of Withholding Income Tax Art 22 for import of machinery and equipment, not including spare part.

ENERGY EFFICIENCY

GOVERNMENT REGULATION ON ENERGY CONSERVATION

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

- Formulation of a National Energy Conservation Master Plan (Rencana Induk Konservasi Energi Nasional, RIKEN), which will be updated every five years or annually, as required;
- Appointment of an energy manager, energy audits and an energy conservation programme for final energy users of 6 000 toe or greater;
- Implementation of energy efficiency standards and energy labelling;

- Government incentives in the form of tax exemptions, fiscal incentives on the import of energy-saving equipment, and low-interest lending rates to encourage investments in energy conservation; and
- Government disincentives in the form of written notices to comply, public announcements of noncompliance, monetary fines, and reduced energy supply for noncompliance.

In order to implement Government Regulation No. 70/2009 Regarding Energy Conservation throughout Indonesia, the government issued Ministerial Regulation No. 14/2012 on Energy Management.

The regulation stated:

- Energy source users and energy users who use energy sources and/or energy of 6000 toe per year or greater shall carry out energy management and have an obligation to establish an energy management team;
- Energy source users and energy users who use energy sources and/or energy of less than 6000 toe per year shall carry out energy management and/or implement energy savings;
- Energy conservation programmes consist of short term programmes (improvements in operating procedures, maintenance, and installation of simple device controls), medium- to long-term programmes (increasing efficiency of equipment, and fuel switching), and continuous improvement of employee or operator awareness and knowledge of energy conservation techniques;
- An energy audit shall be conducted periodically, on at least the main energy-consuming appliances and equipment at a minimum of once every three years;
- An annual report on energy management implementation shall be provided by energy source users and energy users to ministers, governors and regents or mayors within their respective jurisdictions; and
- Give incentives to energy source users and energy users who have succeeded in reducing their specific energy consumption by at least 2.0% per year during a three-year period. These incentives include eligibility for energy audit partnerships funded by the government and/or recommendation for priority access to energy supplies by ministers, governors and regents or mayors within their respective jurisdictions. Impose disincentives to energy source users and energy users who have not implemented energy conservation through energy management. These disincentives include written notices to comply, public announcements of non-compliance, monetary fines (calculated at 5.0% of the cost of energy used during the one year reporting period), and/or reduced energy supply for non-compliance (maximum 5.0% of contract capacity for a period of one month, with an extension possible).

As part of the government commitment to increase energy efficiency and conservation, the Ministry of Energy and Mineral Resources has developed an energy conservation project as one of the Nationally Appropriate Mitigation Actions (NAMAs), namely the Smart Street Lighting Initiative (SSLI). The SSLI Program aims to implement energy efficiency in street lightning by replacing conventional lightning technology with energy efficient technology, namely Light Emitting Diode (LED) in urban areas. The SSLI will be implemented in 22 cities in Indonesia to promote transformational changes in this particular sector. With improvement, this program will be implemented all over Indonesia. The SSLI has been registered with UNFCCC's NAMA in May 2014 to seek international support for implementation. The project has been attracting several development partner supports, namely the Asian Development Bank, USAID, AFD, besides being proposed to the NAMA Facility.

Moreover, with regard to energy efficiency, Indonesia has also issued standard and regulation on energy efficiency in building, namely: National Standard (SNI) No. 03-6390-2011: Energy Conservation for Air Conditioning System in Building; SNI 03-6197-2011: Energy Conservation for Lighting System in Building; SNI 03-6389-2011: Energy Conservation for Building Envelope; and SNI 03-6196-2011: Procedure for Energy Audit in Building. The implementation of this standard is carried out by the Local Government, such as City of Jakarta as part of Governor Regulation on Green Building in Jakarta. Each building, both existing and the new one, must conform to the green building standard, including energy efficiency in order to obtain or renew its building permit. Some buildings, new and existing, are also participating in the Greenship Program by Green Building Council Indonesia. The Greenship Program has four criteria, which are:

- sustainable building material;

- water and waste water management;
- energy efficiency; and
- waste management.
- Currently, there are 41 new buildings and 3 existing buildings registered under this program.

BARRIER REMOVAL

Indonesia is participating in a UNDP–GEF project that 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 programmes promoting energy standards and labelling: policy making, capacity building, manufacture support, regional cooperation and pilot projects.

As part of promotion of the establishment of a legal and regulatory basis for removing from the market technologies that are less energy efficient and produce more emissions, and the adoption of high-efficiency technologies, some of the achievements in 2012 were (UNDP, 2014):

- Regulation No.6/2011 on CFLs, which was issued by the Minister of Energy and Mineral Resources and followed by a Technical Guideline which has been signed and released by the Directorate General of New Renewable Energy and Energy Conservation (DGNREEC);
- Two drafts of ministry regulation on refrigerator and air conditioner labels were submitted to the DGNREEC and will be the basis for creation of technical guidelines for labels;
- Drafts of energy performance tests on rice cookers and electric fans were finalised and submitted to the DGNREEC, to be enacted as the Indonesian Standard for Energy Performance;
- Testing protocol of electronic ballast was submitted to DGNREEC to be evaluated and included as Technical Guideline under ministerial regulation; and
- Regional feasibility study on CFL conducted based on Australian practices and updated for standard harmonisation of CFL energy performance.

RENEWABLE ENERGY

On 17 October 2014 the government has issued the new National Energy Policy under the Government Regulation No. 79/2014 to replace the existing National Energy Policy that was established by Presidential Regulation No. 5/2006. The aim of this policy is to:

- Achieve energy elasticity to GDP of less than one by year 2025;
- Achieve reduction of final energy intensity to 1.0% per year up to year 2025; and
- Realise an optimum primary energy consumption mix where the share of the new and renewable energy will be at least 23.0% by 2025 and at least 31.0% by 2050.

As part of the government commitment to mitigate climate change, the Ministry of Energy and Mineral Resources has developed a renewable energy project a Nationally Appropriate Mitigation Action (NAMAs), specifically, the Debottlenecking Project Financing for small-scale Renewable Energy (DEEP). The DEEP Program aims to promote on-grid renewable energy, particularly bioenergy-based power plants, by increasing the institutional capacity of financial institutions and project developers. Its activities will include technical assistance as well as financial facilities of the renewable energy developer. In addition to this project, Indonesia is currently developing another NAMA project, focusing on small-scale renewable energy (mini/micro-hydro power plant).

BIOFUELS

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

It regulates:

- the utilisation priority of biofuels;
- biofuel categories;
- standards and specifications of quality;
- price setting;

- biofuel commerce, as another fuel;
- directives and oversight; and
- sanctions.

In order to reduce fuel imports by accelerating the improvement and expansion of biofuels, the Government revised Ministerial Regulation No. 32/2008 on 28 August 2013. This regulation sets mandatory targets for the percentage share of biofuels in the share of total fossil consumption (biofuel blend), as shown in Table 4.

Table 4: Minimum obligations for biofuel use (% blend)

Sector	Sep 2013	Jan 2014	Jan 2015	Jan 2016	Jan 2020	Jan 2025
Biodiesel						
PSO transport	10	10	10	20	20	25
Non-PSO transport	3	10	10	20	20	25
Industrial and commercial	5	10	10	20	20	25
Electricity generation	7.5	20	25	30	30	30
Ethanol						
PSO transport	-	0.5	1	2	5	20
Non-PSO transport	1	1	2	5	10	20
Industrial and commercial	-	1	2	5	10	20
Straight vegetable oil fuel						
Industry	1	5	10	20	20	20
Marine	-	5	10	20	20	20
Aviation	-	-	-	2	3	5
Electricity generation	1	6	15	20	20	20

Source: (ESDM, 2013). PSO = public service obligation fuel means subsidised fuel.

Until the end of 2012, the realisation of biodiesel (biofuel and bioethanol) utilisation was 544 963 kL or 38.9% from 1 400 000 kL of the mandatory regulation target under Ministerial Regulation No. 32/2008.

GEOTHERMAL

In 2012, Indonesia's total geothermal capacity was 1 341 MW, which is 4.7% of the total geothermal potential of 28 617 MW (EBTKE, 2013). Indonesia has identified 4 855 MW of geothermal power potential, from existing geothermal plants, through capacity expansion of productive geothermal resources, and from new geothermal projects at 51 sites, specifically 2 585 MW in Sumatra at 18 sites, 1 920 MW in Java at 20 sites, 180 MW in Sulawesi at four sites, 105 MW in the Nusa Tenggara at six sites, and 65 MW in the Maluku Islands at three sites (ESDM, 2014).

This geothermal power potential will be developed under the 10 000 MW *Accelerated Development of Electricity Generation*—Phase II programme, and it is expected that these projects will commence operation between 2014 and 2022. Of this total capacity, 4 515 MW will be developed by IPPs and 340 MW by PLN. Under PLN's Electricity Power Supply Business Plan 2013–2022 (*Rencana Usaha Penyediaan Tenaga Listrik,* or RUPTL), a further increase in geothermal capacity by 1 205 MW is expected between 2014 and 2022 (PLN, 2013).

HYDROPOWER

In 2012, Indonesia's total hydropower capacity was 4 146 MW (including 69 MW of micro and mini hydro), which was 5.5% of the total hydropower potential of 75 GW (ESDM, 2013). Under the 10 000 MW Accelerated *Development of Electricity Generation*—Phase II programme over 2014-22, Indonesia is

committed to developing additional hydropower with a total capacity of about 1 803 MW; of this total capacity, 424 MW will be developed by IPPs and 1 379 MW by PLN.

PLN's Electricity Power Supply Business Plan (RUPTL) also expects an additional 3 891 MW of hydropower capacity during 2014–22 (including mini hydro and pump-storage plants); of this capacity, 339 MW would be developed by PLN, 1 423 MW by IPPs, and the rest of the project's 2 129 MW is not yet decided, however private participation is still open for the project. The hydropower capacity addition includes two pump-storage power plants in Java—specifically the Upper Cisokan (1 040 MW) in West Java and the Matenggeng (900 MW) at the border of West and Central Java. These pump-storage plants are considered important for the technical performance and stability of the Indonesian electricity grid.

These hydropower plants would increase Indonesia's total large hydropower capacity to 9 840 MW, or 13.1% of Indonesia's total hydropower potential. It is worth noting that Indonesia's large hydropower potential is located in the eastern part of Indonesia, far from the large demand centres.

SAVING ENERGY AND WATER

Presidential Instruction No. 13 of the Year 2011 Regarding Saving Energy and Water instructs Ministers of the Unity Indonesia II Cabinet, the Supreme Justice of the Republic of Indonesia, the Commander of the Armed Forces of Indonesia, the Head of State Police Republic of Indonesia, Heads of Non-Ministerial Government Agencies, Heads of State Secretariat Institutions, Governors, and Regents or Mayors to take measures and innovate to save energy and water within their institutional domains and/or in the domains of State Owned Business and Regional Government Owned Business within their jurisdiction.

The Presidential Instruction assigns an electricity savings target of 20.0% from the average electricity use over the six months prior to the Presidential Instruction; fuel savings targets of 10.0% through regulations to limit use of subsidised fuels; and water savings targets of 10.0% from the average water use over the six months prior to the Presidential Instruction.

The Presidential Instruction calls for the creation of a National Team on Saving Energy and Water. The Coordinating Minister of Economic Affairs is the chair and a member of the National Team; the Minister of Energy and Mineral Resources is Executive Chief and a member of the National Team; 11 cabinet Ministers are also members of the National Team. The National Team is supported by the Executing Team headed by the Secretary of the National Team.

NUCLEAR

In 2007, the government of Indonesia established the Nuclear Power Development Preparatory Team, whose task it is to take the necessary preparatory measures and create the plans to build Indonesia's initial nuclear power plants, but to date the team has not conducted any significant activities or performed relevant tasks. The legal basis of Indonesia's nuclear power development includes Law 17/2007 on Long Term Development, Years 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 MW pool-type research reactor is planned for development in the near future.

Indonesia currently has two prospective uranium mines. The first is the Eko-Remaja prospect of the Remaja-Hitam Ore Body, a uranium vein in fine-grained metamorphous rock, estimated to contain between 5 000–10 000 tonnes of uranium with a grade ranging between 0.10–0.30. The second is the Riang Tanah Merah Ore Body, a uranium vein that may contain fewer than 5 000 tonnes of uranium of a grade ranging between 0.30–1.00. The uranium mines are located in West Kalimantan.

Despite the above developments, the Fukushima Daiichi nuclear accident in 2011 generated negative perceptions discouraging prospects for building nuclear power plants in Indonesia. At the same time, people have reisted development on candidate sites making development uncertain. Hence, the government has stated that nuclear power will be the last option to achieve Indonesia's energy demand, which means prioritising renewable energy sources.

CLIMATE CHANGE

Indonesia strongly supports the objectives 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 at the G20 Finance Ministers meeting and Central Bank Governors Summit held in September 2009 in Pittsburgh, the United States. In addition, the government of Indonesia has pledged to reduce GHG emissions from forestry and the energy sector by 26.0% through domestic efforts, and by up to 41.0% through cooperation with other economies.

In response to this 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 into policy instruments, regulations, programmes, 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 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 the 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; and
- 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-emissions programmes, projects and initiatives by private parties. 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

ELECTRICITY

ACCELERATED ELECTRICITY GENERATION PHASE I AND PHASE II

The accelerated power development program 10 000 MW Phase I had completed 4 520 MW of new generation capacity as of the end of November 2012. With regard to project constraints, the Ministry of Energy and Mineral Resources has set a new final completion date for the 10 GW Phase I of 2014.

In 2010, the government mandated PLN to implement Phase II of the program. In this second phase, it is intended that PLN will add 11.1 GW of capacity, based on 68.0% coal, 19.0% geothermal, 10.0% combined cycle gas and 3.0% hydropower. The two-phase accelerated power development program is expected to rapidly increase generating capacity, encourage renewable energy utilisation, and at the same time eliminate oil-based power plants, except in regions where there are no other competitive alternative energy sources.

The composition of generation capacity mix for Phase II of the 10 GW Accelerated Power Program is required to be updated to accommodate the current situation condition. In 2014, MEMR established a new final energy mix for the 10 GW Phase II, with a total capacity of 17 458 MW, 60.0% of which will be

developed from coal, 28.0% from geothermal, 10.0% from hydropower, and 2.0% from gas. The scheduled completion date for the 10 GW Phase II is 2022

HYDROELECTRIC POWER

The Upper Cisokan pumped storage hydroelectric power plant four 260 MW project in West Java received government loans from the World Bank/IBRD in late 2011. Completion of the project is expected in 2017. The Upper Cisokan pumped storage hydropower plant will be the first of its kind in Indonesia.

PLN has also secured financing for construction of the Jati Gede hydroelectric power plant two 55 MW in West Java, Baliem hydroelectric power plant 50 MW in the province of Papua, Asahan III hydroelectric power plant 174 MW in the province of North Sumatera, Sumatera, and the Merangin hydroelectric power plant two 175 MW in the province of Jambi, Sumatra.

REGULATIONS

POWER PURCHASES FROM GEOTHERMAL POWER PLANT AND GEOTHERMAL STEAM BY PLN

On 3 June 2014, the government introduced a ceiling price mechanism under the Ministerial Regulation No. 17/2014 to replace the Feed-in Tariff (FiT) scheme, which was introduced in 2012 (the Ministerial Regulation No. 22/2012). Under this new ceiling price mechanism, the government through the Ministry of Energy and Mineral Resources (MEMR), assigns PLN to purchase electricity from geothermal developers based on price auction results (ceiling price has been set ranging from USD 11.8 cent/kWh to USD 29.6 cent/kWh depending on commercial operation date of the project and the region where the project is located); and within 6 months after PLN got the assignment to purchase electricity from the government, PPA must be signed by both parties. If the delay of PPA is caused by disagreement of geothermal price, independent body to recalculate the geothermal price under the developers cost must be appointed by both parties. The calculation of geothermal price by the independent body will be the final price in the PPA. Moreover, under this regulation, there is an option to escalate the tariff after the developers carry out exploration and feasibility study phases.

POWER PURCHASES FROM HYDRO POWER PLANT BY PLN

On 13 August 2014, the government has established Feed-in-Tariff (FiT) for hydro power plant with the capacity up to 10 MW through the Ministerial Regulation No. 22/2014. Under the FiT mechanism, PLN is obliged to purchase electricity from hydro power plant with the capacity up to 10 MW at a predetermined price. The FiT is set from approximately USD 8.9 cent/kWh to USD 10.6 cent/kWh for the first year to the eighth year depending on the location of the projects within Indonesia and the voltage connection point; and it will be decreased to approximately USD 6.3 cent/kWh to USD 6.4 cent/kWh for the ninth year to the twentieth year depending on the location of the projects within Indonesia and the voltage connection point.

POWER PURCHASES FROM BIOMASS AND BIOGAS BASED POWER BY PLN

On 16 October 2014, the government established Feed-in-Tariff (FiT) for biomass and biogas-based power through the Ministerial Regulation No. 27/2014. Under the FiT mechanism, PLN is obliged to purchase biomass electricity and biogas electricity at a predetermined price (Biomass: from approximately USD 9.6 cent/kWh to USD 12.5 cent/kWh depending on the voltage connection point; and Biogas: from approximately USD 8.6 cent/kWh to USD 11.7 cent/kWh depending on the voltage connection point). Moreover, the FiT can be higher if the project is located in different location areas or islands since there is regional factor (F) with ranges from 1.00 up to 1.60. In addition, there is an incentive to encourage investor interest in biomass power plants and biogas-based power plants if they are operated as load followers.

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USEFUL LINKS

BPH MIGAS—www.bphmigas.go.id

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

PT PLN (Persero)—www.pln.co.id

SKKMIGAS, Satuan Kerja Khusus Pelaksana Kegiatan Usaha Hulu Minyak dan Gas Bumi—www.skspmigas-esdm.go.id

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

UNDP Indonesia—www.id.undp.org

JAPAN

INTRODUCTION

Located in East Asia, Japan 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 and APEC's third largest economy after the United States and China. Its real GDP in 2012 was approximately USD 4 365 billion (USD 2010 at PPP). Japan's population of 127.6 million people in 2012 had a per capita income of USD 34 222. Japan's GDP increased by 1.5% in 2012 compared to 2011. Since indigenous energy resources are modest, Japan imports nearly all of its fossil fuels to sustain economic activity. As of the end of 2011, proven energy reserves included approximately 44 million barrels of oil, 21 billion cubic metres of natural gas and 350 million tonnes of coal.

Table 1: Key data and economic profile, 2012

Key data		Energy reserves (a)	
Area (thousand sq. km)	377.8	Oil (million barrels)	44
Population (million)	127.6	Gas (billion cubic metres)	20.9
GDP (USD (2000) billion at PPP)	4 365.4	Coal (million tonnes)	350
GDP (USD (2000) per capita at PPP)	34 222	Uranium (kilotonnes U)	—

Sources: (EDMC, 2014); a) Proven Reserves at the end of 2011 (BP, 2012).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2012, Japan's total primary energy supply was about 450.1 million tonnes of oil equivalent (Mtoe), 2.9% less than in 2011. By fuel types, oil contributed the largest share (47.0%), followed by coal (25.0%) and natural gas (23.0%). In 2012, net imports of energy sources accounted for 97.0% of the total primary energy supply. With limited indigenous energy sources, Japan imported about 99.6% of its oil, 99.3% of its coal and 97.2% of its gas.

In 2013, Japan was the world's and APEC's third largest oil consumer after the United States and China (BP, 2014) and almost all of the oil was imported. The bulk of the imports (73.4% in 2013) came from economies in the Middle East such as the United Arab Emirates, Saudi Arabia, Iran, Qatar and Kuwait (BP, 2014). In 2012, the primary oil supply was 212.0 Mtoe, an increase of 5.1% from the previous year.

Japan is endowed with only limited coal reserves (347 million tonnes). Japan is the world's largest importer of coking coal for steel production and of steam coal for power generation, and pulp, paper and cement production. Japan's main steam coal suppliers are Australia, Indonesia, Russia, China, Canada, the United States, and South Africa, while for coking coal the main sources are Australia, Indonesia, Canada, the United States, Russia and China.

Natural gas resources are also scarce in Japan. Domestic reserves stand at 20.9 billion cubic metres and are located in the prefectures of Niigata, Chiba and Fukushima. Domestic demand is met almost entirely by imports in the form of liquefied natural gas (LNG) (BP, 2014), which come from Australia (20.5%); Qatar (18.4%); Malaysia (17.1); Russia (9.8%); Indonesia (7.2%); the United Arab Emirates (6.2%); Brunei Darussalam (5.8%); Oman (4.8%) and other economies. In 2013, LNG imports to Japan comprised 36.5% of the 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 2012, the primary natural gas supply was 105.2 Mtoe, an increase of 10.4% from the previous year.

Japan has 287.327 GW (EDMC, 2014) of installed generating capacity and generated 1 113 149 GWh of electricity in 2012. Electricity is generated from thermal fuels (coal, natural gas and oil—84.6%), nuclear (1.6%) and hydro (7.6%); geothermal, solar and wind technologies produce the remainder (6.2%).

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	25 142	Industry sector	134 538	Total	1 113 149
Net imports and other	436 012	Transport sector	78 169	Thermal	941 527
Total PES	450 164	Other sectors	98 875	Hydro	84 157
Coal	112 341	Total FEC	311 582	Nuclear	17 991
Oil	212 037	Coal	33 310	Other	69 474
Gas	105 248	Oil	160 230		
Other	20 538	Gas	30 841		
		Electricity and others	87 201		

Source: (EDMC, 2014).

FINAL ENERGY CONSUMPTION

In 2012, Japan's total final energy consumption was 311.6 Mtoe, or 0.4% less than in the previous year. The industrial sector consumed 43.0% of the total, followed by the transportation sector at 25.0%. By energy source, petroleum products accounted for 51.0% of the total final energy consumption, followed by electricity and other (28.0%), coal (11.0%) and gas (10.0%).

In 2012, energy consumption in the industrial sector decreased by almost 1.6%. The transport sector's consumption increased by 0.7%, and the other sector's energy consumption also increased by 0.4%.

ENERGY INTENSITY ANALYSIS

All energy intensity indices in Table 3, from primary energy to final energy demand by sector, show improvements from 2011 and thus contribute to APEC's overall aspirational goal of a 45.0% intensity reduction by 2035 (2005 as base year). Japan's energy intensity of the primary energy in 2012 was 103.1 tonnes of oil equivalent per million USD, a decrease by 4.3% from 107.71 tonnes of oil equivalent per million USD in 2011. The energy intensity of the final energy demand increased by 1.8% from 72.7 tonnes of oil equivalent per million USD in 2011 to 71.3 tonnes of oil equivalent per million USD in 2012. The industry sector shows the largest energy intensity (30.8 tonnes of oil equivalent per million USD in 2012) and the largest improvement (3.0%), while the energy intensity of the transportation sector and other sectors, which mainly include the commercial and residential sectors, has decreased by 0.7% and 1.1%, respectively.

Table 3: Energy Intensity Analysis, 2012

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	107.7	103.1	-4.3
Final Energy Demand	72.7	71.4	-1.8
Industry	31.8	30.8	-3.0
Transportation	18.0	17.9	-0.7
Others	22.9	22.7	-1.1

Source: (EDMC, 2014).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

The Ministry of Economy, Trade and Industry (METI) is responsible for designing Japan's energy policy. Within METI, the Agency for Natural Resources and Energy is in charge of 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, which was responsible

for the safety of energy facilities and industrial activities in METI, was abolished in September 2012. Its functions in relation to nuclear energy were transferred to the newly-established Nuclear Regulation Authority (NRA), which is an independent commission body affiliated to the Ministry of Environment (MOE), with the aim of achieving 'the separation of nuclear regulatory body from promoting agency.' The Ministry of Foreign Affairs formulates international policies, while MOE is responsible for environmental and global warming-related matters.

Before the Great East Japan Earthquake in March 2011 and the subsequent Fukushima Daiichi Nuclear Power Plant Accident, the aim of Japan's energy policy was to achieve the '3E' goals—energy security, economic growth and environmental protection (for example, against global warming)—in an integrated manner. After these events, Japan aims to achieve the '3E+S' goals— the original 3E concept and safety.

The Basic Law on Energy Policy 2002 presents the core principles of Japan's energy policy (METI, 2008): assurance of a stable supply; adaptation to the environment; and use of market mechanisms. The Strategic Energy Plan was established in 2003.

In 2006, Japan launched the New National Energy Strategy in response to the global energy situation (METI, 2008). The strategy contains a programme of action that extends to 2030 and it 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 Japan's investment in oil exploration and development projects; and reducing overall oil dependence below 40%.

The Strategic Energy Plan based on the law was revised in 2007 (METI, 2008). It focused on achieving the construction of an international framework for energy conservation and countermeasures to global warming; the establishment of a nuclear fuel cycle at an early stage; the promotion of new energy sources for electric power suppliers; assurance of a 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.

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 (METI, 2010). 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 ratio of zero-emission power sources to about 70% (34% at present);
- Halving CO2 emissions from the residential sector;
- Maintaining and enhancing energy efficiency in the industrial sector at the highest level in the world; and
- 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 CO2 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.

Following the Great East Japan Earthquake in March 2011 and the subsequent Fukushima Daiichi Nuclear Power Plant Accident, the Japanese Government decided to review its Strategic Energy Plan. In June 2012, the Energy and Environment Council of the Japanese government announced 'Options for Energy and Environment.' The Energy and Environment Council showed three scenarios for the share of nuclear energy in the power generation mix in 2030, namely, (1) a 0% scenario, (2) a 15% scenario, and (3) a 20-25% scenario (NPU, 2012).

However, Prime Minister Shinzou Abe, who was inaugurated on 26 December 2012, has stated that the coalition of the Liberal Democratic Party and Clean Government Party would reconsider the Democratic Party's nuclear energy policy. In April 2014, the Cabinet decided to approve the revised

Strategic Energy Plan. This forth plan gives a direction of Japan's energy policies for medium/long-term (about next 20 years), and it declares that a period from now to 2018-2020 should be a special stage to reform a variety of energy systems (METI, 2014a). The major principles of energy policy and viewpoints for reform in the fourth plan are as follows:

- Renewables (solar, wind, geothermal, hydro and biomass) are promising, multi-characteristic, important low carbon and domestic energy sources. Japan will accelerate their introduction as much as possible for the next three years, and then maintain their expansions.
- Nuclear is an important base-load power source as a low carbon and quasi-domestic energy source, contributing to the stability of energy supply-demand structure, based on the premise of ensuring its safety because of the following perspectives: 1) superiority in stability of the energy supply and efficiency, 2) low and stable operation cost and 3) free from GHG emissions during operation.
- Dependency on nuclear power generation will be lowered to the extent possible by energy saving and introducing renewable energy as well as improving the efficiency of thermal power generation, etc.
- Japan will revaluate coal as an important base-load power source in terms of stability and cost effectiveness, which will be utilised while reducing environmental load (utilisation of efficient thermal power generation technology, etc.).
- Japan regards natural gas as a main intermediate power source, expanding its roles in a variety of fields, and also regards oil as an important energy resource as well as raw material for the transport/consumer sectors and for a peaking power source.
- Energy mix will be shown soon after this plan, taking a number of consideration factors, including the restarting of nuclear power plants, expansion of renewables, etc.

ENERGY MARKETS

OIL

Japan aims to decrease its oil dependency, partly because of its experiences during the oil crises in 1973 and 1979. However, oil still accounts for around 40% of Japan's total primary energy supply and is expected to continue to dominate Japan's future energy supply. Securing a stable supply of oil will remain one of Japan's major energy policy issues.

Japan's oil supply structure is vulnerable to disruption because Japan imports almost all of its crude oil. In preparation for possible supply disruptions, Japan has created emergency oil stockpiles and independently developed resources and promoted cooperation with oil-producing economies to manage emergencies.

The Japan Oil, Gas and Metals National Corporation (JOGMEC) is responsible for the economy's stockpile business and also provides financial and technical assistance to Japanese oil industries for oil and natural gas exploration and development, both domestically and abroad. Japan's oil stocks are well in excess of the International Energy Agency's 90-day net import requirements. As of September 2014, Japan held the equivalent of 204 days of net imports, including state-owned stocks, private sector stocks and joint oil storage programs with oil producing countries (PAJ, 2014).

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 Energy Sources and Effective Use of Fossil Energy Materials by Energy Suppliers, which requires that heavy oil cracking unit capacity at petroleum companies is raised to 13% of total distillation capacity.

The number of service stations in the economy decreased from 59 615 in 1996 to 34 706 in 2013 as a result of market liberalisation (NPA, 2014). The Provisional Measures Law on Importation of Specific Kinds of Refined Petroleum Products was abolished in March 2012. 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.

The number of oil refineries in Japan decreased from 40 in 1996 to 23 in September 2014. Refining capacity decreased from 5.27 million barrels/day (mbd) in 1996 to 3.95 mbd in September 2014 (Sekiyu Tsushinsha, 2013); (PAJ, 2014).

NATURAL GAS

Demand for natural gas has been increasing rapidly over the past two decades. Between 1990 and 2012, natural gas demand grew at an annual rate of 4.1% (EDMC, 2014). This robust growth is expected to continue, partly for environmental reasons and partly due to its ease of use. Since 1995, Japan has undertaken natural gas market reform 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. Since Japan has placed priority on a 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 the 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 technological developments in the production and processing of methane hydrate, which is abundant in the ocean areas surrounding Japan and is viewed as a future energy resource.

COAL

In 2012, coal accounted for 25% 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, papers and pulp production. Japan is the second biggest coal importer in the world, accounting for about 14.4% of total global coal imports in 2012 (IEA, 2013).

ELECTRICITY MARKET

Electricity was the second largest contributor, after the petroleum industry, to the total final energy consumption in 2012. 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 prices have been among the highest of the developed economies. In order to lower electricity prices and increase industrial competitiveness, Japan has undergone a programme to reform the electricity sector, through amendments to the Electricity Business Act in 1995, 1999, 2004, 2008, 2013 and 2014, respectively.

The three main points of the electricity sector reform in Japan after 2013 are as follows (METI, 2013a):

- First stage: Establishment of the Organisation for Cross-regional Coordination of Transmission Operators (OCCTO);
- Second stage: Full power retail liberalisation; and
- Third stage: Legal unbundling of the transmission/distribution sector and full liberalisation of retail electricity rates.

The amended Electricity Business Act 2013 for the first stage was enacted in 2013, and, on June 27, 2014, the Cabinet decided to approve the Cabinet Order to stipulate the enforcement date of the OCCTO and other entities as of 1 April 2015.

The amended Electricity Business Act 2013 for the second stage was enacted in June 11, 2014. The framework for full retail competition is planned to be enforced in about 2016 (METI, 2014b).

As for the third stage, it will be implemented by approximately 2018-2020, and the bills for the third stage are planned to be submitted in 2015 (METI, 2014b).

FISCAL REGIME AND INVESTMENT

The Japanese government recognises the necessity of encouraging domestic petroleum companies to obtain upstream oil and gas 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 guarantees and building a flexible and effective finance system through JOGMEC, with the objective of reducing geopolitical and technical risks for future projects.

ENERGY EFFICIENCY

The Energy Conservation Law 1979 is the basis of all energy conservation policies in Japan. It was established in 1979, triggered by the Oil Crisis of 1979. It requires improving the energy efficiency of the industrial, consumer (commercial and household) and transport sectors. Japan has improved energy efficiency by approximate 40% after the crisis. The Energy Conservation Law 1979 was partially amended in May 2013. The amendment includes the expansion of the top runner program; not only energy consuming items but also items, which do not consume energy but contribute to high efficiency or energy conservation, such as building insulation materials, were added to the top runner program.

In 2014, the revised Strategic Energy Plan set these initiatives (METI 2014a):

- Enhancing Japan's energy efficiency (already at the highest level in the world) through introduction of the most advanced technologies for replacing equipment in the industrial sector;
- Enhancing support and regulatory measures (including top-runner program) to increase the adoption of highly efficient equipment in each sector. Expanding the coverage of the program; now in includes industrial refrigerators, printers, heat pumps, LED lumps as well as building insulation materials;
- Replacing 100% of lighting with high-efficiency lamps (including LED and organic EL lighting) on a flow basis by 2020 and on a stock basis by 2030;
- Achieving net zero energy with regard to a newly constructed public building by 2020 and to all newly constructed buildings on average by 2030;
- Raising next-generation vehicles' share of new vehicle sales to 50-70% by 2030 while promoting comprehensive measures, including improving traffic flow such as introducing the Intelligent Transportation Systems (ITS); and
- Facilitating introduction of the energy management system, such as BEMS (Building Energy Management System), and encouraging the acquisition of the certification of the ISO50001 standard.

RENEWABLE ENERGY

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

In August 2011, the Purchase of Renewable Energy-Sourced Electricity by Electric Utilities Act 2011 was passed by the Diet (Japanese parliament). This Act took effect on 1 July 2012. It obliges electric utilities to purchase electricity generated from renewable energy sources (solar photovoltaic, wind power, small and medium-sized hydro power, geothermal and biomass) based on fixed-period contracts with fixed prices. Table 4 shows prices for the Feed-In Tariff in FY 2014. Solar power prices for the Feed-In Tariff were reduced from the FY 2013 levels (METI, 2014c).

Table 4: Prices for Feed-In Tariff in FY 2014

Renewable Energy		Prices (JPY per kW)	Years
Solar	Over 10 kW	34.56	20
	Less than 10 kW	38.00	10
	Less than 10 kW (Double generation)	31.00	10
Onshore Wind	Over 20 kW	23.76	20
	Less than 23 kW	59.40	20
Offshore Wind		38.88	20
Hydro	From 1,000 kW to 30,000 kW	25.92	20

	From 200 kW to 1,000 kW	31.32	20
	Less than 200 kW	36.72	20
Geothermal	Over 15,000 kW	28.08	15
	Less than 15,000 kW	45.36	15
Biomass	Methane fermentation gasification	42.12	20
	Unused woods	34.56	20
	General woods	25.92	20
	Waste (excluding woods)	18.36	20
	Recycled woods	14.04	20

Source: (METI, 2013b); (METI, 2014c). Note: 8% of tax is included.

Costs incurred by the utilities in purchasing renewable energy-sourced electricity shall be transferred to all electricity customers, who will pay a surcharge for renewable energy at a rate proportional to their electricity usage. Surcharge for renewable energy is calculated as follows (METI, 2014d):

Surcharge for renewable energy

= Monthly electricity consumption (kWh) ×(0.75 JPY/kWh＋Solar added unit price JPY/kWh)

Each 10 Electric Utility Company has a different level for its solar-added price from 0.03 JPY/kWh to 0.05 JPY/kWh.

Electric utilities are obliged to allow grid connections and execute contracts as required for that purpose. Feed-in tariff (FIT) rates and contract periods are to be determined according to factors such as the type, form of installation and scale of renewable energy sources. Contract rates and periods shall be set by the Minister of Economy, Trade and Industry and will be based on the recommendations of a newly-established independent committee every year. To promote the generation of renewable energy-sourced electricity, special consideration shall be given to the profits of renewable energy-sourced electricity suppliers when decisions are made about the FIT rate for the three years from the enforcement of the Act (METI, 2011).

Table 5 shows the installed generation capacity for each renewable source of energy after the introduction of FIT (METI, 2013c; METI, 2014). Two year after the introduction of FIT, in total 72 370 MW of generation capacity based on renewable energy has been authorised under the FIT scheme, while accumulated generation capacity based on renewable energy by the end of June 2012, that is to say, before the introduction of FIT, was 20 600 MW. This indicates that the generation capacity based on renewable energy has become 4.5 times since the introduction of FIT. The table shows solar capacity boom in Japan, 98.1% of newly installed capacity after FIT and 95.9% of authorised capacity. Start-up generation capacity based on renewable energy is 12 559 MW, only 17.4% of the authorised capacity.

Table 5: Installed Generation Capacity by Renewable Energy after Introduction of FIT (Unit: MW)

	Introduced and Started-up Capacity		**Authorised Capacity**
	Before FIT	**After FIT**	**After FIT**
	Accumulated capacity by the end of June 2012	July 2012 – August 2014	July 2012 – August 2014
Solar (Residence)	4 700	2 564	3 066
Solar (Non-Residence)	900	9 762	66 356
Wind	2 600	111	1 296
Medium Hydro (Over 1 000 kW)	9 400	20	285
Medium Hydro	200	9	35

(Less than 1 000 kW)			
Biomass	2 300	91	1 317
Geothermal	500	0.26	14
＊Total	20 600	12 559	72 370

Source: (METI, 2013c); (METI, 2014e).

NUCLEAR ENERGY

Japan's Nuclear Energy Policy is under review following the Fukushima Daiichi Nuclear Power Plant Accident. Nuclear power plants in Japan have historically stopped operation for periodic inspections, once every 13 months in succession, regardless of the Fukushima Daiichi Nuclear Power Plant Accident. However, in April 2012, the four units of the Fukushima Daiichi Nuclear Power Plant were decommissioned and by May 2012 Japan had no operating nuclear power plants.

In July 2012, two nuclear power plants (Ohi units 3 and 4) restarted operations, but stopped operations again for periodic inspections in September 2013. Since then, Japan has again had no operating nuclear power plants.

New regulations for nuclear power plants came into force in June 2013. Five Electric Utilities Companies have submitted application for the re-start of their nuclear power plants to Nuclear Regulation Authority (NRA). In September 2014, NRA gave the final safety approval to the Sendai Nuclear Power Plant (2 units) owned by Kyusyu Electric Power Company. The power company continues to make progress toward the restart, and, on 7th November, the prefectural assembly of Kagoshima passed a petition for it.

CLIMATE CHANGE

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

At the United Nations Summit on Climate Change in September 2009, then-Prime Minister Yukio Hatoyama pledged that Japan would cut its GHG emissions by 25% from its 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 those economies agreeing on ambitious targets. Japan's GHG emissions stood at 1 341.00 million tonnes of CO2 equivalent in 2012 (preliminary figures, an increase of 2.5% compared to the previous year and an increase of 6.3% compared to the base year 1990) (MOE, 2013).

Japan's GHG emissions in the first UNFCCC's commitment period between 2008 and 2012 stood at 1 279.00 million tonnes of CO_2 equivalent. Therefore, Japan exceeded its emission target of reducing GHGs by 1.4%. The carbon sink by forest ecosystems is equivalent to a 3.8% reduction of GHG, while Kyoto Mechanism Credit is equivalent to a 5.9% reduction of GHG. If these were taken into account, Japan would be able to achieve an 8.2% GHG emission reduction compared to the levels for 1990) (MOE, 2013).

The Tax for Promotion of Global Warming Countermeasures took effect in 1 October 2012 (MOE, 2012b). This tax is levied on crude oil/oil products, gas and coal (MOE, 2012a). The tax value is JPY 289/ton- CO_2 for each kind of product. Revenue from this tax is used for implementing various measures to promote energy efficiency and renewable energy, as well as the use of clean fossil fuels.

The tax values for crude oil/oil products, gas and coal were raised in phases as follows.

Table 5 Tax for Promotion of Global Warming Countermeasures

	October 2012	April 2014	April 2016
Crude Oil/Oil Product (JPY/KL)	250	500	760
Gas (JPY/ton)	260	520	780
Coal (JPY/ton)	220	440	670

Source: (MOE, 2012a).

At the COP 19 Meeting in November 2013, the Japanese Government, through the Ministry of the Environment, announced that Japan would cut its GHG emissions by 3.8% in 2020 compared to those of 2005. This is an aspirational goal of improving energy efficiency, which already stands at the highest level in the world, by 20%. Moreover, Japan does not take into account the effect of nuclear power plants on reducing GHG emissions.

NOTABLE ENERGY DEVELOPMENTS

THE STRATEGIC ENERGY PLAN

As mentioned in 'Energy Policy Framework' part above, in April 2014, the Cabinet decided to approve the revised Strategic Energy Plan. This forth plan gives a direction of Japan's energy policies for medium/long-term (approximately the next 20 years), and it declares that a period from now to 2018-20 should be a special stage to reform a variety of energy systems. The government of Japan (GOJ) confirms '3E+S' concept (Energy Security, Economic Efficiency, Environment and Safety) as the basic viewpoint for its energy strategies. In the plan, GOJ regards renewable as the promising, multi-characteristic, important, low carbon and domestic energy sources, and accelerates their production as much as possible for the next three years and maintains their expansion after that. As for nuclear power, GOJ realises that the effort towards restoration and reconstruction of Fukushima is the starting point for rebuilding Japan's energy policies, and reaffirms its importance as a base-load, low carbon and quasi-domestic energy source, contributing to the stability of the energy supply-demand structure, based on the promise of ensuring its safety (METI, 2014a).

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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

REPUBLIC OF KOREA

INTRODUCTION

The Republic of Korea is located in Northeast Asia between China and Japan. It has an area of 99 538 square kilometres and a population of around 50 million people as of 2012. Korea's population density is very high, with an average of more than 500 people per square kilometre. Around 20% of the population lives in Seoul, Korea's capital and its largest city. The economy's geography is largely made up of hills and mountains, with wide coastal plains in the west and the south. The climate is relatively moderate with four distinct seasons. Air conditioning is commonly necessary during the tropical hot summers and buildings need to be heated during the bitterly cold winters.

During the last few decades, Korea has been one of Asia's fastest-growing and most dynamic economies. Gross domestic product (GDP) increased at a rate of 6.6% per year from 1980 to 2012, reaching USD 1 594 billion (USD (2010) Price and 2010 PPP) in 2012. GDP (PPP) per capita income in 2012 was USD 31 883, almost six 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, 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. Korea imported about 90.0% of its primary energy supply in 2012. It 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, 2012

Key data		Energy reserves	
Area (sq. km)	99 538	Oil (barrels)	–
Population (million)	50.00	Gas (billion cubic metres)	3
GDP (USD (2010) billion at PPP)	1 594.3	Coal (million tonnes)	326
GDP (USD (2010) per capita at PPP)	31 883	Uranium (kilotonnes U)	3 471.5

Sources: (EDMC, 2014) (KEEI, 2014).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Korea's total primary energy supply increased almost seven fold between 1980 and 2012, from 38.3 million tonnes of oil equivalent (Mtoe) in 1980 to 262.8 Mtoe in 2012. In particular, from 1990 to 2000, the energy supply increased at an annual average rate of 7.3%, far exceeding the economic growth rate of 6.5% for the same period. Likewise, the per capita primary energy supply grew from 1.0 tonne of oil equivalent in 1980 to 5.1 tonnes of oil equivalent in 2012. The increase was similar to that of Japan and most European economies.

In 2012, Korea's total primary energy supply was 262.8 Mtoe, a 01.0% increase from the previous year. By energy source, oil represented the largest share (37.0%), followed by coal (29.0%), and gas (17.1%). The remaining 16.9% of the primary energy supply came from nuclear and hydro energy sources. Korea imported around 90.0% of its total energy needs in 2012, including all of its oil, 99% of gas requirements and 98.0% of its coal supply. Energy imports accounted for almost one third of Korea's total import value in 2012.

The oil supply in 2012 was 97.2 Mtoe, a 3.8% increase from the previous year. In 2012, the economy imported more than 80.0% of its crude oil from the Middle East. In the case of coal, its supply in 2012 totalled 76.3 Mtoe, a 4.6% decrease from the previous year. Korea has modest reserves of low-quality, high-ash anthracite coal that are insufficient to meet its domestic demand. Almost all of Korea's coal demand is therefore met by imports. Korea is the world's second-largest importer of both steam and coking coal after Japan. Main coal imports come from Australia; Canada; China; Indonesia; Russia; and the United States.

Since the introduction of LNG in 1986, natural gas use in Korea has grown rapidly. Gas supply reached 45.0 Mtoe in 2012; its share of the primary energy supply was 17.1% in that year. Most of Korea's LNG imports come from Qatar, Indonesia, Oman, Malaysia, Brunei Darussalam and Russia's Sakhalin-2 LNG plant. Korea began producing natural gas domestically in November 2004, after a small quantity of natural gas was discovered in the Donghae-1 offshore field in the south-east of the economy.

Korea's electricity generation in 2012 was 476.9 Terawatt-hours, a 1.0% increase from 2011. Generation by thermal sources, including coal, oil and natural gas, accounted for 66.8% of the total electricity generated, followed by nuclear at 31.5% and hydro at 1.3%.

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	46 040	Industry sector	47 461	Total	476 890
Net imports and other	228 101	Transport sector	30 277	Thermal	318 984
Total PES	262 763	Other sectors	88 364	Hydro	3 969
Coal	76 309	Total FEC	166 104	Nuclear	150 327
Oil	97 151	Coal	9 265	Other	3 610
Gas	44 990	Oil	84 734		
Other	44 312	Gas	22 904		
		Electricity and other	49 201		

Source: (EDMC, 2014).

FINAL ENERGY CONSUMPTION

Korea's total final energy consumption in 2012 was 166.1 Mtoe, a 3.2% increase from the previous year. The industry sector accounted for the largest share at 28.6%, while the transport sector accounted for 18.2%. The remainder (53.2%) was used in the residential and commercial sector and as 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 51.0% of total energy consumption, followed by electricity and other (29.6%), natural gas (13.8%), and coal (5.6%). Natural gas consumption has increased significantly due to the economy's policy measures.

ENERGY INTENSITY ANALYSIS

Table 3: Energy Intensity, 2012

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	167.0	164.8	-1.3
Final Energy Demand	103.2	104.1	0.9
Industry	30.4	29.8	-2.0
Transportation	18.9	19.0	0.5
Others	540.0	55.0	2.7

Sources: (EDMC, 2014).

The growth of Korean GDP of 2.3% in 2012 resulted in 1.3% improvement in the economy's total primary energy supply. This could be translated to an economy-wide energy intensity level of 2.2 tonnes of oil equivalent per USD million USD. For final energy demand, energy intensity level increased by 0.9% from 2012 level of 103.2 tonnes of oil equivalent per million USD to 104.2 tonnes of oil equivalent per million USD in 2012. On per sector analysis, the industry registered the largest reduction of 2.0% in energy use per USD million of GDP from a year ago level of 30.4 tonnes of oil equivalent per million USD to 29.8 tonnes of oil equivalent per million USD. The transport sector posted a lower intensity at 19.0 tonnes of oil equivalent per million USD, a increase of 0.5% from its previous year's level. The other sectors' energy intensity also went up by 2.7% from 2012 level.

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

In the past, Korea's energy policy focused on ensuring a stable energy supply to sustain economic growth. The government is now seeking a new direction in energy policy with the aim of supporting sustainable development that fully considers the 3Es (energy, economy and environment).

The responsibility for energy policy development and implementation is divided between a number of government institutions. The Ministry of Knowledge Energy (MKE) is the primary government body for energy policy.

In 2006, the Korean Government established the National Energy Committee, which is chaired by the president and includes government and non-governmental experts. The committee's role is to deliberate and mediate major energy policies and plans. In addition, it discusses the National Basic Plan for Energy, emergency preparedness, foreign energy resource development, nuclear energy policy, the coordination of energy policies and projects, the prevention and settlement of social conflict related to energy issues, the transportation of and physical distribution plan for energy, the effective execution of the energy budget, and energy issues within the United Nations Framework Convention on Climate Change.

As part of its liberalisation efforts in the energy sector, in 2001 the government established the Korea Electricity Commission (KOREC) to take charge of regulations in the electric power sector and to manage technical and professional competition policy. There is no regulatory commission for the gas industry. The Fair Trade Commission is Korea s anti-trust agency, which monitors monopoly problems and unfair business practices in the energy sector.

The Korea Energy Economics Institute (KEEI) develops energy policies related to the production of energy statistics, as well as demand and supply overviews, energy conservation and climate change, the petroleum industry, the gas industry, the electricity industry, and the new and renewable energy industry, among others. It is financed directly by the government.

The Korea Institute of Energy Research (KIER), funded by the government, is Korea's major energy technology research institute. KIER's mission is to contribute to an economy-wide economic growth by developing industrial core energy technologies and deploying outcomes.

The Korea Energy Management Corporation plays a key role in achieving Korea's research and development (R&D) policy goals for energy efficiency, energy conservation, clean energy, and new and renewable energy technologies. It also manages R&D planning and financial support and management.

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 until 2030.

On 14 January 2014, Korea launched 'The 2nd Energy Basic Plan,' which is the main legal plan in energy sector with a timeframe up to 2035. According to the 2nd energy plan, the total primary energy demand is projected to grow at an annual average rate of 1.3% between 2011 and 2035. Final energy demand will grow at 0.9 % per year. Energy intensity is expected to drop from 0.3 in 2011 to 0.2 in 2035 with an improvement of 1.4% per year, resulting in 30% improvement of energy intensity, which is equivalent to 13.3% reduction in the final energy consumption.

The government proposes six major policy agenda as follows:

- Shift to Energy Management-Oriented Policy;
- Building a Power Generation System based on Distributed Generations (DGs);
- Pursuit of Harmonisation between the Environment and Safety;
- Pursuit of Harmonisation between the Environment and Safety;
- Building a Stable Energy Supply by Source; and
- Pursuing of Energy Policy along with People.

Heavy dependence on the Middle East for its crude oil supply has led the economy to a policy of diversifying its oil supply during the outlook period. The state-owned Korea National Oil Corporation (KNOC) will continue to be responsible for the economy's preparedness for an oil emergency situation by operating oil stockpiling facilities and pursuing stakes in oil projects around the world.

In the natural gas industry, the state-owned monopoly Korea Gas Corporation (KOGAS) will continue to be responsible for managing the import, storage, transmission and wholesale distribution of LNG. The electricity industry will continue to be dominated by the state-owned Korea Electric Power Corporation (KEPCO). It is possible there may be stages of restructuring and liberalisation during the outlook period, allowing more private participation in the oil, gas and electricity industries.

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 1999, in a move to phase in competition in 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.

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 the 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, 51.0% of KEPCO, as a holding company, was owned by the Korean Government. KEPCO is still a dominant player in the electricity sector, controlling 94.0% of total power generation and 100.0% 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 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 the existing import and transportation contracts, the privatisation of import and wholesale businesses, stabilise prices and balance 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 discussions 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, which is 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 2011, no decision on the liberalisation of the gas market had been made.

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 to meet International Energy Agency (IEA) obligations, the Korean Government has been increasing its oil stockpile since 1980. At the end of August 2011, Korea held 117 million barrels in strategic reserves and had already purchased 2.3 million barrels, or 94.0% of that year's purchase target. Korea aims to build its strategic reserves to 141 million barrels, stockpiled at nine locations across the economy, by 2013. The economy-wide stockpile capacity substantially exceeds the IEA's 90-day requirement.

The state-controlled Korea National Oil Corporation has been actively exploring and developing oil and gas, both locally and abroad, to improve energy security. As of the end of February 2011, it was conducting 191 projects in 25 countries. Private companies (including SK, GS Caltex, S-Oil and Hyundai Oil Bank) are also active in the oil and gas sector, as well as the downstream market and wholesale imports areas.

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.

Korea has also been trying to diversify its crude oil supply sources. The number of source countries increased from nine in 1980 to 29 in 2004, but the economy'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, APEC, the Association of Southeast Asian Nations (ASEAN)+3, the International Energy Forum and the Energy Charter, to enhance its crisis management capabilities. 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 and has replaced coal and oil in the residential sector. KOGAS has a monopoly over Korea's natural gas industry, including the gas import, storage, transport and wholesale businesses. Thirty-two 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 such countries as Australia, Uzbekistan and Nigeria.

The Ninth Plan for 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 2007-30. By sector, the city gas sector's demand for natural gas is projected to increase by 2.0% per year, while the demand for gas for power generation is projected to decrease by 3.8% per year.

The Korean Government is considering new reforms for the gas industry, with the introduction of gas-to-gas competition by unbundling imports and sales activities from the operation of terminals and transmission facilities, and by instituting an open access regime for receiving terminals and the transmission network.

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%; then between 1990 and 2009, installed capacity increased by more than threefold from 21 GW in 1990 to 78 GW in 2009.

The Fourth Basic Plan of Electricity Demand and Supply (2008–22), finalised by MKE in December 2008, projects that electricity demand will grow by 2.1% per year from 2008-22 and an additional capacity of 33.6 GW will be required by 2022. When decommissioning is taken into account, this translates to about 101 GW of total generation capacity for that period.

Korea's electricity industry is dominated by KEPCO. KEPCO was separated into six power generation subsidiaries in April 2001: Korea Hydro & Nuclear Power, which owns the economy's nuclear-energy power plants and large hydroelectric dams, and five state-owned generating companies, which took over ownership of the economy's thermal power plants. KEPCO retained the economy-wide transmission and distribution grids.

To rectify an energy supply and demand structure that is 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-energy power plants, seven coal-fired power plants, and 11 gas-fired power plants are planned for construction. Korea has been building nuclear-energy power plants since the 1970s as nuclear energy is a strategic priority for the government. Its share of total electricity production capacity is projected to increase to 32.6% in 2022.

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 benefits for research and development (R&D).

In 2007, the corporate tax rate was 25.0% on taxable income over KRW 200 million and 13.0% on taxable income below that amount. Under the tax reforms, these rates were scheduled to be lowered further from 22.0% in 2009 to 20.0% in 2010, and from 11.0% to 10.0% for the same period, respectively. However, implementation of the tax rate reduction was 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 an R&D reserve fund, which will be deductible up to 3% of sales revenue, an increase in investment tax credits for R&D facilities from 7% to 10% and an increase in 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 that is effective until 2012. This initiative aims to improve energy efficiency by 11.3% by 2012 compared with 2007 and to save 34.2 Mtoe. Announced in August 2008, it is part of Korea's long-term energy plan, which aims to achieve a 4.6% annual energy efficiency improvement compared to the previous year by 2030.

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

RENEWABLE ENERGY

In September 2014, the Korean Government announced the 4th Korea's National Basic Plan for New and Renewable Energy. According to the plan, Korean government plan to provide 11% of total primary energy supply with new and renewable energy (NRE) by 2035. Development of solar and wind power as main energy sources will allow that 13.4% of total electric energy in Korea will be supplied by NRE by 2035.

CLIMATE CHANGE

On 15 August 2008, a new 'Low Carbon, Green Growth' vision for Korea was announced. The vision aimed to shift the traditional development model of fossil fuel-dependent growth to an environmentally friendly one.

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 took effect in April 2010. This legislation provided 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 calls for building a comprehensive, long-term (2009–50) master plan to address the challenges caused by climate change and resource depletion. The strategy 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, 2009b)
  - Reduction in fossil fuel use and the enhancement of energy independence
  - Strengthening the capacity to adapt to climate change.
- Creation of new engines for economic growth
  - Development of green technologies (KEEI, 2010b)
  - Greening of existing industries and the promotion of green industries
  - Advancement of industrial structure
  - Engineering a structural basis for the green economy (KEEI, 2010c).
- Improvement in the 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 programmes designed to implement the long-term strategy for green growth. Table 4 outlines the policy indicators for the first plan for 2009–13 and shows the years beyond as a reference.

The Five-Year Plan for Green Growth envisages fiscal spending of KRW 107 trillion (USD 86 billion) for 2009–13. Under the plan, 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, the restoration of the four major rivers and green transportation.

Table 4: Policy indicators, five-year plan, 2009–2013

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

Source: (MKE, 2009a).

Roughly 2.0% of the economy's annual GDP is being allocated to green investment, which is twice the amount recommended in the Green Economy Initiative advocated by the United Nations Environment Programme (1.0% of GDP). Table 5 shows the rates of green investment in Korea up to 2013.

In its response to climate change, the Korean Government a) has set an economy-wide greenhouse gas (GHG) reduction goal; b) supports voluntary reduction efforts by industry; c) has activated the carbon market by expanding market mechanisms such as the carbon neutral programme and the carbon fund, and fosters companies that specialise in emissions trading schemes; and d) is considering introducing a system for the mandatory supply of new and renewable energy focusing on the electricity generation sector. It will also introduce legal controls in part, such as obligating Renewable Portfolio Agreements based on existing voluntary agreements.

Table 5: 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
Mitigating climate change and achieving 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
Improving quality of life and enhancing international standing	27.9	5.2	10.5	12.2	3.6

Source: (MKE, 2009a).

NOTABLE ENERGY DEVELOPMENTS

CLEAN ENERGY/ENERGY EFFICIENCY

R&D PLAN TO NURTURE THE GREEN INDUSTRY

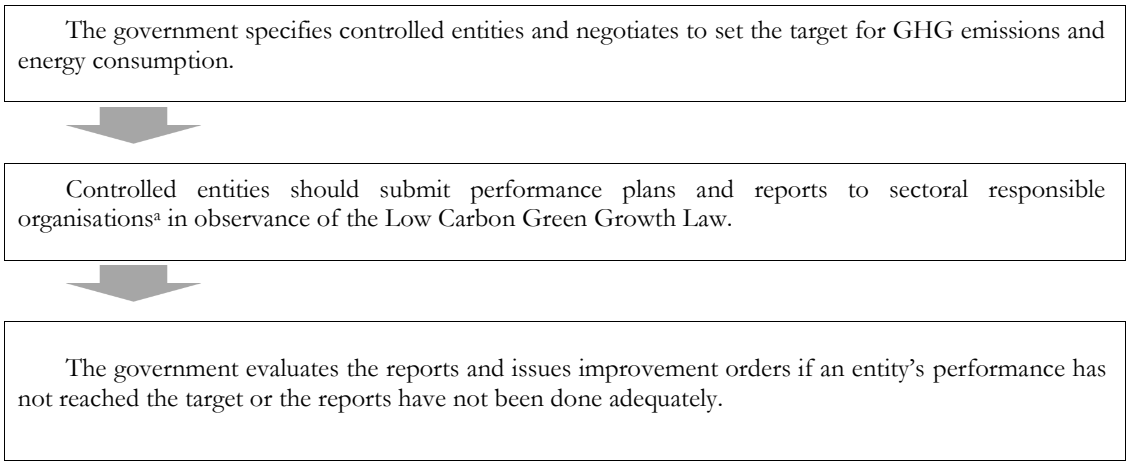
As part of its efforts to become one of the world's top-five green energy powerhouses by 2020, Korea intends to double its budget for energy R&D between now and then. Under a plan announced in November 2011, Korea will strengthen its core technology in the area of green energy and secure 10.0% of the global market. Technology development and R&D carried out under the plan will effect a 12.0% increase in energy efficiency and account for half the reduction in emissions needed for Korea to meet its 2020 target of 30.0% below the business-as-usual level (MKE 2011).

GREENHOUSE GAS EMISSIONS AND ENERGY TARGET MANAGEMENT

The GHG Emissions and Energy Target Management scheme aims to set and implement a target for GHG emissions reductions that will apply to large public/private emitters.

Controlled entities are selected by their average GHG emission and energy consumption performances over the last three years. Table 6 shows the suggested GHG emissions and energy standards of specified controlled entities; the standards will be valid from 2011–14 during the first phase.

Figure 1: Operational process and roles in GHG emissions and energy target management



a. Sectoral responsible organisations: Industry and electricity generation: Ministry of Knowledge Economy; Building and transport: Ministry of Land, Transport, and Maritime Affairs; Agriculture and livestock: Ministry for Food, Agriculture, Forestry, and Fisheries; and Waste: Ministry of Environment (main authority).

Table 6: GHG emissions and energy standards in Korea of specified controlled entities, valid from 2011–14

Concept	Until 12 December 2011		From 1 January 2012		From 1 January 2014	
	Company	Business unit within company	Company	Business unit within company	Company	Business unit within company
GHG emission (tCO_2)	125 000	25 000	87 500	20 000	50 000	15 000
Energy consumption (TJ)	500	100	350	90	200	80

Source: (Republic of Korea, 2011). Note: 1 TJ = 23.8846 toe; 1 toe = 3.2 tCO_2.

To increase the awareness of business and to enhance the acceptability of the system, the government launched 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 pilot projects. Total energy consumption for all participating companies accounts for 41.0% of the total energy use in the industry sector.

After the pilot projects, the government selected 471 controlled entities in 2010. GHG emissions from those entities account for approximately 60.0% of the total emissions in Korea. These entities also account for 40.0% of the economy's total energy consumption. The industry and power generation sectors are the biggest consumers, accounting for 80.0%. The number of entities will be increased until 2014.

Table 7: Specified controlled entities in Korea for GHG emissions and energy consumption performances

Sector	No. of entities	Percentage
Industry, power generation	375	79.6
Building, transportation	46	9.8
Agriculture, livestock	27	5.7
Waste	23	4.9
Total	471	100.0

Source: (Republic of Korea, 2014). Note: Sector estimated and target GHG emission in 2012 (unit: thousand tonnes of CO_2).

The sectoral responsible organisations evaluate the performance of the controlled entities in terms of GHG emissions and energy consumption, and take any necessary measures, including enforcement notices. Entities with improvement orders are expected to incorporate the improvements into their new implementation plans. The government has the right to impose penalties if companies fail to follow the scheme.

The government is focusing on building infrastructure, supporting finance, and supporting small and medium-sized enterprises to stimulate the early stage of implementing the GHG Emissions and Energy Target Management scheme.

President Park Geun-hye in October 2013 proposed the 'Eurasia Initiative' that calls for linking the energy and logistics infrastructure across the continent. It would expand ties among Eurasian countries through connections of energy infrastructure, roads and railways to build the new 'Silk Road Express,' which would run from South Korea to Europe via North Korea, Russia and China.

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USEFUL LINKS

Korea Electric Power Generation Corporation—www.kepco.co.kr/eng/

Korea Energy Economics Institute—www.keei.re.kr

Korea Energy Management Corporation—www.kemco.or.kr

Korea Gas Corporation—www.kogas.or.kr

Korea National Oil Corporation—www.knoc.co.kr

Ministry of Trade, Industry and Energy—www.motie.go.kr/language/eng/index.jsp

Ministry of Strategy and Finance—http://english.mosf.go.kr/

Statistics Korea— http://kostat.go.kr/portal/english/index.action

MALAYSIA

INTRODUCTION

Malaysia is located in Southeast Asia with a total territory of about 330 803 square kilometers covering the states in Peninsular Malaysia, the Federal Territories of Kuala Lumpur Putrajaya, and Labuan, and Sabah and Sarawak on the island of Borneo. Kuala Lumpur is the capital of Malaysia, while Putrajaya is in the seat of the Federal Government (EPU, 2013). In 2012, the economy's population stood at 29.2 million, which grew by 1.7% from the previous year's level of 28.7 million (WB IBRO-IDA, 2014).

Malaysia's GDP in 2012 reached USD 627.94 billion (USD 2010 Price and 2010 PPP), an improvement of 5.6% from USD 594.42 billion GDP in 2011 (EDMC, 2013). Among the sectors, services and manufacturing exhibited the largest contributions to GDP at 54.6% and 24.9%, respectively. However, it may be noted that the construction sector registered the highest growth at 18.1% compared to its last year's performance (MOF, 2014). The main export products of the economy are electrical and electronics (E&E) products (about 30.0% share to total export), palm oil products (10.0% share), petroleum products (8.0% share), liquefied natural gas (LNG) (8.0% share), and crude petroleum (5.0% share). The economy's exports fell by 5.8% in 2012 from a year ago level due a decrease in E&E and palm oil exports (DOSM, 2013). With better economic performance, GDP per capita (USD 2010 Price and 2010 PPP) likewise improved by 3.9% from USD 20 669 per person in 2011 to USD 21 476 per person (EDMC, 2014).

Malaysia is endowed with rich energy resources both conventional and renewable energy. In 2012, the economy's oil reserves (including condensate) were 5.9 billion barrels, 40.0% of which is found in Peninsular Malaysia (Malay basin). The abundant natural gas reserves of the economy are estimated at 2.58 trillion cubic metres (92.12 trillion standard cubic feet) with nearly 50.0% is in Sarawak basin. On the other hand, the coal reserves deposit, which is assessed at 1 938 million tonnes, is shared mostly by Sarawak and Sabah (EC, 2013). Likewise, the economy has vast hydropower potential sites with an estimated capacity of 29 000 megawatts, the majority (85%) of which is found in East Malaysia. Palm oil, wood and agro-industrial wastes are the main sources for biomass (APERC, 2011).

Table 1: Key Data and Economic Profile, 2012

Key Data		Energy Reserves	
Area (sq. km)[a]	330 803	Oil (billion barrels)—proven[c]	5.9
Population (million) [b]	29.24	Gas (trillion cubic metres)—proven[c]	2.58
GDP (USD (2010) billion and 2010 PPP)[b]	627.94	Coal (million tonnes)[c]	1 938
GDP (USD (2010) per capita at PPP)[b]	21 476	Uranium (million tonnes)	N/A

Sources: a. (EPU, 2013); b. (EDMC, 2014) ; c. (EC, 2013).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Malaysia's total primary energy supply was at 76 621 kilotonnes of oil equivalent (ktoe) in 2012, with a very nil increase of 0.08% from a year ago level of 76 555 ktoe. Natural gas contributed the largest share at 42.0% (32 222 ktoe), followed by oil with 35.5% share (27 170 ktoe) and coal with 20.6% share (15 796 ktoe). Meanwhile, other resources including hydro provided a minimal share of 1.9% (1 433 ktoe) to the primary energy supply (EDMC, 2014).

The economy also exports energy products, mainly crude oil and petroleum products, LNG and natural gas. The economy registered total energy exports of 53 230 ktoe in 2012, which was up by 8.3% from previous year's level of 49 142. The economy is the second-largest exporter of LNG in the world, and the second-largest producer of crude oil and natural gas in Southeast Asia (EIA, 2014). In the same

year, energy imports of the economy also increased by 8.7% from 41 244 ktoe in 2011 to 44 823 ktoe (EC, 2013).

OIL

Malaysia's oil reserves are the fourth largest in Asia Pacific, which come mostly from offshore fields. The economy's continental shelf is divided into three producing basins, namely: Malay basin in offshore of peninsular Malaysia in the west; and the Sarawak and Sabah basins in the east. The bulk of the oil reserves are located in the Malay basin, which are light and sweet crude oil (EIA, 2014).

The economy's average daily oil production was 584.8 thousand barrels per day (mbbl/d) in 2012, around 80.0% of which was crude oil. Malay basin yielded almost 50.0% of total oil production and the remaining was shared by Sarawak and Sabah basins (EC, 2013).

The economy has five (5) oil refineries with a combined capacity of 566 mbbl/day (including condensate splitter capacity). Petronas, which has three (3) refinery facilities, provided more than 50.0% of the total daily refinery production. Petrol and diesel accounted for about 70.0% of the total domestic consumption of petroleum products in 2012. For the same year, the economy imported a total of 13 966 ktoe of petroleum products to meet the growing domestic requirement (EC, 2013).

NATURAL GAS

Most of the gas reserves of Malaysia are in offshore of Peninsular Malaysia in the eastern areas, Sarawak and Sabah. Most of the economy's gas reserves are non-associated, while the remaining is associated with oil basins. Sarawak hosts 47.0% of the total reserves followed by Peninsular Malaysia with 39.0% and Sabah with 14.0%. In 2012, the average daily natural gas production was at 184.65 million cubic meters per day (mcmd) (6 521 million standard cubic feet per day), lower by 10.7% from last year's level of 206.7 mcmd due to decreased production from Peninsular Malaysia and Sarawak gas fields (EC, 2013). Most of the production came from Sarawak with 60.8% share to total, Peninsular Malaysia with 32.5% share, and Sabah with 6.7% share. In order to meet the local demand, the economy imported gas via pipeline from Thailand and Indonesia. As such, natural gas imports picked up by 12.7% during the same year from 6 979 ktoe in 2011 to 7 886 ktoe (EC, 2013).

Malaysia has an extensive gas pipeline network running through Peninsular Malaysia and pipelines connected to offshore fields at the eastcoast of Peninsular Malaysia. The Peninsular Gas Utilisation (PGU) network, which started in 1984, covers over 2,500 kilometers (km) pipelines composed of main pipelines, supply pipelines and laterals linking most cities in Peninsular Malaysia and with cross-borders interconnections to Singapore and Songkhla, Thailand. The PGU network is comprised of six (6) gas-processing plants with a combined capacity of 56.2 mcmd (2,000 million standard cubic feet), producing methane, ethane, butane and condensate (Gas Malaysia, 2012). The PGU is linked to the Trans Thailand-Malaysia Gas Pipeline System (Joint Development Area) for additional supply security for Malaysia (Petronas-PGU). The network receives gas from offshore Peninsular Malaysia fields and imports from the Joint Development Area and West Natuna. Nearly half of the gas from PCU is distributed for power plants usage, and the rest is consumed for non-power uses in industries and exported to Singapore (Maybank, 2012).

The second gas pipeline linking the states of Sabah and Sarawak—the Sabah-Sarawak Gas Pipeline (SSGP)—is under construction and expected to be completed in 2014. The SSGP is one of the components of the Sabah-Sarawak Oil and Gas Project, which also includes Sabah Oil and Gas Terminal (SOGT) (EIA, 2014). The pipeline system is approximately 521 km (323 miles) in length that will transport 0.28 billion cubic meters per day (bcmd) (1 billion cubic feet/day) of gas from SOGT in Kinamis, Sabah to Bintulu, Sarawak for processing into LNG facility for export. Further, the pipeline system will have provisions for future domestic consumption in Sabah and Sarawak (Petronas-SSGP).

The economy has extensive LNG export facilities and contributed about 10.0% of the world's LNG exports (BP, 2013). In 2012, Japan remained the largest importer for the economy's LNG with about a 62.0% share, followed by Korea with 17.0%, Taiwan with 12.0% and China with 9.0% (EC, 2013).

COAL

Malaysia's coal resources are mostly made up of bituminous and sub-bituminous coal with estimated reserves of about 1,938 million tonnes, which are found in Sabah and Sarawak. Even with substantial coal resources, domestic coal production has not been that aggressive since most of the coal deposits are far inland with no adequate infrastructure in place that makes extraction costs high. Likewise, some areas have been declared protected areas, such as the Maliau Basin in Sabah, prohibiting coal mining activities. It is

only in Sarawak that has coal mining activity in the areas of Mukah-Balingian (the largest producing coal basin) with 2,316,103 metric tonnes production in 2012, Kapit with 600,959 metric tonnes, and Sri Aman with 33,975 metric tonnes (EC, 2013).

In 2012, the economy's domestic coal consumption decreased slightly by 0.85% from 1 759 ktoe in 2011 to 1 744 ktoe. Of the total coal consumption, about 90.0% was consumed by the power generation sector, while the remainder was consumerd by the industry—iron and steel and cement industries. The economy imports coal to meet its growing requirements from Australia, Indonesia and South Africa (EC, 2013).

ELECTRICITY

Malaysia's total installed power generation capacity in 2012 was recorded at 29 143 MW, a minimal increase of 1.4% from 2011 level of 28 749 MW. Such an increase in the installed capacity was attributed to the additional capacity of 300 MW from Bakun hydro project in Sarawak. About 60.0% of the total installed capacity was owned by the independent power producers (IPPs) and the rest by government-linked utilities, self-generation and co-generation facilities (EC, 2013).

In the same year, total electricity generation was at 132 493 gigawatt-hours (GWh), an improvement of 5.6% from the previous year's level. Thermal generation, mostly from natural gas and coal, accounted for 93.0% of the total power generation, while hydropower accounted for the remainder (EDMC, 2014).

FINAL ENERGY CONSUMPTION

Table 2: Energy Supply and Consumption, 2012

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous production	85 883	Industrial sector	15 310	Total	132 493
Net imports and other	- 8 291	Transport sector	15 146	Thermal	123 239
Total PES	76 621	Other sectors	14 163	Hydro	9 254
Coal	15 796	Total FEC	44 619	Nuclear	–
Oil	27 170	Coal	1 744	Geothermal	–
Gas	32 222	Oil	22 716	Other	–
Other	1 433	Gas	10 147		
		Electricity and other	10 012		

Source: (EDMC, 2014).

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

In 2012, Malaysia's final energy consumption reached 44 619 ktoe, registering an increase of 2.8% from a year-ago level. The industry sector was the biggest energy consumer, overtaking the transport sector, accounting for 34.3% share of the total final energy consumption or about 15 310 ktoe. The transport sector followed next with 33.9% share or 15,919 ktoe. However, the sector's energy consumption declined 11.2% from previous year's level. The other sectors used by 31.7% of the total, with an increase of 9.2% (EDMC, 2014).

In terms of fuel type, oil was still the most consumed fuel, particularly for the transport sector, accounting for about half of the total energy demand, followed by gas with 22.7% share, electricity with 22.4% share, and coal with 3.9% share. Oil consumption went down by 5.1% from a year-ago level of 23 943 toe to 22 716 toe. On the other hand, natural gas consumption expanded by 19.8% due to the increase in demand of petrochemical industry (EC, 2013).

ENERGY INTENSITY ANALYSIS

Table 3: Energy Intensity Analysis

Energy	Energy Intensity (Toe/Million USD)		Change (%)
	2011	2012	2011 vs. 2012
Primary Energy	128.79	122.02	-5.3
Final Energy Demand	73.02	71.06	-2.7
Industry	22.49	24.38	8.4
Transportation	28.71	24.12	-16.0
Others	21.82	22.56	3.4

Source: (EDMC, 2014).

The economy's real GDP growth (USD 2010 Price and 2010 PPP) of 5.6% in 2012 resulted in primary energy intensity of 122.02 tonnes of oil equivalent per USD million GDP (toe/USD million), a decline of 5.3% from previous year's energy intensity, while final energy consumption dropped by 2.7%.

By sector, the industry sector consumed more energy per output as the energy intensity accelerated by 8.4%. However, the transport's energy intensity fell by 16.0% from the level a year ago, which may be attributed to the increasing use of more efficient alternative fuels or technologies for transport. The other sectors' energy intensity demonstrated that the higher energy intensity increased by 3.4% from the 2011 level.

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

Malaysia's National Energy Policy, which was first formulated in 1979, serves as the overall framework for the development of the energy sector and consists of the following three (3) principal objectives:

- **The Supply Objective:** To ensure the provision of an adequate, secure and cost-effective supply of energy through the development of indigenous energy resources and diversification of energy supply from domestic and international sources;
- **The Utilisation Objective:** To promote efficient utilisation of energy and to discourage wasteful and non-productive patterns of energy consumption; and
- **The Environmental Objective**: To minimise the negative impacts of energy production, transportation, conversion, utilisation and consumption on the environment (KeTTHa, 2010).

This policy has been instrumental in the development of Malaysia's energy sector. Subsequent policies are designed to support these objectives and their implementation.

In 1980, the National Depletion Policy was enacted to safeguard and preserve the economy's energy resources, particularly its oil and gas resources. Under this policy, total annual production of crude oil should not exceed 3.0% of "oil initially in place," which effectively limits the production of crude oil to 650 mbbl/d. The policy also extended to the production of natural gas imposing a limit of 2000 million standard cubic feet (56.6 mcmd) in Peninsular Malaysia (UNPAN).

After a year, the economy introduced the Four-Fuel Diversification Policy to expand the fuel mix for power generation. Initially, the focus of the policy was to reduce the economy's dependence on oil as the dominant energy source. It likewise aimed to optimise the fuel mix for power generation, which consists of four (4) fuels—oil, gas, coal and hydro. With this policy, the contribution of oil in power generation significantly reduced and was replaced with gas and coal. The scope of the Four-Fuel Policy was further

expanded in 2001 through the implementation of the Fifth-Fuel Diversification Policy, which incorporated renewable energy (e.g. such as biomass, solar and mini-hydro) as the fifth fuel.

In support of the Fifth-Fuel Policy, the National Biofuel Policy was launched in 2006 to diversify fuel for non-power sectors, specifically for the transport sector, and also to reduce dependence on fossil fuels. The policy mandates a 5.0% biodiesel blend from processed palm oil with diesel fuel. To ensure effective implementation of the policy, the economy sets industry quality standards for diesel, as well as encourages investment in building additional biodiesel plants to stimulate production.

The National Renewable Energy Policy and Action Plan (NREPAP) was formulated in 2009 as the policy framework to advancing the development of indigenous renewable energy and expand its contribution to the power generation mix. The NREPAP provides long-term goals and holistic approach for sustainable development of renewable energy with the following policy objectives:

- To increase RE contribution in the national power generation mix;
- To facilitate the growth of the RE industry;
- To ensure reasonable RE generation costs;
- To conserve the environment for future generations; and
- To enhance awareness on the role and importance of RE.

The NREPAP intends to accelerate the renewable energy power capacity to 2,080 MW (11.3 GWh) by 2020 and 4,000 MW (17.2 GWh) by 2030, contributing 11% and 17% share, respectively, to the total generation mix. Such targets could bring about an estimated cumulative CO_2 avoidance of 42.2 million tonnes (mmt) in 2020 and 145.2 mmt in 2030 (APERC, 2014).

The Tenth Malaysia Plan (2011-2015), the government's latest five-year economic plan published in 10 June 2010, includes the New Energy Policy, which consists of short-and medium-term energy strategies with emphasis on energy security, economic efficiency, and environmental and social considerations. The New Energy Policy has identified five (5) strategic pillars:

- Strategic development of energy supply by diversifying energy resources to include renewable energy resources, as well as nuclear to be considered as an alternative energy option;
- Rationalise pricing through adoption of market-based energy pricing;
- Accelerate energy efficiency implementation;
- Strong governance; and,
- Managing change through integrated approach (EPU, 2010 and 2010b).

ENERGY SECTOR STRUCTURE

Petronas owns Malaysia's oil and gas reserves. It is a government-owned corporation created under the Petroleum Development Act of 1974, which holds the exclusive rights for exploration and production of petroleum, as well as the responsiblity for the planning, investment and regulation of the upstream sector. Foreign and private companies can only operate through a production-sharing contract (PSC) with Petronas.

On the other hand, the economy's power industry is dominated by three (3) vertically integrated utilities, namely: Tenaga Nasional Berhad (TNB) serving Peninsular Malaysia, Sabah Electricity Sendirian Berhad (SESB) in Sabah state and Sarawak Energy Berhad (SEB) in Sarawak state. These utilities undertake electricity generation, transmission, distribution and supply activities in their respective areas. TNB is the largest power utilities, which is publicly listed, while SESB is a subsidiary of TNB with 80% owned by TNB and 20% by the State Government of Sabah. SEB is wholly-owned by the Sarawak State Government (Hapua, 2013). Various independent power producers (IPPs), dedicated power producers and co-generators complement the three utilities.

The key ministries and government agencies for the economy's energy sector are (APERC, 2014):

- The Energy Planning Unit sets the general direction and strategies for the economy's energy policies.
- The Ministry of Energy, Green Technology and Water, formulates plans and implements policies, programmes and projects of the energy sector covering electricity supply, development of renewable

energy and promotion of energy efficiency, among others. Part of its role is the formulation of energy policy in coordination with the EPU.

- The Energy Commission is a statutory body established in 2001 to serve as a regulator for electricity and piped gas supply industries in Peninssular Malaysia and Sabah. The commission's main functions are to provide technical and performance regulations for the electricity and piped gas supply industries, to act as the safety regulator, and to protect consumers by ensuring the quality of services and the supply of electricity and piped gas, and at reasonable prices.

ENERGY SECURITY

The New Energy Policy under the Tenth Malaysia Plan outlines the strategic approaches to improve energy supply security. One of the measures identified is the diversification of energy resources, specifically increasing the contribution of renewable energy in primary energy and power generation mix. Nuclear energy has also been considered as a possible energy supply option for the economy in the future.

Another measure to improve energy security is through importing liquefied natural gas (LNG). The economy is confronting the issue of the geographic disparity of the natural gas supply and demand among its regions. The Western of Peninsular Malaysia is requiring more natural gas supply for power and industrial uses, while Sawarawk and Sabah are producing natural gas but lack local demand. To address these concerns, LNG Regasification Terminals (RGTs) are being put up to increase the supply security thorugh imports of LNG from the global gas market (EIA, 2014). The economy completed its first RGT in Malacca (Melaka), which commenced operation in May 2013 with a capacity of 2 x 130,000 cubic metres with an annual storage volume of 3.8 million mt (15 mcmd) (Petronas, 2012). The RGT will improve the security of the natural gas supply in Peninsular Malaysia and can also accommodate LNG importation. The building of a second RGT is planned for Johor in the Peninsular Malaysia as part of the Pengerang Integrated Petroleum Complex (PIPC), which also comprises the Refinery and Petrochemical Integrated Development (RAPID) project. The PIPC is seen to be the next regional downstream oil and gas industrial hub in Asian region (Petronas, 2014). A third RGT is proposed for Lahad Datu in Sabah to fuel a 300-MW power plant (EIA, 2014).

Regional energy cooperation under the Association of Southeast Asian Nations (ASEAN) framework also addresses energy security. Among the agreements reached on energy security is the ASEAN Petroleum Security Agreement (APSA) signed in 1986 and updated in 2009 to further enhance petroleum security in the ASEAN region. The ASEAN members through the Trans-ASEAN Gas Pipeline Project (TAGP) and the ASEAN Power Grid Project (APG) have also entered into interconnection cooperation agreements on power and natural gas. The TAGP will provide the region with a secure supply of natural gas by way of interconnection of gas pipelines and associated infrastructure. The economy may serve as a hub in the TAGP given its location and extensive natural gas infrastructure (EIA, 2014). The APG will integrate the power grids of ASEAN members for regional sales of electricity, which will also optimise the development of energy resources in the region.

GREEN TECHNOLOGY POLICY

In pursuing low-carbon economy, Malaysian government launched the National Green Technology Policy in July 2009, which serves as the basis for all Malaysians to enjoy an improved quality of life, by ensuring that the objectives of the national development policies will continue to be balanced with environmental consideration. The policy is built on four pillars i.e.:

- **Energy** – *Seek* to attain energy independence and promote efficient utilisation;
- **Environment** – To conserve and minimise environmental impacts;
- **Economy** – To enhance economic development through the use of green technology;
- **Society** – To improve quality of life for all.

Four sectors have been identified as the primary focus of the policy:

- **Energy.** Application of green technology in power generation and in energy supply-side management, including cogeneration by the industrial and commercial sectors, in all energy-consuming sectors, and in demand-side management programs;
- **Buildings.** Adoption of green technology in the construction, management, maintenance and demolition of buildings;

- **Water and waste management.** Use of green technology in the management and use of water resources, wastewater treatment, solid waste and sanitary landfill; and,
- **Transport.** Incorporation of green technology into transportation infrastructure and vehicles, in particular biofuels and public road transport (KeTTHA, 2011).

Among the policy's long-term goals include: infuse in the Malaysian culture the green technology and significant reduction of energy consumption. Malaysia has joined the global endeavour by earmarking to promoting Green Technology through the establishment of the Ministry of Energy, Green Technology and Water in April 2009 replacing the Ministry of Energy, Water and Communication. In addition, the Malaysian Energy Centre was restructured into the Malaysian Green Technology Corporation, becoming the lead agency of the Ministry for the promotion, development and implementation of green technology.

The -Green Technology Master Plan is formulated to provide strategic directions for the implementation of the green technology policy and to realise its aspirations and goals. The Master Plan also serves as a guiding reference in developing action plans, programmes and projects for the 11th and 12th Malaysia Plan.

The Green Technology Financing Scheme (GFTS) launched in 2010 with allocated government fund amounting to MYR 1.5 billion (USD 427 million), is a special financing scheme for soft loans to companies that produce and utilise green technology. As of the end of December 2012, 102 projects have been granted certification under GTFS. Due to the overwhelming response on GTFS, the government allocated another MYR 2 billion (USD 570 million) for the scheme to be utilised until December 2015 (GreenTechMalaysia, 2013). By December 2014, RM 2.04 billion has been approved under the Green Technology Financing Scheme.

The introduction of) MyHIJAU Labelling Programme will ensure the availability of green products and services to be on par with international standards and regulations. This includes the National Eco Labelling Program to certify eco-friendly domestically manufactured products, and the Energy Star Rating certification for energy-efficient home appliances.

The Green Building Index (GBI) has also been developed as a rating tool to promote green technology in the building sector. It also intends to raise awareness for developers and building owners to design and construct green and sustainable buildings. A GBI certificate is being granted to developers and building owners who have satisfied the standards in six (6) areas: energy efficiency, indoor environmental quality, sustainable site planning and management, materials and resources, water efficiency, and innovation. Building owners acquiring GBI certificates from 24 October 2009 to 31 December 2014 will be given income tax exemptions equivalent to the additional capital expended in obtaining such certificates. Meanwhile, buyers purchasing buildings or house with GBI certificates from developers will be given stamp duty exemptions on instruments of transfer of ownership. Such exemption is the amount equivalent to the additional cost incurred in obtaining the GBI certificates. The exemption is given to buyers who execute sales and purchase agreements from 24 October 2009 to 31 December 2014.

Other initiatives being implemented are the Government Green Procurement (GGP) and Green Township projects. The GGP integrates environmental considerations in the public sector procurement process to protect the natural environment, conserve resources and lessen the harmful effects of human activities. By 2020, the GGP will be implemented in all government offices, and will ensure that 20.0% of the public sector's purchases of products and services are green -labelled. The Green Township advocates for the adoption of "Low Carbon City Framework (LCCF)" by the city councils, developers and town planners. The project provides a systematic process and strategies for reducing carbon emission in urban developments (GreenTech-Flagship and Ongoing Projects).

ENERGY MARKETS

MARKET REFORM

Malaysia's energy market is under a regulated environment and the government provides subsidies to energy consumers. However, the economy will be embarking on implementing energy market reforms as postulated in the Tenth Malaysia Plan through the gradual removal of energy subsidies. As a strategy to rationalise subsidies, the plan states that gas prices for both power and non-power sectors will be revised every six (6) months to gradually reflect market-based prices. The approach would be to unbundle energy bills to itemise subsidy values, which will eventually delink subsidies from energy use. The first round of subsidy cuts for the power sector's natural gas prices has been in place since 1 June 2011. As a social safety net, government assistance in different forms will be extended to low-income households and other groups. To institutionalise greater market discipline, other measures like separate accounting for

generation, transmission and distribution activities, performance-based regulations and review and renegotiation of power purchase agreements will also be pursued (EPU, 2010).

As part of the market reform and to move towards a better regulation, the Energy Commission will start to impose Incentive Based Regulation (IBR) on the utility companies. TNB, as the largest utility company in the economy, will be the first company that need to abide to the IBR which it will be later on expanded to other utility companies. IBR is a mechanism or methodology to determine the electricity tariff, focusing more efficiency gains and a structured process in tariff evaluation. It is considered as an effective mechanism that being used globally, sometimes called as performance-based regulation. Through the IBR implementataion, only the efficient cost (CAPEX and OPEX) in electricity electricity supply will be accounted in the tariff calculation. The IBR is expected to benefit both, the utility companies as well as the consumer in terms of electricity tariff (EC, 2013).

UPSTREAM ENERGY DEVELOPMENT

As the Malaysia's oil and gas basins are becoming mature fields, the government, through Petronas, has intensified exploration efforts in more challenging fronts of underexplored deepwater and ultra deepwater, high pressure, high temperature (HPHT) and high CO2 fields. In 2013, 100 active production-sharing contracts (PSC) are in operation as a result of having favourable upstream investment environment—stable fiscal environment, commercial and tax incentives, infrastructure support, and availability of local-based service companies that support upstream activities. PSC is a sort of public-private partnership model where Petronas holds the public responsibility and the contractors take on the private interest. The year also saw 10 new discoveries with estimated additional reserves of 0.98 billion barrel of oil equivalent (boe). To date, about 30 players are already engaged in upstream activities in the economy, which include eminent international oil exploration companies (Petronas, 2013).

To aggressively encourage players to explore and develop marginal fields, Petronas introduced a variation of the PSC in 2011 known as Risk Service Contract (RSC). The RSC involves risk shared between Petronas, the project owner and contractor. Under this service contract model, the contractors will provide the upfront capital expenditure (capex), but the capex will be reimbursed upon first commercial production. The contractor will also be entitled to a Remuneration Fee per barrel from a pre-determined percentage of the field revenue. There are already four awarded RSCs with the first RSC (Berantai Field) commenced gas production in 2012. The other two RCS—the Balai Cluster awarded in 2011 and Kapal Banang Meranti in 2012—also showed significant progress and expected their first hydrocarbon production in 2013 (Petronas, 2013).

In 2013, the economy's total reserves increased slightly by 1.5% to 22.57 billion barrels of oil equivalent (boe) from 22.24 billion boe a year ago. It may be noted that in 2012 total reserves ALSO went up by 4.4% from its 2011 level. The top two new notable discoveries in 2012 were the Kasawari gas field and Kuang North. Such accomplishments were achieved through improved gas recovery (IGR), improved oil recovery (IOR) and enhanced oil recovery (EOR) projects.

ELECTRICITY AND GAS MARKETS

Malaysia's electricity supply industry is monopolistic in nature as it is vertically integrated where each of the utility companies (TNB, SESB and SEB) undertakes generation, transmission and distribution of electricity in its respective region. However, there are IPPs operating and providing a portion of electricity supply to utility companies. All electricity utilities have government stake—as government-owned or as a main shareholder. The industry is highly regulated and governed by several institutions (EPU, KeTTHa and ST) with each having specific functions and jurisdiction.

In view of the global energy prices volatility and declining domestic gas production, the economy will continue its efforts to ensuring greater electricity supply and a sustainable electricity supply system as adopted under the Tenth Malaysia Plan. Further, the Plan also espouses the importance of enhancing productivity and efficiency of utility providers. Strategies identified in the Plan for having a reliable and stable electricity supply industry include: increasing and diversifying generation capacity; strengthening transmission and distribution networks; restructuring the electricity supply industry; and, improving customer service delivery.

In order to increase and diversify its generation capacity, the economy will aggressively develop alternative sources of energy, specifically hydro, and increase coal and LNG importation by 2015. There are plans to expand the generating capacity of coal-fired power plants in Peninsular Malaysia and Sarawak using more efficient coal technology, which inlcude supercritical or ultra supercritical technology. This new technology will reduce CO_2 emission from coal-fired power plants (EPU, 2010). Nuclear energy will

also be explored as a long-term option for electricity generation. It may be recalled that prior to the Fukushima incident the economy considered building nuclear power facilities by 2021 (EIA, 2014).

On the other hand, transmission and distribution systems will be expanded and improved to minimise losses. The System Average Interruption Duration Index (SAIDI) will be put in place by 2015 to enhance supply reliability from 68 to 50 minutes per customer per year in Peninsular Malaysia. The possible application of Smart Grid system will be studied and considered to reduce losses and costs, as well as increase reliability (EPU, 2010).

The gradual reduction of the subsidy for gas would eventually allow for the adoption of a market price level for gas, which is expected to have a significant effect on the electricity supply industry. Currently, gas for power generation supplied by the Peninsular Gas Utilisation (PCU) pipeline system is heavily subsidised by the government. Other reforms will likewise be implemented such as the introduction of performance-based regulation, the renegotiation of power purchase agreement, and separate accounting (unbundling) for generation, transmission and distribution activities.

The use of new technologies and performance-based regulation will be instituted to accelerate delivery of services by utilities to new and existing customers like faster and better response for new electrical connections and in restoration of supply interruptions.

In addition, access to electricity supply in rural areas will be extended through grid expansion and alternative systems, such as mini hydro and solar hybrid. By 2015, the coverage of the electricity supply, on household basis, is targeted to be nearly 100% in Peninsular Malaysia and 99% in Sabah and Sarawak (EPU, 2010).

ENERGY EFFICIENCY

Energy efficiency has been an important element in the Malaysia's plan and energy policy. The Tenth Malaysia Plan incorporates energy efficiency measures to realise energy savings potential, as well as reduce CO2 emissions and dependency on fossil fuels. Energy efficiency strategies are categorised per demand sectors as follows:

- **Residential sector:** Phasing out of incandescent light bulbs by 2014 to reduce energy usage and carbon dioxide emissions. And, increasing energy performance labelling from four (air conditioner, refrigerator, television and fan) to ten electrical appliances (six additional appliances—rice cooker, electric kettle, washing machine, microwave, clothes dryer and dishwasher) to enable consumers to make informed decisions as they purchase energy efficient products.
- **Township:** Introduction of guidelines for green townships and rating scales based on carbon footprint baseline and promoting such townships, starting with Putrajaya and Cyberjaya.
- **Industrial:** Increasing the use of energy efficient machineries and equipment such as high efficiency motors, pumps and variable speed drive controls. And, introducing minimum energy performance standards for selected appliances to restrict the manufacture, import and sale of inefficient appliances to consumers.
- **Buildings:** Revising the Uniform Building By-Laws to incorporate the Malaysian Standard: Code of Practice on Energy Efficiency and Renewable Energy for Non-Residential Buildings (MS1525). This allows for integration of renewable energy systems and energy saving features in buildings. Wider adoption of the Green Building Index (GBI) to benchmark energy consumption in new and existing buildings. Increasing the use of thermal insulation for roofs in air-conditioned buildings to save energy (EPU, 2010).

A National Energy Efficiency Master Plan (NEEMP) under formulation with the primary aim of promoting and implementing energy efficiency measures in a well-coordinated and cost-effective way in the industrial, commercial and residential sectors. This is in line with the policy direction of 'Promoting Energy Efficiency to Ensure Productive Use of Energy and Minimise Waste to Contribute to Sustainable Development and Increase Welfare and Competitiveness.' The NEECMP is crafted based on five major thrusts, which include:

- Establishing an overall long-term national plan for energy efficiency;
- Strengthening implementation capacity to promote energy efficiency;
- Creating adequate and sustained funding mechanism for energy efficiency;
- Implementing energy efficiency programmes; and

- Enabling commercial finance institutions to support energy efficiency.

Likewise, the NEEMP proposes five key initiatives on energy efficiency programmes, which are: rating and labelling of applicances; minimum energy performance standards (MEPS); energy audits and management in buildings and industries; energy efficient building design; and, a support programme to cover additional costs of efficienct technology. The overall target of the plan is to reduce electricity consumption by 6.0% over the 10 years during which the Plan is implemented (APERC, 2011).

RENEWABLE ENERGY

Malaysia's Fifth-Fuel Policy in 2001 recognised the importance of renewable energy and adopted as the fifth fuel in the energy supply mix together with natural gas, oil, hydro and coal. Under the Tenth Malaysia Plan, the economy sets a target of 985 MW additional capacity from renewable energy resources by 2015 to come from biomass (330 MW), biogas (100 MW), solid waste (200 MW), mini-hydro (290MW), and solar photovoltaic (65 MW) sources. These capacity additions from renewable are expected to contribute 5.5% to the total generation mix.

The National Renewable Energy Policy and Action Plan (NREPAP) in 2009 paved the way for the enactment of two (2) important legislations, the Renewable Energy Act 2011 and the Sustainable Energy Development Authority (SEDA) Act 2011. The primary role of SEDA is to administer and manage the implementation of the feed-in-tariff (FIT) mechanism as mandated in the Renewable Energy Act 2011. FIT is a fixed premium payable for each unit of renewable energy sold to distribution utilities, which is a guaranteed return on investments for the RE players. FIT eligible renewable energy resources are biomass, biogas, small hydro and solar photovoltaic.

CLIMATE CHANGE

Malaysia is a signatory to the United Nations Framework Convention on Climate Change (UNFCC) and ratified it on 17 July 1994. The National Climate Committee was established in 1995 composed of various government agencies and stakeholders from business and civil society groups to guide national responses to climate change mitigation and adaption. At the 2009 Climate Change Summit in Copenhagen, Malaysia's Prime Minister made a pledge for a voluntary reduction of up to 40% of CO2 emission intensity of GDP by 2020 compared to 2005 levels. However, the reduction is conditional on financial and technical assistance from Annex 1 partners (developed countries) corresponding to what is required to realise the goal. To support the said goal, two signicant policies were approved in 2009—the National Green Technology Policy and the National Climate Change Policy—to strengthen the national agenda on environmental protection and conservation.

The National Climate Change Policy has three main objectives. First to mainstream measures to address climate change through efficient management of resources and enhanced environmental conservation resulting in strengthened economic competitiveness and improved quality of life. Second, integration of resposnes into national policies, plans and programmes to strengthen the resilience of development from arising and potential impacts of climate change. Third, strengthening of institutional and implementation capacity to better harness opportunities in reducing negative impacts of climate change. The Policy outlines 10 strategic thrusts and 43 key actions based on five principles:

- **Development on a Sustainable Path.** Integrate climate change responses into national development plans to fulfil the aspiration for sustainable development.
- **Conservation of Environmental and Natural Resources.** Strengthen implementation of climate change actions that contribute to environmental conservation and sustainable use of natural resources.
- **Coordinated Implementation.** Incorporate climate change considerations into implementation of development programmes at all levels.
- **Effective Participation.** Improve participation of stakeholders and major groups for effective implementation of climate change responses.
- **Common but Differentiated Responsibilities and Respective Capabilities**. International involvement in climate change issues will be based on the principle of common but differentiated responsibilities and respective capabilities (NRE, 2009).

The Tenth Malaysia Plan also stressed the efforts to address the challenges of climate change by developing a roadmap for climate resilient growth covering adaptation and mitigation approaches. In reducing the economy's carbon footprints, efforts will focus on the development of renewable energy, promotion of energy efficiency, forest conservation and solid waste management.

NOTABLE ENERGY DEVELOPMENTS

IMPLEMENTATION OF THE B7 (BIODIESEL) PROGRAMME FOR THE SUBSIDISED SECTOR

B7 programme (blending of 7% palm biodiesel with 93% petroleum diesel) for the subsidised sector will be implemented in Peninsula in stages beginning November with Sarawak, Sabah and Wilayah Persekutuan Labuan by December 2014. 4. This programme will consume 575,000 tonnes of biodiesel and it is expected to contribute towards a savings of 667.6 million litres of diesel a year. The move to implement B7 has positioned Malaysia at par with other nations in the use of renewable energy sources (MPIC, 2014).

INTRODUCTION OF MANAGED FLOAT SYSTEM FOR FUEL PRICING

The Malaysian Government announced to completely remove the subsidies for fuel (Petrol RON 95 and diesel) beginning 1 December 2014. The price of fuel will be fixed accordingly to a managed float system whereby average price difference in the cost of the fuels in a month would determine the retail prices for the following month (KPDNKK, 2014).

PENGERANG INTEGRATED PETROLEUM COMPLEX (PIPC)

The Pengerang Integrated Petroleum Complex (PIPC) was declared a National Project of Strategic Importance during the Economic Council Meeting in February 2012 chaired by the Malaysia Prime Minister. The PICP is being developed as part of the Economic Transformation Programme to establish a dynamic oil and gas downstream industry. The project is located on a single plot of land (about 8,100 hectares) in Pengerang, Johor at the south-east tip of Peninsular Malaysia, which is strategically accessible to major international shipping lanes. To manage and administer efficiently the different projects within the PIPC, a new federal government agency has been created—the Johor Petroleum Development Corporation (JPDC).

The PICP will house oil refineries, naphtha crackers, petrochemical plants, LNG import terminal and a regasification plant. As of January 2013, two projects have been committed in the PICP area. The first is the Pengerang Independent Deepwater Petroleum Terminal (PIDPT), a deepwater oil terminal that is expected to be completed by 2020 with planned total storage capacity of five million cubic metres. Oil refineries in PICP will be value added to imported crude oil through PIDPT. The other project is the PETRONAS's Refinery and Petrochemical Integrated Development (RAPID), which will include a 300 Mbbl/d crude oil refinery to provide feedstock for the RAPID's petrochemical complex as well as produce gasoline and diesel that meet European specifications. (MPRC, 2013)

On April 2014, PETRONAS made an announcement on the Final Investment Decision (FID) for the development of the PIPC with a total investment of USD27 billion inclusive of RAPID's development and other facilities. (PETRONAS, 2014)

NEW ENERGY POLICY STUDY (2013-2050)

The Economic Planning Unit (EPU) of the Prime Minister's Office conducted a study for the formulation of an energy policy for Malaysia covering a longer horizon of 2013-2050. The objectives of the study are: to conduct a comprehensive review of energy and energy-related policies; formulate a long-term energy policy for Malaysia; and to develop the implementation plan for the energy sector. Seven working groups were established to study the broad issues in the energy sector comprising of energy security and emergency, gas and LNG, power, energy efficiency, transport, refining and petrochemicals, energy security, and even governance. The study's initial findings revealed opportunities for improvement that need to be addressed in the proposed policy. The final report of this study will include an implementation plan, policy recommendations and an energy balance model. The results of this study are expected to be part of the The Eleventh Malaysian Plan that currently is being drafted by the Economic Planning Unit. The Eleventh Malaysian Plan is expected to be unveiled by middle of 2015 by the Government of Malaysia. (EPU, 2013b).

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Energy Comission—www.st.gov.my

Ministry of Energy, Green Technology and Water—www.kettha.gov.my

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Sabah Electricity Sdn.Bhd.—www.sesb.com.my

Sarawak Energy Berhad—www.sarawakenergy.com.my

Tenaga Nasional Berhad—www.tnb.com.my

MEXICO

INTRODUCTION

The United Mexican States (*Estados Unidos Mexicanos* in Spanish), more often known simply as Mexico, is a federal republic located in North America, bordered by the United States to the north, by Belize and Guatemala to the South and by the Atlantic and Pacific Oceans. Owing to its cultural settings and historic roots, Mexico is also one of APEC's three Latin American economies.

Mexico has an approximate land area of 2.0 million square kilometers rich in biodiversity and natural resources that include oil and gas. The economy's climatic conditions range from very dry with high temperatures in the north, to very humid with high temperatures in the south, mild temperatures in the center and warm on the coasts. According to official statistics (CONAPO, 2014), Mexico's total population by mid-2013 amounted to 118.4 million, and it is expected to grow to 150 million by 2050. According to the World Bank the total population in 2013 was slightly higher, with about 122.3 million that put Mexico in the 11th place among worldwide economies, and the sixth in APEC after China, United States, Indonesia, Russia and Japan (World Bank, 2014).

Within its territory, Mexico City not only is the capital city but represents as well one of the largest urban centers in the world, with more than 20 million inhabitants living in an area that includes Mexico's Federal District and 60 surrounding municipalities spanned in other two Mexican States (INEGI, 2013). After Mexico City, the economy's most important cities are Guadalajara and Monterrey, which are respectively located in the west-central and northeastern side of the territory.

Mexico's economy is mainly composed by crude oil exports, remittances (mostly from the US), manufacturing and tourism, with the Mexican Peso (MXN) as its currency. The economy's growth between 2000 and 2012 has been meager, rising at an annual average rate barely above 2.0%, with Mexico's real gross domestic product in 2012 amounting to USD 1 878 billion in USD 2010 on a PPP basis- (EDMC, 2014). As of recently, and due to the accomplishment of significant political, fiscal and economic reforms, Mexico's economy has been stronger, growing 4.0% from 2011 to 2012 (EDMC, 2014). In line with these structural changes, official projections expect annual growth rates in Mexico's gross domestic product to reach 3.7% by 2014, 4.9% by 2015 and 5.1% from 2016 to 2020 (SHCP, 2014). In spite of the economic progress, by the end of 2012, approximately 45.0% of the Mexican population was deemed poor and 10.0% was still living under extreme poverty conditions.

The energy sector is highly relevant to the Mexican economy, and it is poised to become one of the economy's main growth levers through the structural changes recently approved. The oil sector in particular is a central component, and even though oil exports just represented 13% of Mexico's total exports in 2013, they provided one-third of the government's total revenue, of which a large share is allocated to social development expenditures (Banxico, 2014), (INEGI, 2014). As shown in Table 1, Mexico's proven primary energy reserves were 10.2 million barrels of crude oil (11.4, if gas liquids are included), 0.35 trillion cubic meters of natural gas, 1.2 billion tonnes of coal, and 2.8 thousand tons of uranium.

Table 1: Key data and economic profile

Key data[a]		Energy reserves	
Area (million sq. km)	2.0	Oil (billion barrels) [b]	10.1
Population (million)	118.4	Gas (billion cubic metres) [b]	0.4
GDP (USD (2010) billion at PPP)	1 878	Coal (billion tonnes)[c]	1.2
GDP (USD (2010) per capita at PPP)	15 542	Uranium (kilotonnes) [d]	2.9

Source: a. By mid-2013 (CONAPO, 2014); b. As of 1 January 2013; Oil reserves do not include condensates and natural gas liquids, 'Gas reserves' refers to dry gas, (PEMEX, 2013); c. At the end of 2013 (BP, 2014); d. As of 1 January 2013, 'Reserves' refers to reasonably assured resources, (NEA, 2014); for all other figures (EDMC, 2014).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Mexico's net primary energy supply in 2012 amounted to 188 514 kilotons of oil equivalent (ktoe), a 2.6% increase from 2011, mainly as a result of a higher production of oil and gas, as fossil fuels remained dominant with nearly 90.0% of the economy's primary energy supply; non-fossil sources such as nuclear power and renewable energy made up the remainder (EDMC, 2014). According to official information, by the end of 2012, Mexico's proven oil reserves were 10.1 billion barrels and proved natural gas reserves were 0.4 trillion cubic meters. Owing to these figures, Mexico was the 18th economy in the world for its oil reserves and the 30th for its natural gas reserves (PEMEX, 2013).

In 2013, Mexico produced 2.5 million barrels per day of crude oil, mostly heavy oil. In recent years, PEMEX has focused its efforts on discovering and exploiting new fields to offset the natural decline of its once largest oil asset, Cantarell, which peaked in 2004 with 2.1 million barrels per day of oil and has dropped ever since at very fast rates. Mexico is a net crude oil exporter with around half of its total indigenous crude oil production, sent overseas, especially to the United States, making Mexico the third largest oil supplier to that economy after Canada and Saudi Arabia (EIA, 2014). Mexico's National Refining System (Sistema Nacional de Refinación, or SNR) is made up by six oil refineries located across its territory (Cadereyta, Madero, Minatitlán, Salamanca, Salina Cruz and Tula). In spite of the total distillation capacity of 1.7 million barrels per day of crude oil, this infrastructure is still insufficient to meet the domestic market's demand for oil products, which has resulted in Mexico being a net oil product importer, especially of gasoline. In 2013, about 43.0% of the economy-wide gasoline demand was met through imports (Secretaria de Energia, 2014b).

Mexico's proven natural gas reserves at the beginning of 2013 totaled 0.4 trillion cubic meters, with production in the same year reaching 0.2 billion cubic metres per day, of which roughly 70.0% was associated with crude oil production. As a net natural gas importer, Mexico looks forward to boosting its domestic gas resources, including shale gas, although these efforts have yielded few results so far and depend on the success of the energy reform. Due to the lower levels in the Henry Hub marker price, which is used as a reference to set gas prices in Mexico, demand in the industrial and electricity generation sectors has expanded substantially in recent years, leading to a rapid growth in the natural gas imports of about 9% from 2012 to 2013, reaching nearly 66 million cubic meters (CRE, 2014). More than half of these imports came by pipeline from the United States, while the rest were received as liquefied natural gas (LNG) from shipping tankers arriving to Mexico's three regasification terminals, two of them in located in its Pacific Coast (Ensenada, Baja California and Manzanillo, Colima) and another one in its Atlantic Coast facing the Gulf of Mexico (Altamira, Tamaulipas).

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	218 999	Industry sector	30 197	Total	293 862
Net imports and other	-22 885	Transport sector	52 411	Thermal	240 916
Total PES	188 514	Other sectors	34 407	Hydro	31 855
Coal	9 183	Total FEC	117 015	Nuclear	8 770
Oil	102 006	Coal	1 746	Geothermal	12 321
Gas	58 487	Oil	73 796	Others	293 862
Other	18 838	Gas	14 445		
		Electricity and other	27 028		

Source: (EDMC, 2014).

COAL

In Mexico, coal represents only a small proportion of the total primary energy supply, equivalent to less than 5.0% in 2012, or 9 183 ktoe (EDMC, 2014). Most of Mexico's recoverable coal reserves of 1.2 billion tons are located in the state of Coahuila in the northeastern part of its territory, while some significant additional resources are found in Sonora in the northwest and Oaxaca in the south. Around 71.0% of the recoverable reserves are of anthracite and bituminous types, while 29.0% are of sub-bituminous and lignite types (BP, 2014).

ELECTRICITY

Electricity generation in Mexico amounted to nearly 294 terawatt hours (TWh) in 2012, with the majority coming from thermal power plants (EDMC, 2014). In 2013, the total installed power capacity for public service was of 54 035 megawatts, an increase of 920 megawatts from 2012, as a result of new power plants and also upgrades. A little more than three-quarters of this capacity for public service was run by the state-owned utility Federal Electricity Commission, with the remainder coming from independent power producers (IPPs). This capacity was made up by thermal power plants (including combined cycle technologies from IPP generators) with 68.6%, hydropower with 21.4%, coal-fired thermal plants with 4.8%, nuclear with 2.6%; geothermal with 1.5%, wind with 1.1% and solar photovoltaic with 0.01%.

FINAL ENERGY CONSUMPTION

Mexico's total final energy consumption in 2012 was 117 015 ktoe, a slight increase of 0.8% from 2011. By energy source, oil-based products accounted for 63.1%; electricity and others for 23.1%; natural gas for 12.3% and coal for 1.5% (EDMC, 2014). This structure remained very similar to that of the previous year. By use, the bulk of final energy consumption in 2012 was located in the transport sector (44.8%), the residential, commercial and agricultural sectors altogether (29.4%) and the industry (25.8%) sectors.

ENERGY INTENSITY ANALYSIS

In the last decades, Mexico has implemented several actions to improve its energy efficiency, with a cumulative positive effect on its energy intensity levels. As shown in Table 3, from 2012 to 2013, energy intensity declined more than 1.0% considering the economy-wide's energy supply. As for the final energy demand, the effects were deeper, with total energy demand intensity dropping 3.1% in 2013 when compared to 2012. Likewise, for the same period, energy intensity across all final sectors went down, with 5.0% for the residential, commercial and agricultural sectors altogether, and 3.2% for the transportation sector. Not shown in the Table below, the decline of energy intensity from 2005 to 2012 was 6.1% for the primary energy supply and 6.6% for the final energy demand, which confirms a descending trend in Mexico.

Table 3: Energy Intensity Analysis, 2012

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	101.7	100.4	-1.3
Final Energy Demand	64.3	62.3	-3.1
Industry	16.2	16.1	-0.7
Transportation	28.8	27.9	-3.2
Others	19.3	18.3	-5.0

Source: (EDMC, 2014).

ENERGY POLICY OVERVIEW

ENERGY POLICY FRAMEWORK – ENERGY REFORM 2013

In the last decade, Mexico had made some significant changes to reorient its energy policy, but the set of legal modifications promulgated by President Peña Nieto on 20 December 2013 has transformed the energy sector. This reform represents an ambitious milestone of constitutional reforms that strengthen the capabilities of Mexico's energy sector by complementing the state-owned energy companies with private participation across the oil and gas and electricity value chains. In this way, the energy sector's competitiveness is expected to improve, to ensure a steady energy supply and contribute more effectively to the benefit of the Mexican economy and population.

Mexico's energy policy is led by the Ministry of Energy (Secretaría de Energía, or SENER), which in addition to the formulation of the Strategy, is required by law to develop an Energy Sector Program with the main energy objectives and strategies to be enforced at the beginning of every six-year presidential term. The current Energy Sector Program in force until 2018 set several short and medium term actions to remove the hurdles hampering energy supply, to promote the development of energy infrastructure, and to foster the efficiency and modernisation of regulatory institutions and state-owned companies. In that sense, such objectives seem to have leapfrogged significantly through the attainment of the energy reform.

With the reforms introduced, the Ministry of Energy is strengthened as the head of the energy sector as it defines the economy's energy policy. In the oil and gas industry, it will adjudicate assignments to Petróleos Mexicanos (PEMEX), and award permits related to oil and natural gas processing. As for exploration and production activities, the Ministry will select the areas and design the technical guidelines subject to public bidding. The Ministry of Finance will determine the fiscal and economic terms for oil and gas exploration and production contracts, while the National Hydrocarbons Commission will award those contracts and authorise the working plans stemmed from them.

Specifically, the energy reform strives to:

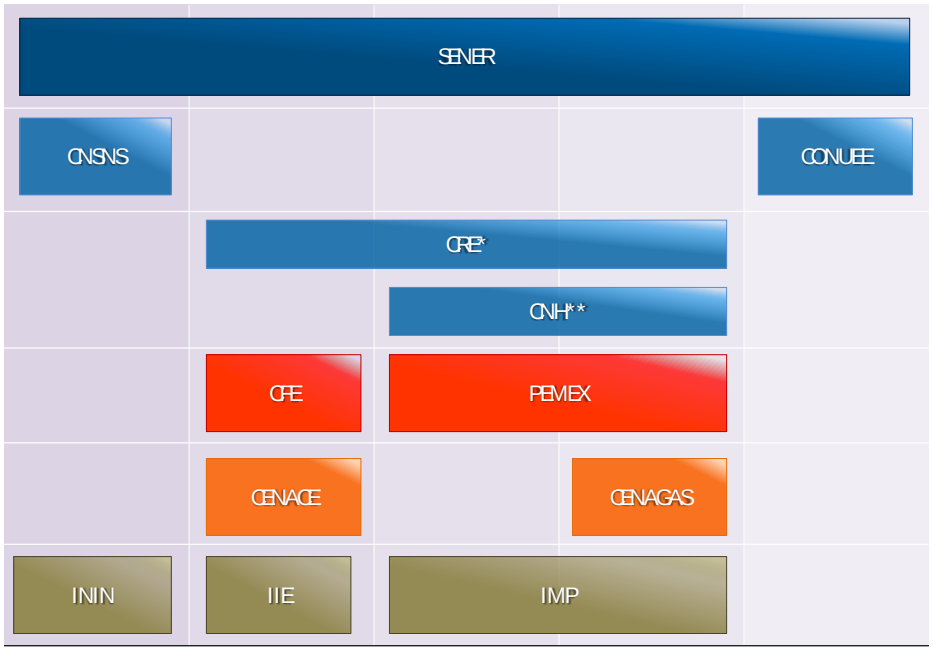
- Strengthen the economy's energy supply at more competitive prices;
- Foster economic development including social and environmental responsibility considerations;
- Accomplish international standards in the economy-wide energy supply in terms of efficiency, quality and reliability; and
- Improve the transparency and accountability throughout the energy sector's activities.

To that end, the following major changes were brought about:

- The reform to articles 25, 27 and 28 of the Mexican Constitution reaffirms the Mexican member economy government's ownership of all hydrocarbons in the subsoil and introduces more competition in the energy sector.
- To promote more investment inflows that foster Mexico's development, in addition to the state productive enterprises, private companies are allowed to participate in the production and refining of oil, as well as transport, storage and distribution of oil, natural gas, gasoline, diesel, other oil products and the entire petrochemical value chain. In the electricity industry, with the exception of nuclear energy, private parties are allowed to participate in electricity generation and marketing activities under state regulation. Concerning transmission and distribution, private parties may participate under contract with the Federal Electricity Commission (CFE in Spanish), which will be restructured with clear and transparent rules.
- In their new character as 'state productive enterprises', PEMEX and CFE will be able to strengthen their capabilities without being privatised. The technical, managerial and budgetary autonomy given to these enterprises will allow them focus on the creation of economic value and maximisation of Mexico's income while ensuring social and environmental equality as well as accountability.
- To strengthen the regulation of the energy sector, the National Hydrocarbons Commission (CNH in Spanish) and the Energy Regulatory Commission (CRE in Spanish) became coordinated regulatory organisms with own legal personality, technical and management autonomy, and budgetary self-sufficiency.
- To ensure that assignments and contracts granted to public and private enterprises contribute to the economy-wide industry, legislation will be required to establish minimal percentages of domestic content. Private investment must promote the inclusion and development of domestic and local suppliers in the value chain of the entire industry.
- To enhance transparency, several mechanisms will be implemented, including external audits and citizens participation to verify the payments made to companies.

To facilitate the understanding of the new institutional arrangement of Mexico's energy sector, and its areas of influence, a schematic representation is shown in Figure 1 and its elements are examined in the sections below.

Figure 1: Institutional arrangement of Mexico's energy sector after the legal reform



SENER	Ministry of Energy
CNSNS	National Commission for Nuclear Safety and Safeguards
CONUEE	National Commission for Efficient Energy Use
CRE	Energy Regulatory Commission. * In the oil and gas industries its regulation is applicable only to the midstream and downstream segments.
CNH	National Hydrocarbons Commission. ** In the oil and gas industries its regulation is applicable only to the upstream segment.

CFE	Federal Electricity Commission
PEMEX	Petróleos Mexicanos
CENACE	National Center for Energy Control
CENAGAS	National Center for Natural Gas Control
ININ	National Institute for Nuclear Research
IIE	Electricity Research Institute
IMP	Mexican Petroleum Institute

Source: (APERC, 2014 based on México – Gobierno de la República).

OIL AND GAS

Under the previous legal framework, PEMEX was Mexico's only operator across the oil and gas value chain and the actor responsible for nearly all the final distribution of most oil products in the economy. Prior to the energy reform, the Political Constitution granted the State absolute ownership of oil and gas resources as well as the duty to exploit them across the value chain exclusively through PEMEX, which blocked upstream oil and gas activities to private participants since the nationalisation of the petroleum industry in 1938. Considering this background and the chronic underinvestment that led to obsolete technology and infrastructure, the energy reform looked forward to capitalising on Mexico's resources through the introduction of private competition that would complement PEMEX's activities, especially in the riskiest and most capital-intensive development projects like deep-water oil and shale gas.

With the reform enacted, the State can perform hydrocarbon exploration and extraction activities through assignments and contracts with PEMEX, private operators, or both parties in association. Four types of combinable contracts for hydrocarbons are established: services, profit sharing, production sharing, and licenses. In particular, the last three will allow the transfer to contractors of the geological and financial risks involved in the exploration and extraction activities. To preserve PEMEX's assets and value

creation in this new institutional arrangement, it was provided with a round zero, a new tax regime and best corporate governance practices.

In terms of regulation, with its new capacities, the CNH will perform public biddings on hydrocarbons, to determine winners and administer the incumbent contracts. The CNH is also responsible for the quantification of Mexico's oil and gas potential and geological records, for the announcement, tendering and signing of exploration and production contracts and oversees the technical issues related to all the permits awarded to maximise the economy's rent perceived for its hydrocarbons. In line with the competition introduced, a National Center for Natural Gas Control (CENAGAS in Spanish) was created to administer, coordinate and manage efficiently and independently the pipeline grid and the storage of natural gas. It will act as an independent transmission operator

In addition, the Mexican Fund of Petroleum for Stabilisation and Development was created to safeguard, manage and distribute the income produced from hydrocarbons assignments and contracts, with the exception of taxes. The Fund is a trust within Mexico's Central Bank, with a Technical Committee made up of four independent board members and three members from the State.

ELECTRICITY

Since 1992, the public and private sector have carried out Mexico's electricity generation, due to the industry's partial liberalisation that allowed private companies to generate electricity provided that their power was either sold to CFE or used for own purposes (self-supply). However, the 2013 Energy Reform stresses the need to expand generation and retail segments so that CFE becomes more competitive and is able to regain major customers. Therefore, private generators will eventually compete with CFE for medium-sized customers.

As this Energy Reform retains state control over transmission and distribution activities, it is expected that CFE will be able to contract private companies to undertake the expansion and operation of Mexico's transmission and distribution lines, enhancing investments and introducing new technologies, which may reduce the system's losses and improve its reliability. Some of the most remarkable features of the Energy Reform are the following:

- The government's exclusive faculty to plan and control the National Electricity System is preserved in order to enhance its competitiveness and drive prices down.
- The National Center for Energy Control (CENACE) will be withdrawn from the CFE to become a public decentralised entity that will be in charge of operating the government's power system, the wholesale power market, and will guarantee open and non-discriminatory access to the government's transmission grid and distribution grids.
- The Regulatory Energy Commission (CRE) is strengthened by granting it legal personality, technical and management autonomy, as well as budgetary self-sufficiency. It will regulate the activities of the electricity industry, as well as the storage, transport and distribution of oil products through the pipeline.

NUCLEAR

Mexico is experienced in the development of nuclear energy to generate electricity, with its only plant with two nuclear reactors (Laguna Verde) in operation since 1990. As per the last edition of the National Energy Strategy, the Mexican government has not put forward any actions indicative of a stronger will to expand its nuclear-based electricity generation; it must be added that after the energy reform passed, this technology remains reserved to the State.

ENERGY EFFICIENCY

Mexico has had energy efficiency programs in place since 1989. The institution in charge of promoting these programs and providing technical advice is the National Commission for Efficient Energy Use (CONUEE in Spanish). Through Conuee, the government has driven the promotion and assessment of the sustainable use of energy. To strengthen Mexico's energy efficiency policies, and in line with the energy reform, the National Program on the Sustainable Use of Energy 2014-2018 was released on April 2014. The program was jointly created by the Ministry of Energy and Conuee, and encompasses the next general objectives:

- To design and develop programs and actions that foster an optimal energy use in the processes and activities across the energy sector.
- To strengthen the energy efficiency regulation of energy-based equipment and devices made and/or marketed in Mexico.
- To strengthen the governance of energy efficiency systems at federal, state and municipal levels including public, social, private, and academic entities.
- To promote the development of technical and technological capabilities related to the sustainable use of energy.
- To contribute to the development and dissemination of energy-saving practices among the population.
- To promote technological research and development in the field of energy efficiency.

RENEWABLE ENERGY

To achieve its goal of reducing hydrocarbon fuel dependency and integrating sustainability into the energy policy framework, the 2008 Energy Reform allowed the development of new policy and regulatory instruments to promote the introduction and growth of renewable energy, including biofuels and research activities.

In addition, derived from the Law for the Use of Renewable Energy and Finance of the Energy Transition, the Special Program for Renewable Energy Utilisation was issued in 2009 to provide the institutional framework for designing public policies in the renewable energy sector. It sets out goals and actions for promoting the use of renewable energy. The program envisions renewable energy utilisation in a sustainable way in the short and long term, with the dual goals of contributing to the economy's development and mitigating climate change effects.

ENVIRONMENTAL SUSTAINABILITY

With the structural changes achieved, the State will promote actions that protect the environment through lower carbon intensity in its domestic energy demand and supply, as well as the reduction of polluting emissions from the electricity industry. Consistent with Mexico's cross-sectorial public policies, environmental sustainability is a major component of the economy's energy planning.

In agreement with the energy reform and its precepts to minimise the negative impact to the environment, the Ministry of Energy coordinated a cross-institutional effort towards the development of the Special Program for Climate Change 2014-2018. The Program contains 38 action lines oriented to the adaptation and mitigation of climate change, from which eight of them have specific goals. According to the Program, the energy sector's impact to climate change is considerable, as it accounts for 61.0% of the mitigation commitments established.

Additionally, the energy reform created the National Agency for the Industrial Safety and Environmental Protection in the Hydrocarbons Sector, an organism attached to the Federal Ministry of Environmental but with technical and management autonomy. The Agency will be responsible of the supervision and sanction of the operators across the oil and gas value chain (upstream, midstream and downstream) in terms of industrial and operational safety; plugging and abandonment of wells and facilities; and control of polluting emissions and waste. In so doing, the Agency will look forward to complying with domestic and international technical standards.

RESEARCH AND DEVELOPMENT

In Mexico, the Ministry of Energy, through its Vice-Ministry for Energy Planning and Transition, is in charge of fostering research and development policies, which are predominantly carried out by three public research bodies: the Mexican Petroleum Institute, which supports the hydrocarbons sector; the Electricity Research Institute for electric power and energy efficiency; and the National Institute for Nuclear Research, in charge of research in nuclear-based power generation and other peaceful applications.

Energy-related research and development in strategic areas has been enhanced by the creation of two trust funds managed jointly by the Ministry of Energy and the National Technology Council (Conacyt): the Trust Fund for Hydrocarbons and the Trust Fund for Energy Sustainability. These trust funds are financed from fee payments collected from PEMEX Exploration and Production as required by the National Income Law, and they are oriented to fund scientific and applied research projects, as well as

supporting the adoption, innovation, assimilation of technological development and training of specialised human resources.

While the Trust Fund for the Hydrocarbons Sector is oriented to upstream and downstream hydrocarbon activities, including basic petrochemicals, the Trust Fund for the Energy Sustainability Sector supports clean technologies, diversification of energy sources, renewable energy sources and energy efficiency. In addition, the Trust Fund for Energy Transition and Sustainable Use, which is financed through the Federal Budget, aims to promote the use of renewable energy and energy efficiency. It supports projects for the diversification of primary energy use and energy savings in industrial and domestic activities, as well as some research projects.

NOTABLE ENERGY DEVELOPMENTS

Please note that the majority of the relevant energy achievements are encompasses in the prior sections regarding Mexico's energy sector reform.

OIL AND GAS

Aside from the scope and results brought about with the energy reform, PEMEX presented its strategies within its Business Plan 2014-18. Four action lines are included: growth, operational efficiency, corporate responsibility and management innovation. In terms of reserves, the following objectives are enforced:

- Implementing best practices in the field of primary oil recovery to manage the natural decline of fields.
- Increasing the oil recovery factor to a range of 3.0% to 8.0% from the original volume, through the implementation of best practices in the field of enhanced and secondary recovery.
- Developing a master plan for the extraction and commercialisation of extra-heavy oil fields in Mexico's marine regions.
- Hastening the production of new fields by reducing the time between their discovery and commercial development.

To underpin Mexico's natural gas supply, on December 2014, the first phase of the Los Ramones natural gas pipeline project was formally launched by President Peña Nieto. The project is an ambitious transport system with a capacity of around 34 million cubic meters per day that goes from Agua Dulce, in Texas, United States to Los Ramones in Nuevo León, Mexico. This infrastructure will strengthen Mexico's natural gas market to increase natural gas flows up to the largest consuming centers.

ELECTRICITY

Most of the Mexico's territory is covered by a single grid, although two systems remain isolated in the Baja California peninsula; altogether, these three systems form the National Electricity System (in Spanish, Sistema Eléctrico Nacional, or SEN). CFE manages all the electricity produced by private independent power producers.

Several major electricity projects were underway up to the first half of 2014, most of them related to infrastructure. This included 13 electricity generation plants, 11 of them considered of greenfield type and two of them in the brownfield category. Overall, these projects will add 1.9 gigawatts of installed capacity, with capital investments worth USD 2.6 billion. The margin reserve of the economy-wide grid was around 21.0%. During the same period, Mexico's main electricity infrastructure was made up by nearly 187.6 giga volts amps, which represented an increase of 1.5% from the first half of 2013. To catch up with the growing electricity demand, the extension of the transmission network and the number of power substations grew from the first half of 2013 in 0.2% and 2.3%, to reach more than 51 209 circuit kilometers and 385 substations.

ENERGY EFFICIENCY

Mexico was able to save more than 5 000 GWh of energy during the first half of 2014. This substantial outcome was the result of several programs, many of them implemented for long in four major areas: normalisation and standards, households, facilities (industrial, residential and commercial), and daylight savings (Horario de Verano) (Secretaria de Energia, 2014b).

RENEWABLE ENERGY

Due to its geophysical conditions, Mexico's potential for renewable energy development is very promising. To this end, the economy has promoted more intensively the development of renewable technologies for power generation, cogeneration and biofuels. By June 2014, actions relevant to be reported include:

- Pursuant to the Law for the Use of Renewable Energy and Funding of Energy Transition, the Special Program for the Use of Renewable Energy was issued on April 2014. The Program sets a goal by 2018 of 24.9% of the economy's electricity generation based on renewable energy and cogeneration technologies, considering a 2012 baseline of 14.7%. To that end, the Program set the next particular objectives:
    - To expand electricity's installed capacity and generation based on renewable energy;
    - To increase private and public investment inflows on electricity generation and interconnection infrastructure for projects based on renewable energy;
    - To expand the share of biofuels in the economy-wide energy matrix;
    - To promote the development of technology, human resources and value chain for renewable energy; and
    - To provide equal access to renewable energy by means of rural electrification, small-scale thermal use and social participation.
- Between September 2013 and August 2014, the Trust Fund for Energy Transition and Sustainable Use had approved eight projects amounting to approximately USD 86 million, centered on three major areas: energy efficiency and conservation in the residential and commercial sectors; geothermal development; and promotion of clean energy projects.
    - Through these projects 22 500 households in the States of Chihuahua, Guerrero, Michoacán and Sonora replaced their incandescent light bulbs for energy-saving fluorescent lamps; more than 5 000 firms were able to purchase highly efficient freezing and air conditioning equipment; and the implementation of two projects oriented to prefeasibility studies and the design of financial instruments for geothermal energy will help expand the use of this resource across Mexico.
- To facilitate investment inflows for renewable energy through regulatory simplification. To that effect, a goal was set to reduce the average processing time for the operation of renewable energy projects from 620 to 465 days.
- The Large-Scale Renewable Energy Project (PERGE in Spanish) was extended by the World Bank up to 30 April 2016. Launched since 2006 and funded from a donation of USD 25 million from the Global Environment Fund, the intention of this project is two-fold: it aims to reduce the greenhouse gas emissions produced from the electricity generated with conventional energy sources; and to overcome the barriers that hamper the development of markets and technologies for renewable energy.
- In step with the changes introduced with the energy reform, by the first half of 2014, two permits had been granted to private operators for geothermal development projects; one each for the modalities of self-supply and small producer. Mexico was a pioneer in the use of geothermal energy, with its first geothermal well being drilled in the 1950s. By the end of 2014, four geothermal fields were under commercial exploitation by CFE: Cerro Prieto, Los Azufres, Los Humeros and Tres Vírgenes. These private projects are expected to begin operations by the first quarter of 2015 and the first quarter of 2016, respectively, and add a joint installed capacity of 65 megawatts.
- In order to provide electricity to 33 rural communities in a number of States through a microgrid of solar photovoltaic panels, the Integral Energy Services Project under the guidance of CFE launched its first phase by putting five solar power plants in operation up to June 2014 with investments worth more than USD 3 million. The second leg was scheduled to begin operations during the second half of 2014, with capital investments of more than USD 7 million. So far, the cumulative capital investment of this project amounts to roughly USD 28 million.
- In compliance with the Law for the Use of Renewable Energy and Finance of the Energy Transition, the Ministry of Energy is responsible for the management and update of Mexico's Renewable Energy Inventory (INER in Spanish). This inventory is based on statistical and geographical systems to enhance the decision-making conducive to investments on renewable energy. By the end of June 2014, the Mexican compendia of biomass, tidal currents and water resources had been finished, and the ones corresponding to solar radiation, geothermal potential and small-scale hydroenergy will be available during 2015.

In terms of biofuels, up to the first half of 2014, there were 411 biodigesters in Mexico, most of them distributed in the northwest and central-west parts of the territory; with 182 of them using the biogas produced from piggeries and dairy farms for electricity generation with an equivalent installed capacity of 12.3 megawatts. With preliminary assessments that place Mexico's potential biogas installed capacity at 500

megawatts, the Ministry of Energy launched a project that provides economic incentives to businesses aiming to use the biogas for electricity purposes and wishing to interconnect to the main grid. As for biodiesel, by the end of June 2014, 17 marketing permits and 15 permits for small producers had been granted.

In addition, PEMEX proposed a 10-year project to introduce up to 5.8% of ethanol in the gasoline marketed in the States of San Luis Potosí, Tamaulipas and Veracruz, which will demand approximately 190 million liters of ethanol by 2020 and opens the door to assess the volume that could be produced from agricultural crops.

ENVIRONMENTAL SUSTAINABILITY

Owing to the predominance of fossil fuels in Mexico's economy and energy matrix, the Ministry of Energy fosters the application of carbon capture use and storage (CCUS) in Mexico to mitigate carbon emissions. To that end, Mexico's CCUS Technology Roadmap was issued, with the aims of:

- Outlining a critical path towards CCUS spanning its whole lifecycle;
- Developing a systemic database that facilitates the management of the economic and regulatory resources associated to CCUS technology; and,
- Articulating the necessary research tasks and activities to optimise CCUS implementation.

RESEARCH AND DEVELOPMENT

As for the Conacyt-SENER-Trust Fund for Hydrocarbons, with four new projects authorised until the end of June 2014 and oriented to enhanced oil recovery and the reduction of field decline rates, the total number of projects added up to 50, with resources committed for an amount of about USD 269 million. Some of the most relevant projects refer to the acquisition, assimilation and interpretation of 3D seismic data for shale plays, a technology center for deep-water projects, and the development of specialised human resources to improve the capabilities in the Mexican energy sector.

In the case of the Conacyt-SENER-Trust Fund for Energy Sustainability, at the end of June 2014, there were 51 projects with resources worth USD 213 million. Some of the projects with the largest impact are the Mexican Centers for Energy Innovation, which will promote research and development in the fields of geothermal, wind and solar energy.

INTERNATIONAL COOPERATION

Mexico has played a significant role in international energy cooperation for many decades. In accordance with its foreign policy principles, Mexico has promoted comprehensive and sustainable development through multiple bilateral and multilateral fora. During 2013 and up to the first half of 2014, Mexico promoted strategic cooperation with a number of economies, mainly in areas of energy efficiency, energy sustainability, climate change and geothermal development. These economies were Belize, Canada, Cuba, Ecuador, El Salvador, Guatemala and the United States in the Americas; Denmark, France, Germany, Italy, Portugal and the United Kingdom in Europe; Djibouti in Africa; and Japan in Asia.

On a multilateral level, Mexico participated and led several spaces of dialogue during 2013 and up to June 2014, mainly through its Ministry of Energy. Mexico collaborated with several multilateral bodies, including the International Energy Agency, the International Energy Forum, the Nuclear Energy Agency, the International Renewable Energy Agency, the Latin-American Energy Organisation, the Energy and Climate Partnership of the Americas, the International Atomic Energy Agency, the G20, the World Petroleum Council, the Carbon Sequestration Leader Forum, and the Extractive Industries Transparency Initiative. Mexico also held the preparatory meeting towards its hosting of the Clean Energy Ministerial in 2015.

In December 2014, Mexico had signed a trilateral Memorandum of Understanding along with Canada and the United States, concerning cooperation on energy information, with the aim of creating a common framework for sharing publicly available energy information among the three economies. This effort looks forward to setting the stage for dialogue, and harmonise each of the economies' energy outlooks and information (NRCan, 2015). Mexico also continued enhancing its collaboration with the State governments of California, and New Jersey in the United States; the Basque Country in Spain; as well as China, Guatemala, Norway and Saudi Arabia.

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USEFUL LINKS

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Comisión Federal de Electricidad (CFE)—www.cfe.gob.mx

Comisión Nacional para el Uso Eficiente de la Energía (CONUEE)—www.conuee.gob.mx

Comisión Nacional de Hidrocarburos (CNH)—www.cnh.gob.mx/

Comisión Regulatoria de Energía (CRE)—www.cre.gob.mx

Comisión Nacional de Seguridad Nuclear y Salvaguardias—www.cnsns.gob.mx/

Instituto Mexicano del Petróleo (IMP)—www.imp.mx/

Instituto de Investigaciones Eléctricas (IIE)—www.iie.org.mx/

Instituto Nacional de Investigaciones Nucleares—www.inin.mx/

Instituto Nacional de Estadística y Geografía (INEGI)—www.inegi.org.mx

Petróleos Mexicanos (PEMEX)—www.pemex.gob.mx

Presidencia de la República—www.presidencia.gob.mx

Secretaría de Energía (SENER)—www.energia.gob.mx

Secretaría de Hacienda y Crédito Público (SHCP)—www.shcp.gob.mx

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 the North Island, South Island and numerous outer islands. While its land area is between that of Japan and the United Kingdom, its low population of about 4.4 million is comparable to a medium-sized Asian city. Due to its remote location, New Zealand has no electricity or pipeline connections to other economies. New Zealand is a mature economy with a per capita GDP of about USD 31 300 (USD 2010 at PPP), although this is below the average of the OECD member economies.

New Zealand is self-sufficient in all energy forms except for oil. New Zealand has vast renewable energy potential, which in 2013 accounted for 75.0% of electricity generation, largely from hydro, geothermal and wind. For fossil energy resources, the reserves are more modest including: 124.5 million barrels of oil, 56.4 billion cubic meters of natural gas and LPG and 571 million tons of coal at the end of 2012 (MBIE, 2014; BP, 2014).

Table 1: Key data and economic profile, 2012

Key data		Energy reserves	
Area (sq. km)[a]	269 652	Oil (million barrels)[b]	124.5
Population (million)	4.47	Gas (billion cubic metres)[c]	53.8
GDP (USD (2010) billion at PPP)	138.8	Coal (million tonnes)[d]	571
GDP (USD (2010) per capita at PPP)	31 315	Uranium (kilotonnes U)	–

Source: a. (Statistics New Zealand, 2014); b. shown as 'Remaining Reserve P90 as at 1 January 2014' and includes LPG (MBIE, 2014); c. shown as 'Remaining Reserve P90 as at 1 January 2014' (MBIE, 2014); d. Proven reserves at the end of 2013 from (BP, 2014). Other data (EDMC, 2014).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2012, New Zealand's total primary energy supply was 18,859 kilotons of oil equivalent (ktoe). A number of energy sources contributed to this total, including oil (34.0%), geothermal (21.0%), gas (20.0%), hydro (10.0%), and coal (8.0%), with wind, biomass, biogas, waste heat and solar providing the remainder (7.0%). It is of note that geothermal electricity generation has an efficiency of 13.0% in New Zealand (MBIE, 2014); as such, the geothermal share of the final energy supply is significantly smaller than its primary energy supply share. New Zealand's energy self-sufficiency (indigenous production/primary energy supply) in 2012 was 85.0%, down from 89% in 2011 as growth in total primary energy supply outpaced growth in indigenous production. Since 2000, growth in New Zealand's primary energy supply has been modest, increasing at an average annual rate of 1.2% (EDMC, 2014).

Coal, predominantly lignite, is New Zealand's most abundant fossil energy resource. However, almost all coal production is comprised of sub-bituminous and bituminous coals. In 2012, coal production remained constant on an energy-equivalent basis compared with 2011 (EDMC, 2014).

Oil is sourced from 19 fields in the Taranaki region in the North Island (MBIE, 2014, p. 31). The production of crude oil, natural gas liquids and condensate was down 11.0% on an energy-equivalent basis in 2012 compared with 2011. Oil production peaked in 2008 underpinned by the coming on-stream of the newest fields, Pohokura, Kupe, Tui, and Maari, and from such onshore fields as Cheal and Sidewinder (MBIE, 2014). New Zealand oil is mostly exported due to its high quality (it is 'sweet' and 'light'). The vast majority of domestic oil demand is met by importing crude oil and refining it at the one New Zealand refinery at Marsden Point, or importing refined oil products. New Zealand is a net importer of oil, with production meeting around 30.0% of domestic oil demand in 2013.

Natural gas is sourced from 18 fields (MBIE 2013). In 2012, natural gas production decreased by 9.0% compared with 2011 (EDMC 2014). Gas is used for electricity generation, and in methanol and urea production. All the gas used in New Zealand is domestically produced since there are no facilities for importing liquefied natural gas (LNG). In 2013, there was a significant increase in gas and LPG remaining reserves (up 31.0%), with Pohokura, Maui, and Mangahewa providing most of this increase. In 2012

Methanex, which produces methanol with natural gas as a feedstock, signed a 10-year gas supply agreement with the Mangahewa field operator..

In 2012, New Zealand generated 41 616 GWh of electricity, a very slight decrease on 2011 (EDMC 2014). New Zealand has plentiful hydro and renewable energy resources. Reflecting this, about 73.0% of electricity generation was from hydro and renewable sources. Hydro is the major source of electricity generation, accounting for 58.0% of total generation in 2012. Hydro production fluctuates from year to year depending on rainfall. Geothermal generation accounted for another 13.0% (MBIE, 2013, Table 6). More than two-thirds of New Zealand's hydroelectricity 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, although a small share of wind generation is located in the south island (MBIE, 2013). The only existing coal plant is being gradually decommissioned with two of its four 250 MW units already mothballed and the remaining two being currently assessed.

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	15 942	Industry sector	3 989	Total	41 616
Net imports and other	3 793	Transport sector	4 543	Thermal	10 277
Total PES	18 859	Other sectors	4 351	Hydro	22 894
Coal	1 600	Total FEC	12 883	Nuclear	–
Oil	6 352	Coal	567	Geothermal	8 445
Gas	3 841	Oil	5 778	Others	41 616
Other	7 066	Gas	1 928		
		Electricity and other	4 610		

Source: (EDMC, 2014).

FINAL ENERGY CONSUMPTION

In 2012, New Zealand's final energy consumption was 12 883 ktoe, just over 1.0% higher than in 2011. The transport sector consumed 35.0% of the final energy, while the industry sector consumed 31.0%, and other sectors 34.0%. Final energy consumption was dominated by oil, accounting for 5 778 ktoe (45.0%), followed by electricity and other (mainly heat) at 4 595 ktoe (36.0%), gas at 1 704 ktoe (15.0%) and coal at 556 ktoe (4%) (EDMC, 2014).

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 79.0% of domestic oil consumption in 2012. Consumption of oil products in the other sectors was shared between residential, commercial and agricultural (11.0%), industry (6.0%) and non-energy or other (5%) (EDMC, 2014).

ENERGY INTENSITY ANALYSIS

New Zealand's energy intensity of primary energy in 2012 was 135.9 tonnes of oil equivalent million USD of GDP, an increase of 1.9% from 133.3 tonnes of oil equivalent million USD in 2011. This is partly due to an increase in natural gas supply for non-energy purposes, and an increase in geothermal energy for electricity generation. The energy intensity of final energy demand decreased by 0.9% from 93.7 tonnes of oil equivalent million USD in 2011 to 92.8 tonnes of oil equivalent million USD in 2012. The energy intensity of both the industry sector and transport sector decreased by 2.1% and 3.0%, respectively, reinforcing the overall improvement in consumption intensity, while the energy intensity of the other sectors, which includes the commercial and residential sectors, has increased by 2.6%.

Table 3: Energy Intensity Analysis

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	133.3	135.9	1.9

Final Energy Demand	93.7	92.8	-0.9
Industry	29.4	28.7	-2.1
Transportation	33.78	32.7	-3.0
Others	30.6	31.4	2.6

Source: (EDMC, 2014).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

A new Ministry of Business Innovation and Employment (MBIE) was created in July 2012 through the merger of four government ministries. These were the recently established Ministry of Science and Innovation, the Ministry of Economic Development (formerly responsible for energy policy), the Department of Labour and the Department of Building and Housing. The merger was part of a broader effort to simplify government departments, enhance performance and reduce government spending. MBIE is responsible for developing New Zealand's energy policies and strategies with assistance from a number of other agencies, and it reports to the Minister of Energy and Resources.

New Zealand's oil and gas exploration and production activities are 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 open to competition. In 2013, the government began a process of privatising 49.0% of the three remaining state-owned electricity generators. Transpower is the transmission grid operator, a state-owned enterprise. 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 August 2011, the government released New Zealand's overarching energy policy framework, the *New Zealand Energy Strategy 2011–21: Developing Our Energy Potential* (the Energy Strategy) (MBIE 2012a) to replace the 2007 New Zealand Energy Strategy. The new strategy focuses on four priorities: diverse resource development; environmental responsibility; efficient use of energy; and secure and affordable energy. The Energy Strategy includes the New Zealand Energy Efficiency and Conservation Strategy 2011–2016 (NZEECS), which replaces the 2007 version.

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. There 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 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 the independent Electricity Technical Advisory Group (ETAG). A discussion paper was released in August 2009 (MED, 2009b). 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 replacing the Electricity Commission with the Electricity Authority, which has more independence from the government. This change was effective from 1 November 2010 (EA 2012). Some of the responsibilities of the Electricity Commission that overlapped with those of other agencies have been transferred to those 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 provisions 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 that a state-owned reserve power station, criticised for distorting market incentives, be sold

so that it can be operated on a commercial basis (NZG, 2010a). This plant was sold to Contact Energy in 2011.

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, 2014).

FISCAL REGIME AND INVESTMENT

In New Zealand, the ownership of all petroleum resources, including natural gas, rests with the Crown, regardless of the ownership of the land. However, some coal resources are privately owned (Harris 2004). The New Zealand Petroleum & Minerals (NZP&M) business unit within the MBIE manages the New Zealand Government's oil, gas, mineral and coal resources, known as the Crown Mineral Estate. NZP&M was formed in May 2011 to maximise the gains to New Zealand from the development of its oil, gas, coal and mineral resources, in line with the government's objectives for energy and economic growth. Its role is to efficiently allocate rights to prospect for, explore for and mine Crown owned minerals, the effective management and regulation of those rights and ensuring a fair financial return to the Crown for its minerals. NZP&M also has a role in promoting investment in the mineral estate. NZP&M replaces the former Crown Minerals Group. The Resource Markets Policy team of the Resources, Energy and Communication Branch of MBIE, advises the New Zealand Government on policy and operational regulation in the mineral estate.

Corporations earning income in New Zealand were previously taxed at a flat rate of 30.0% (Inland Revenue 2012). The tax rate has dropped to 28.0%, effective from 1 April 2011 (Inland Revenue 2012). Corporations are also required to pay other indirect taxes such as payroll tax and fringe benefits tax.

For petroleum production, companies must pay an ad valorem royalty of 5.0% (i.e. 5.0% of the net revenues obtained from the sale of petroleum) or an accounting profits royalty of 20.0% (i.e. 20.0% 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 1.0% is applied to natural gas or an accounting profits royalty of 15.0% on the first NZD 750 million for offshore projects or 15.0% on the first NZD 250 million for onshore projects (NZP&M, 2014).

For the production of Crown-owned coal, the royalty payable will depend on when the initial permit was awarded. For initial permits awarded between 1991 and 2008 an ad valorem royalty of 1.0% 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 5.0% of accounting profits, whichever is higher (NZP&M, 2014). For initial permits awarded between 1 February 2008 and 23 May 2014, a unit-based royalty of 1.40 per tonne is payable for hard and semi-hard coking coal, NSD 0.8 per tonne is payable for thermal and semi-soft coking coal, and NZD 0.3 per tonne is payable for lignite. For initial permits awarded since 24 May 2014, an ad valorem royalty of 2.0% of net sales revenue or 10.0% of the accounting profits, whichever is higher.

New Zealand has good oil and gas resources potential, but it is considered underexplored (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 that 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; and
- developing a fit-for-purpose legislative framework for the petroleum sector (NZG 2010b; MBIE, 2012a).
- In August 2011, the government announced a new approach to allocating petroleum exploration rights. Previously, New Zealand primarily used a 'first-in, first-served' priority-in-time allocation scheme. Under the new scheme, the government will announce 'block offers' for specific acreage and invite competitive bids to develop them. The goal of the change is to attract significant additional

investment to New Zealand while providing the government with more control over where, when, and to whom exploration rights are granted (NZP&M, 2014).

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 includes essentially 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, 2014).

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, which made a number of recommendations that were included in the Resource Management (Simplification and Streamlining) Amendment Act 2009 (MFE, 2011b).

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, or where insufficient expertise and resources are available, especially for major projects. The Resource Management (Simplification and Streamlining) Amendment Act 2009 responded to this criticism by establishing a transitional Environmental Protection Authority (EPA) within the Ministry of the Environment to receive resource consent applications for proposals of national significance and to support the boards of inquiry (or the Environment Court) in making decisions regarding those proposals (MFE, 2014). Under legislation passed in May 2011, the EPA was changed to a stand-alone agency with expanded powers as of 1 July 2011 (NZG, 2011a).

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, 2014). 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, 2014).

Further changes to the RMA have been proposed that will build on previous amendments, but that may also include more widespread changes primarily designed to address housing affordability concerns.

- In response to the Deepwater Horizon Gulf of Mexico oil spill, in June 2010 the government initiated a review of offshore petroleum health, safety and environmental (HSE) legislation. In December 2010, the Comparative Review of Health, Safety and Environmental Legislation for Offshore Petroleum Operations Report was released. The report concluded that New Zealand's HSE arrangements for offshore petroleum operations incorporate a number of key characteristics of international best practices. However, there were some areas in which New Zealand's regulatory framework could be improved (MED 2010).

- Responding to a key recommendation of the review, in 2012 the government passed the Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012. Currently, the Resource Management Act 1991 regulates operations in New Zealand's Exclusive Economic Zone (EEZ) out to 12 miles at sea, but beyond 12 miles many activities have historically been unregulated. This legislation makes the Environmental Protection Authority responsible for the consenting, monitoring and enforcement of activities in the EEZ that have an impact on the environment, including petroleum exploration and marine energy development (NZG, 2011b).

- Since the EEZ Act came into force on 28 June 2013m the EPA has received six marine consent applications: four applications for discretionary activities (seabed mining and petroleum development drilling) and two applications for non-notified discretionary activities (petroleum exploration drilling).

- Some stakeholders have raised concerns about these early experiences, particularly about whether the consenting regime allows for an appropriate balance between managing environmental effects in the EEZ and maximising economic opportunities. The government is currently considering these concerns.

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, 2012a).

In August 2011, the government released the New Zealand Energy Efficiency and Conservation Strategy 2011–16 (NZEECS) to replace the 2007 strategy. The overall goal of the new strategy is for New Zealand to continue to improve its energy intensity (energy used per unit of GDP) by 1.3% per year to 2016. In addition, New Zealand is part of the voluntary APEC-wide target to reduce energy intensity by 45.0% from its 2005 levels by 2035 (APEC, 2012).

Some of 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 businesses, support for the innovative and replicable projects, awarding prizes for efficiency excellence, and energy auditing support.
- for buildings, assistance for an expected 188 500 homes to install insulation and clean heating equipment by 2013, energy efficiency building codes, and energy efficiency rating tools for homes; and
- for products, Minimum Energy Performance Standards (MEPS) and related labelling (coordinated with Australia) (MBIE, 2012a).

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, 2011). As part of the Energy Strategy, the New Zealand government retains the target of generating 90.0% of its electricity 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 (MBIE, 2012a).

Hydro has historically been New Zealand's major source of renewable energy. However, the best hydro sites have already been developed, and there is strong social opposition to develop any further sites, so New Zealand has been focusing on geothermal and wind to meet its 90.0% 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 that development (NZG, 2011c).

On 14 April 2011, the government issued a National Policy Statement for Renewable Electricity Generation. This policy statement requires decision-makers at all levels of government, especially at the local level, to recognise the economy-wide significance of renewable electricity generation in their plans and policy statements (MFE, 2011).

In the transport sector, a previous grant of up to 42.5 cents per litre for biodiesel producers was ended on 30 June 2012 (EECA 2012b). However, electric and plug-in electric light vehicles continue to be exempted from road user charges, which for the average user equates to a saving of around NZD 700 per year (NZG 2011d; MT, 2015). For more information see the Energy Wise website: http://www.energywise.govt.nz/your-vehicle/electric-vehicles/regulations.

NUCLEAR

New Zealand does not have any commercial nuclear reactors and has no plans to develop a nuclear energy industry.

CLIMATE CHANGE

The government has adopted an economy-wide target for a 50.0% reduction in New Zealand's carbon-equivalent net emissions, compared with the 1990 levels, by 2050. New Zealand is willing to commit to reducing greenhouse gas emissions by between 10.0% and 20.0% below 1990 levels by 2020, if there is a comprehensive global agreement and certain conditions are met (MBIE, 2012a, MFE, 2012).

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, 2011).

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 were able to purchase permits from the government at a fixed price of NZD 25 per ton of CO_2-equivalent. Over the same period, participants in the stationary energy, industrial and liquid fuel sectors (that is, all sectors in the scheme at that time except forestry) will have to surrender only one permit for every two tons of CO_2-equivalent emitted, effectively reducing the price of permits to NZD 12.50 per ton. These transitional provisions were extended by the Climate Change Response (Emissions Trading and Other Matters) Amendment Act 2012 (CCINZ, 2012a).

Previously all sectors of the economy were expected to be included from at the latest 2015. However, in 2012, the government revised the scheme to exclude the agriculture sector until there are economically viable and practical technologies. The revised timetable for sector entry into the emissions trading scheme is detailed in **Error! Reference source not found.**. Furthermore, a raft of other changes was included, which will extend the transitional period and introduce the offsetting of emissions with pre-1990s forests.

For energy, the point of obligation under the scheme generally lies with energy suppliers, not with end-users. This means that only energy suppliers and a few large industrial facilities are directly involved in the scheme. The government is providing free units to energy-intensive trade-exposed industries to protect them from international competition that does not face a carbon cost (FL, 2012).

New Zealand is a party to the Kyoto Protocol, and according to the latest Ministry for the Environment projections, it will exceed its 2008–12 commitment to reduce greenhouse gas emissions by 21.9 million tons (MFE 2011f). However, New Zealand announced it would not sign up for any continuation of the Kyoto Protocol beyond the initial commitment period beginning 2008 and ending in 2012. New Zealand intends instead to pursue domestic policies to reduce greenhouse gas emissions (CCINZ, 2012b).

Table 4: 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	No Date Set

Source: (CCINZ, 2013).

NOTABLE ENERGY DEVELOPMENTS

ELECTRICITY MARKET

In 2014, the New Zealand government has completed the partial privatisation of the three large state-owned energy utilities by selling 49.0% of each company. The partial privatisation of government-owned utilities is expected to raise as much as NZD 6 to 7 billion, which has been set aside for reinvestment in education and infrastructure (FT, 2013).

Uncertainty exists regarding the demand side stemming from the reduction of capacity in New Zealand second largest electricity consumer; there are also doubts about the profitability the Tiwai Point Aluminium Smelter (TPAS), which accounts for about 14.0% of New Zealand's total electricity demand. The New Zealand government supplied a short term NZD 30 million one-off subsidy to ensure the plant continues to operate for the next few years (NZAS, 2013). It is uncertain as to what capacity the TPAS will

be able to operate in over the medium to long term, but a complete loss of the TPAS may result in short term over capacity of generation and lead to market price depression until new demand can replace what is lost or alternatively an older less efficient thermal plant is retired.

Another development includes the deployment of the smart metering devices throughout the market. To date, approximately 52% of meters have been replaced. The key driver for this development is for electricity retail operations, but the newly formed Smart Grid Forum believes there is potential to expand benefits into streamlining the market. (MBIE, 2014b)

NEW PROJECTS

At the end of 2012, 270 MW of new geothermal generation, 60 MW of new wind and 6 MW of hydro were in construction to contribute to the total renewable generation capacity in New Zealand (MBIE, 2013). Also importantly, 250 MW of coal electricity generation were decommissioned as unit 4 from Huntly Power Station was put into storage (MED, 2013, p. 63).

There are a number of large-scale wind, geothermal, and hydro projects that have regulatory and environmental consent to proceed. However all of the large utility companies have stated that they are unlikely to develop any new large-scale projects for the next several years owing to the current market's oversupply of capacity and tepid electricity demand growth. With continued improvement in energy intensity demand, growth may be much slower in the medium to long term than seen historically.

The New Zealand grid system operator Transpower has recently completed or will complete essential major upgrade projects to maintain grid security and keep up with demand. These include: the NZD 417 million North Auckland and Northland Grid Upgrade Project (completed in 2013); the North Island grid upgrade project (completed in 2012); the NZD 100–NZD 300 million Wairakei to Whakamaru Replacement Transmission Line Project, due for completion in 2013; and the NZD 672 million high voltage direct current (HVDC) Inter-island Link Project, due for completion in 2014 (Transpower, 2013).

In transport, Z Energy is currently building New Zealand's largest biofuel plant with a capacity of 20 million litres per year. It is expected to be operational by 2015 (Z Energy, 2014). In addition, a consortium led by Z Energy and partly funded by the government is investigating the large-scale production of next generation biofuels from domestically grown timber.

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USEFUL LINKS

Climate Change Information, Ministry for the Environment—www.climatechange.govt.nz

Electricity Authority—www.ea.govt.nz/

Energy Efficiency and Conservation Authority (EECA)—www.eeca.govt.nz

Environmental Protection Authority—www.epa.govt.nz/Pages/default.aspx

Ministry of Business Innovation and Employment (MBIE)—www.med.govt.nz

New Zealand Government (portal for access to New Zealand government agencies and government-funded websites)—www.newzealand.govt.nz

New Zealand Government (news and speeches from government ministers)—www.beehive.govt.nz

New Zealand Parliament—www.parliament.govt.nz

New Zealand Petroleum & Minerals (formerly Crown Minerals)—www.nzpam.govt.nz/cms

Transpower—www.transpower.co.n

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 seven million, spread across a total area of 462 840 square kilometres. The resource development industry, which includes minerals, oil and gas, contributes to approximately 80.0% of PNG's export income (MRA 2012a).

In 2012, its real GDP was estimated at USD 16.74 billion (USD (2010) at PPP), an increase of 9.0% from 2010.

Table 1: Key data and economic profile, 2012

Key data		Energy reserves[a]	
Area (thousand sq. km)	463	Oil (million barrels)	190.0
Population (million)	7.0	Gas (billion cubic metres)	155.19
GDP (USD (2010) billion at PPP)	16.7	Coal (million tonnes*)	–
GDP (USD (2010) per capita at PPP)	2 336	Uranium (kilotonnes U)	–

Source: (EDMC, 2014); a. Proved reserves as of 2013 (US EIA, 2013).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2012, PNG's net primary energy supply was 2 085 ktoe. Light crude oil and petroleum products accounted for 71.9%, gas for 6.6%, and hydro and other renewables for the remaining 21.5% (EDMC, 2014).

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 that resulted in the development of additional oilfields, and crude oil production is expected to be depleted by 2026. Oil production in 2009 was 35 050 barrels a day. Crude oil has been refined locally since the first refinery plant was commissioned in 2004 (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 provides 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.

The PNG LNG Project is operated by the Esso Highlands Limited (Company). The project is a joint venture between Esso Highlands Limited, a subsidiary of ExxonMobil, and its partners—Oil Search Limited, Santos, AGL, JX Nippon Oil & Gas Exploration, Minerals Resources Development Company and Petromin PNG Holdings Limited, as well as local landowners. It is a 6.9 million tonne per annum integrated LNG project sourced from the Hides, Angore and Juha fields and from associated gas in the Kutubu, Agogo, Moran and Gobe Main oil fields. The PNG LNG Project began production in April 2014 and the first LNG deliveries began in May 2014, ahead of schedule (PNG LNG, 2014). It will supply LNG to major customers in Asia.

In 2012, PNG generated 4049 gigawatt-hours (GWh) of electricity, a 3.1% increase from 2011. Sources of generation included thermal at 65.0%, hydro at 25.0%, and geothermal at 10.0% (EDMC, 2014). There is little economic potential for the expansion of large hydropower plants due to the lack of substantive demand near the 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.

Geothermal power generation in PNG was commissioned in April 2003. In 2007 the installed capacity of the geothermal power stations was 56 MW. 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 (GEA, 2010). In 2010, traditional biomass accounted for over approximately 50.0% of PNG's energy consumption (IRENA 2013). However, as there are no recent surveys to track its use, this is largely undocumented.

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	1 341	Industry sector	445	Total	4 049
Net imports and other	-1 280	Transport sector	517	Thermal	2 632
Total PES	2 085	Other sectors	247	Hydro	995
Coal	–	Total FEC	1 209	Nuclear	–
Oil	1 500	Coal	–	Geothermal	422
Gas	137	Oil	884	Others	–
Other	449	Gas	–		
		Electricity and other	325		

Source: (EDMC, 2014).

FINAL ENERGY CONSUMPTION

In 2012, total final energy consumption in PNG was 1 209 ktoe, a decrease of 15.4% from 2011. The industrial sector's consumption decreased 47.5% from 2011, and the sector was the second largest end user, accounting for 36.8% of the energy used, after the transport sector at 42.8%. The other sectors, including agriculture and residential/commercial, were 204.4%. By energy source, petroleum products accounted for 73.1% of the total consumption, while electricity and other sources accounted for 26.9%.

In PNG, around 85.0% 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 (PPL) and the PNG Government, with the assistance of the World Bank, is continuously extending its rural distribution network throughout the economy, especially within the outskirts of urban areas. PNG aims to increase electricity access to 41.0% of the population by 2020 and to 70.0% by 2030 (IRENA, 2013).

ENERGY INTENSITY ANALYSIS

PNG's primary energy intensity in 2012 was 124.5 tonnes of oil equivalent per million USD, which has decreased by 14.5% from 145.6 tonnes of oil equivalent per million USD n 2011. The energy intensity of final energy demand has increased 20.7% from 91.017 tonnes of oil equivalent per million USD in 2011 to 72.2 tonnes of oil equivalent per million USD in 2012. The energy intensity of both industry sector and the other sector which includes commercial and residential sector decreased by 43.0% and 8.7% respectively, while the energy intensity increased by 9.3% in the transport sector.

Table 3: Energy Intensity Analysis

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	145.6	124.5	-14.5
Final Energy Demand	91.0	72.2	-20.7
Industry	46.6	26.6	-43.0
Transportation	28.3	30.9	9.3
Others	16.2	14.8	-8.7

Source: (EDMC, 2014).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

Papua New Guinea, or the Independent State of Papua New Guinea, is a constitutional parliamentary democracy and a Commonwealth realm. Jurisdiction over energy matters is the responsibility of the Papua New Guinea government's Energy Division within the Department of Petroleum and Energy (DPE). In 2011 the Energy Division authored a number of draft energy policies, however they have yet to receive formal status and are under review. The key draft policies included the National Energy Policy, the Rural Electrification Policy and Strategy, the Geothermal Policy, the Renewable Energy Policy and the Electricity Industry Policy (IRENA, 2013). The exploration and development of petroleum resources have also been authorised and administered by the DPE.

The PNG Government initiated The National Strategic Plan 2010–2050, which has seven pillars. Natural resources, climate change and environmental sustainability are among the areas of focus.

In March 2010, the Papua New Guinea Government announced the Development Strategic Plan (DSP) 2010–2030, which has five pillars, one of which is 'natural resources and environment'. The DSP 2010–2030 also set this goal: All households are to have access to a reliable and affordable energy supply, and sufficient power is to be generated and distributed to meet future energy requirements and demands (12.4% of households had access to electricity in 2010).

In October 2010, the Papua New Guinea Government announced its Medium Term Development Plan (MTDP) 2011–2015. The MTDP 2011–2015 will focus on increasing access to electricity for all households in the member economy government. New investment from the private sector in solar technology is also expected during the period of the first MTDP. A comprehensive analysis will be necessary to analyse the cost effectiveness of the various alternative sources of power.

ENERGY MARKETS

PNG's power authority, PNG Power Limited (PPL) is responsible for generating, transmitting, distributing and retailing electricity throughout PNG. 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 and petroleum 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 PPL and selected corporatised government statutory entities. This made it responsible for setting prices or tariffs for electricity and petroleum products. PPL was also corporatised under the Electricity Commission (Privatisation) Act 2002.

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. PPL has an exclusive licences until 31 2017 to sell electricity under this contract (PPL, 2014). PPL sold 1023 GWh in 2014.

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 a 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 30.0% of the taxable income, which is lower than the tax rate for income from petroleum projects established before 1 January 2001 (50.0%), and the rate for projects established after that date (45.0%). The new 30.0% 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.

Papua New Guinea has arguably the most competitive terms for oil and gas investment in the region. There is no capital gains tax, and a full (100.0%) tax deduction is available for exploration expenditure. The PNG Government's equity is set at 20.5% and landowners' at 2.0%. The effective royalty rate is 2.0%, and the government's share of that is approximately 50.0.0 (PPL, 2008).

ENERGY EFFICIENCY

Energy efficiency policies and regulations are regulated by the Energy Efficiency Division of the Department of Petroleum and Energy. While energy efficiency is not currently a major priority for the PNG government, it might prove to be an important factor if the DSP 2010-2030 goals are to be achieved. Since there are only two separate power grids (the Port Moresby grid, which depends heavily on diesel generation, and the Ramu grid), urban areas are forced into expensive and inefficient self-generation, and large industries such as mining sites operate using off-grid self-generated power.

RENEWABLE ENERGY

Renewable energy is also regulated by the Division of Energy. PNG's renewable energy potential is very high, however the remote locations and terrain have meant that renewable energy has not been readily exploited.

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 lifted Lihir Gold's total geothermal generating capacity to 56 MW, around 75.0% of the economy's total electricity requirements in 2007 (Newcrest Mining, 2010).

Lihir Gold Limited was 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 (see 'Climate Change' section) and reducing dependency on fuel oil for electricity generation. The Lihir Mine's geothermal plant generates approximately 40.0% of the mine's current power requirements and provides free electricity to residents who live near the Lihir mine site. It saves the plant approximately USD $2 000 000 per year in fuel oil costs (Booth, GMII, and Bixley, PF, 2005).

The Department of Petroleum and Energy's Energy Division assessed 45 hydro-electricity power sites in 1987 and completed three small hydro systems in 1992. In 2010, the Australian state of Queensland discussed a partnership with PNG to develop a 1800 MW hydro-electricity power plant on the Pukari River. This plant would make 600 MW available for local use and the majority would go to Queensland through a 350km undersea cable (IRENA, 2013).

PPL is considering constructing a wind farm near Port Moresby, but they have not commenced wind monitoring. In 2002 the Chinese Government donated 50 small combined wind/solar generators, some of which have been installed at coastal locations (IRENA, 2013).

NUCLEAR

PNG has no nuclear energy industry and there are no current plans to develop one.

CLIMATE CHANGE

Climate change is one of the important pillars in the National Strategic Plan 2010–2050 (see 'Energy Policy Framework' section). The Office of Climate Change and Development (OCCD) administers the member economy government's Climate Compatible Development Management Policy (NCCDMP), which is based on the National Strategic Plan. The NCCDMP aims to: achieve GDP per capital of USD 3000 by 2030; reduce GHGs by 50.0% through land use, land-use change and forestry; and become carbon neutral by 2050 (OCCD, 2014).

The geothermal power plant (mentioned in the 'Renewable Energy' section) was the first project in PNG to be registered for carbon credit trading under the Kyoto Protocol. The amount of greenhouse gas emissions reduced by the geothermal plant is approximately 4.0% of PNG's total CO_2 emissions (Newcrest Mining 2012). There are currently 9 clean development mechanism (CDM) projects registered with the United Nations Framework Convention on Climate Change CDM Board(OCCD, 2014). DMsallow developed countries to set up emissions reduction projects in developing countries to earn certified emissions reduction credits under the Kyoto Protocol.

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

September 2003 introduction of internationally competitive fiscal incentives designed to attract oil exploration.

In November 2011, Lihir Gold Ltd extended its drilling contract with Energy Development Corporation to 31 December 2012 (The Manila Times, 2011).

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, Merlin Petroleum Company (a subsidiary of Nippon Oil) and local landowners. The feed gas is 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 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 6.9 million tons of LNG from Papua New Guinea each year. ExxonMobil and its joint partners completed the front-end engineering and design phase for the project in November 2009. In November 2011, Marubeni, a highly diversified corporation, acquired a 21.0% share of the Merlin Petroleum Company (Marubeni, 2011). Production began in April 2014, and the first deliveries in May 2014. It is the largest ever private sector investment in PNG and it is expected to increase 21.0% 2015 due to the project (ADB, 2014).

REVIEW OF THE MINING AND PETROLEUM TAXATION REGIME

The International Monetary Fund provided technical assistance to the PNG Department of Treasury to conduct a review of mining and petroleum taxation in 2013. The review's purpose is to determine the 'appropriateness of the mining and petroleum taxation arrangement compared to similar resource rich countries' (MRA 2012b).

RENEWABLE ENERGY DEVELOPMENT AND RURAL ELECTRIFICATION

In 2013, the World Bank and the PNG Government signed a four-year agreement for renewable energy development and rural electrification. The project aims to help expand electricity to millions of people in Port Moresby and rural communities, and to develop clean energy options. Assistance will be given in the form of finance, expert advice and studies to help PPL and the PNG Government. The project will aim to increase electrification rates from below 10.0% to 70.0% by 2030 (World Bank 2013).

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PERU

INTRODUCTION

Peru is a constitutional republic located in South America, bordered by the Pacific Ocean, Chile to the south, Ecuador and Colombia to the north, and Brazil and Bolivia to the east. Peru is one of two APEC economies in Latin America located on the Pacific coast of South America (the other is Chile). With a land area of 1.3 million square kilometres Peru has three main geographical regions: the Costa to the west, the Sierra (Andes mountains), and the Selva, covered by the Amazon rainforest. The economy is divided into 25 political departments (administrative regions), and in 2012 had a total population of about 29.9 million people, which represents a growth of 1.3% from the previous year (EDMC, 2014). Around 23.9% of Peru's population is considered poor and 4.7% extremely poor; its major population centre is the Lima region, which represents nine million people, nearly a third of the total population (INEI, 2013a). Peru's urbanisation rate is 76.0% (INEI, 2013b).

Peru has a market-oriented economy, which in 2013 was composed of services (47.5%), manufacturing and construction (21.8%) and agriculture and mining (17.3%). Economic growth, low and controlled inflation and a decreasing unemployment rate are the fundamentals of Peruvian macroeconomic stability, which has increased exports and sustained inflows of private investment (BCRP, 2013). The economy has been driven by the internal demand mainly private investment, exports and domestic consumption. Mining is especially important and Peru is a major global producer, being the third in silver, third in zinc, third in copper and tin, fourth in lead, and sixth in gold (USGS, 2012). As a consequence, mineral exports have consistently accounted for a significant portion of the economy's export revenue, with as much as 55.0% in 2013 (BCRP, 2014).

Peruvian economic growth marked a rate of 6.0% from 2011 to 2012, its GDP reaching USD 320.9 billion (USD (2010) at PPP in 2012), and its GDP per capita growing 4.6% to reach USD 10 702 (EDMC, 2014). In addition, Peru's foreign reserves reached a record USD 63.9 billion while its fiscal deficit represented 3.3% of the GDP (BCRP, 2013).

Owing to its scarce oil resources, Peru is a net importer of oil. Particularly, domestic production is not only insufficient to meet the economy's demand, but since most crude oil produced is of extra-heavy quality and several of Peru's domestic refineries are unable to process it, a substantial share of domestic production is exported. In contrast, natural gas resources are significant and the economy is a major global gas producer.

Table 1: Key data and economic profile, 2012

Key data		Energy reserves[a]	
Area (million sq. km)	1.3	Oil (million barrels)	1 400
Population (million)	29.9	Gas (trillion cubic metres)	0.4
GDP (USD (2010) billion at PPP)	320.9	Coal (million tonnes)[b]	6.4
GDP (USD (2010) per capita at PPP)	10 702	Uranium (kilotonnes U)[c]	50.6

Source: (EDMC, 2013); a. (BP, 2014); b. (MINEM, 2012); c. (Ingemet-Peru, 2007).

Peru's proved energy reserves by the end of 2012 were 1 400 million barrel of crude oil (including gas liquids), 0.4 trillion cubic metres of natural gas and 6.4 million tonnes of coal.

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Peru's total primary energy supply (TPES) in 2012 was 20 327 kilo tons of oil equivalent (ktoe), which represented an increase of 3.2% from 2011, due to the growth observed in the production of natural gas and its liquids. By energy source, in 2012 almost half (10 330 ktoe) of TPES came from oil, 34.0% from natural gas (6 826 ktoe), and 4.0% from coal (849 ktoe). Non-fossil energy sources, such as hydro, wood, biomass, wind and others contributed to the remainder at 11.0% (2 322ktoe) (EDMC, 2014).

Peru is a major gas producer. In 2012, the economy produced around 16.4 billion cubic metres (bcm) of natural gas, an increase of 7.0% over 2011, mainly as a result of the addition of Block 56's output which alone represented 56.0% of the total production at Camisea (MINEM, 2012b).

In this regard, nearly all of the domestic supply of natural gas is non-associated to crude oil and produced in the Camisea Basin, which encompasses several natural gas fields in the Ucayali basin in south-eastern Peru, mainly in the San Martín and Cashiriari reservoirs, commonly known as 'Block 88', along the Camisea River. Discovered in the 80's, it was not until 2000 that a 30-year production contract was signed between the government and the production companies, with project development beginning in 2004. Since Camisea´s begin, output capacity at Camisea has grown steadily as drilling activities have also expanded to Block 56, adjacent to Block 88. While the Camisea project was initially aimed to meet domestic demand for natural gas, production levels, which have increased at an annual average rate of 62.6% since 2004, have allowed the development of an export market in the form of liquefied natural gas (LNG), which is sent by ships primarily destined for Mexico and Europe (MINEM, 2012a). In 2012, Peruvian LNG exports from 'Melchorita' liquefaction plant amounted to 5.4 billion cubic metres to Mexico, Japan, Thailand, Spain and South Korea.

Peru's proved coal reserves are around 6.4 million tonnes, of which most (92.2%) is anthracite and the remainder bituminous coal, with the majority of reserves being located in the La Libertad, Ancash and Lima departments. Peru is a net importer of coal, with 73.3% of its coal demand in 2012 met by imports and 16.7% by domestic production (MINEM, 2012b).

In 2012, Peru's electricity generation totalled 39 908 gigawatt-hours (GWh), a 1.8% increase from the 39 222 GWh generated in 2011. Hydropower's share of this total was the largest, at 54.0% (21 354 GWh), with electricity generated from thermal plants accounting for 45.0% (17 866 GWh) and the remainder being met by other sources such as biomass and wind (EDMC, 2014).

In the other energy sectors, other types of biomass (such as firewood, vegetable coal, dung and yareta—a moss-type plant dried and then burned) are used for heating and cooking. In 2012, energy supply from renewable sources was made up of firewood with 40.2%, hydropower with 46.0% and other biomass sources with the rest (MINEM, 2012b).

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	21 233	Industry sector	4 264	Total	39 908
Net imports and other	2 377	Transport sector	6 873	Thermal	17 866
Total PES	20 327	Other sectors	3 505	Hydro	21 354
Coal	849	Total FEC	14 642	Nuclear	–
Oil	10 330	Coal	574	Others	688
Gas	6 826	Oil	9 517		
Others	2 322	Gas	1 427		
		Electricity and others	3 124		

Source: (EDMC, 2014).

FINAL ENERGY CONSUMPTION

Final energy consumption in Peru grew by 0.9% in 2012, reaching 14 642 ktoe. Transportation was the most dynamic sector, growing 3.9% from the previous year, and representing 47.0% of total final energy consumption in 2012. The industrial sector's share was 29.0%, while the combined 'other' residential, commercial and agriculture sectors consumed 24.0%. Accordingly, oil products dominated the total energy consumption in 2012 with 65.0%, the majority of which was consumed as diesel, gasoline and liquefied petroleum gas. Electricity made up 21.0% of the total end-use energy demand, while gas and coal accounted for the remaining 10.0% and 4.0%, respectively (EDMC, 2014).

ENERGY INTENSITY ANALYSIS

Peru's energy intensity has been decreasing since 2011 as a consequence of the better use of energy sources. Peru's primary energy intensity in 2012 was 63.3 tonnes of oil equivalent per USD, reducing by 2.7% from 2011 when it was 65.1 tonnes of oil equivalent per USD. Similarly, a reduction of 4.8% is observed in the final energy intensity for 2012 (45.6 tonnes of oil equivalent per USD) from 2011 (47.9 tonnes of oil equivalent per USD) levels. On a sectoral basis, energy intensity improved in the industrial, transport and others sector over the same period.

Table 3: Energy Intensity Analysis, 2012

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	65.1	63.3	-2.7
Final Energy Demand	47.9	45.6	-4.8
Industry	14.2	13.3	-6.8
Transportation	21.8	21.4	-2.0
Others	11.8	10.9	-7.8

Source: (EDMC, 2014).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

In Peru, the organisation responsible for the formulation and evaluation of energy and mining policies as well as the energy sector's guidance is the Ministry of Energy and Mines (MINEM), which is divided into two sub-ministries: the Vice-Ministry of Energy and the Vice-Ministry of Mines. MINEM is also responsible for environmental issues concerning energy and mining activities. Through its General Directorates (Electricity, Rural Electrification, Hydrocarbons, Energy Efficiency, Mining, Energy-Environmental Issues and Mining-Environmental Issues), the ministry stretches across the major areas of influence in the sector, overseeing its activities and promoting investment to achieve sustainable development. In addition to MINEM, the autonomous regulatory agency created in 1996, Organismo Supervisor de la Inversión en Energía y Minería (OSINERGMIN) is in charge of setting electricity tariffs and gas transportation rates. Its goal is to promote efficiency in the power and gas sectors at the lowest possible cost for the customer through the design and implementation of effective regulation.

In May 2010, the Vice-Ministry of Energy issued Peru's Energy Policy Proposal 2010–2040 for public discussion. After forums were held and feedback received, the Energy Policy of Peru 2010–2040 was approved on 24 November 2010 (Supreme Decree No. 064–2010–EM – El Peruano 2010) with the goal of meeting Peru's energy demand in a safe, sustainable, reliable and efficient way, supported by planning, research and technological innovation with the following objectives (MINEM, 2010a):

- a diversified and competitive energy matrix with emphasis on renewable energy and energy efficiency;
- a competitive energy supply;
- universal access to energy supply;
- the highest efficiency levels in energy production and utilisation systems;
- self-sufficiency in energy production;
- building an energy sector with minimal environmental impact and low carbon emissions, as part of sustainable development;
- development of the natural gas industry and its use in household, transportation, commercial and industrial activities as well as efficient electricity generation;
- strengthening of the institutions involved in the energy sector; and
- joining regional energy markets in order to achieve Peru's long-term vision.

Stemming from Peru's Energy Policy Proposal 2010–40, in January 2012 MINEM published a study on a sustainable energy matrix proposal including its environmental assessment (*Nueva Matriz Energética Sostenible y su Evaluación Ambiental Estratégica, com oInstrumentos de Planificación*), which aims to provide a reference on the Peruvian energy sector and to support energy planning purposes towards new regulations and policies. The main goals for the year 2040 are (MINEM, 2012):

- Diversified structure of energy supply: 40.0% hydro, 40.0% gas and 20.0% Non conventional Renewable Energies (NCRE);
- Develop of petrochemical industry in the south of Peru;

- Decentralise the transport of Gas to other regions;
- Up to a 19.0% of families using natural gas at home;
- Energy efficiency that will bring a 15.0% reduction in the energy demand, increasing the balance trade and energy security; and
- A long-term goal to increase biodiesel use to 5.0%.

ENERGY MARKETS

Peru's economy has become more market-oriented following the structural reforms of the 1990s with the mining, electricity, hydrocarbons and telecommunications industries being partially privatised. Several new laws have established a regime under which domestic and foreign investments are subject to equal terms, and this has encouraged foreign companies to participate in almost all economic sectors. In 1999, Peru passed the Law for Promotion of Natural Gas Industry Development (Law No. 27133), which established 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 the energy supply and improve the competitiveness of a productive sector of the economy (El Peruano 1999).

As a part of the deregulation plan of the economy, during the 1992 the Peruvian government issued the Electric Power Concession Law. This law established a new regulatory framework to promote competition and efficiency in generation, transmission and distribution of electric power. This law is very important because permits to set electricity tariffs based on the marginal costs and free market forces. There was the chance for the large customers to negotiate directly with generation and distribution companies.

This reform had four main components:

- the vertical and horizontal de-integration of the Electroperú and Electrolima companies in power generation, transmission and distribution;
- the progressive and partial privatisation of those state utilities;
- the creation of a free market where energy providers with a capacity larger than 1 MW could freely negotiate the conditions of their supply contracts; and
- the establishment of a new mandate for the former Electricity Tariffs Commission (CTE), which in 2000 merged with OSINERGMIN.

Although Peru had an open electricity market, there were still barriers to the market's efficient operation. On July 2006, the government 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; modification of the functions held by the Electric Energy Operation and Dispatch Committee (Comité de Operación Económica del Sistema Interconectado Nacional - COES), which is now a private, independent operator and planner for the electricity system; and adjustments to the legal framework related to the formation of transmission prices.

In 2013, there were 38 companies in charge of electricity generation - 63.0% are private and the rest are state companies. In the same period, there were 8 transmission companies and 21 distribution companies (52.0% private and 48.0% state companies) (OSINERGMIN 2013).

FISCAL REGIME AND INVESTMENT

The Peruvian government strives to attract foreign investment to sustain economic growth and improve competitiveness. In recent years, Peru has expanded and streamlined the available investment schemes, with particular focus on areas involving exports, infrastructure, and services to the population. As such,

investments in oil and gas upstream activities are conducted under licence or service contracts granted by the government.

The Peruvian government guarantees the legal stability to foreign investors, mainly on income tax regulations and dividend distributions. Additionally, Peruvian laws, regulations, and practices cannot discriminate between Peruvian and foreign companies. In that sense, both kinds of companies are equals under the law. There are no restrictions on repatriation of revenues, international transfers of capital, the remittance of dividends, interests and royalties. (E&Y 2014).

The Global Competitiveness Report during the 2013 Peru is ranked as 61 among 144 countries. According to this ranking, Peru is among the top countries in Latin America in terms of macroeconomic environment, market size, financial market development, labour market efficiency, and goods market efficiency (E&Y 2014).

The production scale methodology sets a percentage for royalties (starting at 5.0%) over certain a scale of production (i.e. volume of barrels per calendar day) for liquid hydrocarbons and natural gas liquids, and other royalty percentages for natural gas for each valuation period. On the other hand, under the economic results methodology, the royalty percentage is set by adding a fixed royalty percentage of 5.0% to a variable royalty percentage, established according to certain economic results ratios (Ernst & Young 2014).

To promote domestic and international investment in the energy sector, Peru has looked forward to shifting its legal framework. In 1991, the government passed the Foreign Investment Promotion Law, Supreme Decree No. 662. A second law, concerning 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 effect in 2000 and provided a framework for private investors in telecommunications, energy, transport and sanitary services, specifying how operations in each of these public service sectors were to be organised. Overall, Peru strives to ensure proper conditions to attract and retain investment. Foreign investors are given equal treatment to Peruvians, most activities are unrestricted and several schemes are possible.

ENERGY EFFICIENCY

In 2010 the Peruvian government create the General Direction of Energy Efficiency (DGEE) as part of the Ministry of Energy and Mines. The mission of the DGEE is to identify, develop, promote, implement and spread the technologies, process, renewable energies and patterns of consumption to let improve of the efficiency and energy sustainability in the country.

The main goals of the DGEE are:

- To reduce the energy intensity, by promoting; the best use of energy; the use of renewable resources; energy savings and generating a culture of energy efficiency, without affecting the social welfare; and
- To make compatible the use of energy with the environment preservation.

In 2000, the government passed the Law for the Promotion of the 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, created significant initiatives to support energy efficiency through mechanisms. These include DS–No. 034–2008–EM of 19 June 2008 (Energy Saving Measures in Public Services), and RM No. 038–2009–MEM/DM of 21 January 2009 (Energy Consumption Indicators and their Monitoring Methodology). Through the 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 at which 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, 2009). The Referential Plan aims to reduce energy consumption by 15.0% from the 2007 levels by 2018 through energy efficiency measures. The plan includes an analysis of energy efficiency in Peru, identifying sector programmes that could be implemented to achieve the proposed targets.

In workshop discussions, the following 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 enable them to implement the Referential Plan;
- Use renewable energies according to the geography and climatic conditions of several regions; and
- Get the commitment of the mining and energy sectors to being role models of efficiency.

On May 2010, the Peruvian Government created the General Directorate of Energy Efficiency (DGEE) within the Vice-Ministry of Energy (through Supreme Decree No. 026–2010–EM). The DGEE serves as the technical regulatory body, proposing and assessing energy efficient use and production while also covering non-conventional renewable energy issues. The DGEE also leads the economy's energy planning, and is responsible for developing the National Energy Plan. This plan must to incorporate the electricity sector development in line with Peruvian development policies and the Energy Policy Framework 2010-2040 (El Peruano, 2010).

RENEWABLE ENERGY

Peru has established goals to increase renewable energy use and has set out a legislative and policy programme to support its development. Electricity generation from renewable resources is being expanded from an already significant reliance on hydropower generation. The *Law on Promotion of Investment for Electricity Generation with Renewable Energies (Law No. 1002)* was enacted in May 2008, and the Regulations for Generation of Electricity with Renewable Energies (Supreme Decree No. 050–2008–EM) were issued in October of that year. Among the incentives contained in the law are (El Peruano, 2008a, 2008b):

- a five-year target for the share of domestic power consumption to be generated from renewable energy sources, excluding large hydropower generation (i.e. less than 20 MW of installed capacity);
- a firm price guaranteed for bidders who are awarded energy supply contracts for up to 20 years; and
- priority in loan dispatch and access to networks.

To achieve these goals, MINEM established open auctions for renewable energy supplies in order to ensure competitive conditions for the electricity generators and their customers. The first auction was completed in March 2010 and added a total renewable energy capacity to the National Interconnected Electric System (SEIN) of 411 MW, awarded across 26 projects using wind, solar, biomass and mini-hydro. A second auction, open in the second half of 2011, aimed at obtaining 1981 GWh, out of which 681 GWh were restricted exclusively for hydroelectric projects (OSINERGMIN, 2011).

To promote renewable energy, in 2006, the government passed Law No. 28876, which provides in advance tax reimbursement on the electricity sales of renewable energy-based utilities. In 2008, Law No. 1058 was passed, which allows tax benefits to investment participants in electricity generation that is based on renewable energy (including hydro), by means of accelerated depreciation of their investments by up to 20.0% per year in order to improve the projects' feasibility (MINEM, 2010b).

As for biofuels, government objectives were first set in 2003 and there are three regulations that provide their legal framework: 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 Commercialisation of Biofuels). These regulations also establish responsibilities among different government and agencies:

- Ministry of Agriculture (MINAG): Promotes the development of fields for biofuels production;
- Ministry of Energy and Mines (MINEM): Authorises the commercialisation of biofuels and their blending with gasoline and diesel;
- Ministry of Production: Authorises the operation of biofuel production plants;
- OSINERGMIN: Supervises and controls operations during the different stages of the production chain; and
- PROINVERSION: Promotes investment in the biofuels sector.

Under this legislation, quality standards for biofuels and procedures to register a fuel blend with MINEM were established. A schedule for blending biofuels in the conventional fuel supply was set as well. Beginning in 2010, gasoline must include 7.8% bioethanol and from 2011 diesel must contain 5.0% biodiesel (known as B5).

Production of ethanol for fuel in Peru began in August 2009, with operations in the northern region of Piura. In 2011, Caña Brava, the only producing company, reached an output of 0.3 million barrels of

ethanol. A new ethanol project carried out by Maple Ethanol Peru, began operations in late 2011and includes a processing capacity of 0.82 million barrels per year. Sugar cane's high yields and year-round harvest grants Peru's ethanol production a competitive advantage over other producers in the region.

As for biodiesel, its production for 2011 was estimated at 0.1 million barrels. In spite of the volume produced, imports are still necessary in order to meet Peru's biodiesel demand, especially in the light of the compulsory fuel blending standards as described above (MINEM, 2011b).

The Reference Plan for the Efficient Use of Energy establishes up to 15.0% in energy savings for the year 2018 in the residential, industrial, services, public and transportation sectors.

The potential market for Renewable Energy Generation can reach a total investment potential of more than 10 thousand million dollars until 2040.

Table 4: Generation Potential – Projection 2012-2014

Renewable Energy Source	Potential Cumulative Demand (MW)	Installed Investment Costs (Million USD/MW)	Total Investment Potential USD/MW
Photovoltaic	540	2.5-3.0	1 350-1 620
Wind	1 800	1.8-2.0	3 240-3 600
Hydropower	2 000	1.5-1.8	3 000-3 600
Biomass	1 800	1.8-2.5	3 240-4 500
Total	6 140		10 830-13 320

Source: (IFC, 2011).

NUCLEAR

Although Peru does not use nuclear energy for electricity generation, a government-run nuclear program has been in operation since 1975. This program involved constructing a basic infrastructure, human resources training, and the establishment of the Peruvian Institute of Nuclear Energy (IPEN) as part of MINEM. Peru has been a member of the International Atomic Energy Agency since the creation of that international body in 1957. The mission of the IPEN is to promote and develop research and nuclear applications to improve the country competitiveness and the quality of life of its inhabitants.

In late 2009, IPEN presented its Institutional Strategic Plan 2010-2016. The document comprises three main objectives, one of them regarding the promotion of electricity generation based on nuclear energy (IPEN 2009).

CLIMATE CHANGE

As one of the economies most vulnerable to climate change, Peru has looked forward to implementing an effective and sustainable strategy for adapting to and mitigating its effects.

As part of its environmental strategy policy, in October 2003 the Peruvian Government, by Supreme Decree No. 086–2003–PCM, approved the National Strategy on Climate Change (NSCC), for the mitigation of an adaptation to 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 through the use of renewable energies and energy efficiency programmes in production sectors.

The NSCC was subsequently updated in 2009, and in May of that year the Climate Change Commission, which brought together regional, social, academic and private participants, was created.

After the United Nations Climate Change Conference of Parties (COP16) held in Cancun, Mexico in late 2010, Peru submitted its Nationally Appropriate Mitigation Action (NAMA) in which it agrees to reduce its emissions by accomplishing the following objectives (UNFCCC, 2011):

- Reduction to zero of net deforestation of natural or primary forests;
- Modification of the current energy grid, so that renewable energy (non-conventional energy, hydropower and biofuels) represents at least 33.0 per cent of the total energy use by 2020; and
- Design and implementation of measures, which allow the reduction of emissions caused by the inappropriate management of solid waste.

Peru's international climate change commitments are the responsibility of MINAM, which is in charge of the design and execution of related policies. As of 2011, MINAM had reported progress on several of Peru's climate change projects and defined new specific priorities to be tackled. International cooperation and sufficient funding of projects were stressed as specific factors needed to carry out projects successfully (MINAM, 2011). In 2014, Peru will be hosting the COP20 conference and will receive approximately 15 000 people representing 194 countries and actors in international organisations, civil society, private sector and various media as well as presidents and ministers, all in a period of fifteen days. The main goal of the COP20 is to obtaining a new climate agreement.

NOTABLE ENERGY DEVELOPMENTS

In 2014, the Peruvian Government presented the New Energy Plan: 2014–2050. The main goals of the Energy Plan are as follows:

- To provide energy security and universal access to the energy supply; and
- To develop energy resources under a social and environmental perspective.

Under the energy efficiency goals Peru has:

- Established new labeling rules for electrical appliances, water heaters, lighting, electric engines and cauldrons;
- Promoted an Energy Efficiency culture;
- Established an exclusive way for the public transportation system;
- Maximised the use of natural gas in transportation;
- Promoted the substitution between natural gas and GLP and diesel; and
- Tried to keep energy prices in real terms.

At the same time, the Plan considers the expansion of gas pipelines to cover the whole coast region. It is expected that this will increase the consumption of natural gas in Peru in the 2025 to reach almost the 35.0% of the final energy demand.

The plan mentions some social indicators as is summarised as follow:

- Electric Frontier: 99.0% of the population with direct access to electricity;
- Connexions to natural gas grid: 1 800 000 in 2025 versus 164 000 in 2013.

The Government considers the plan its main guide for reaching the long-term goals of efficiency. The total amount of investments will be at least USD 49 650 million.

Table 5: Investments required according to the New Energy Plan 2014-2025

		GDP 4.5%	GDP 6.5%
Electricity	Generation	6 700	7 300
	Transmission	1 700	1 700
Gas	Upstream	5 200	6000
	Gas pipelines	11 550	11 680
	Petrochemical	5 000	5 000
Oil	Upstream	16 000	18 000
	Downstream Refineries	3 500	3 500
Total *USD Millions		49 650	53 180

Source: (Plan Energético Nacional 2014-2025).

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Banco Central de Reserva del Perú——www.bcrp.gob.pe

Comité de Operación Económica del Sistema Interconectado Nacional——www.coes.org.pe

Instituto Nacional de Estadística e Informática——www.inei.gob.pe

Instituto Peruano de Energía Nuclear——www.ipen.gob.pe

Ministerio del Ambiente——www.minam.gob.pe

Ministerio de Economía y Finanzas——www.mef.gob.pe

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Proyecto Camisea—www.pluspetrol.net/camisea.html

THE PHILIPPINES

INTRODUCTION

The Philippines is an archipelago consisting of 7 107 islands and covers a total land area of 300 000 square kilometres and with coastline of 36 289 kilometres. It is located in the south-eastern part of Asia and bordered by the Philippine Sea on the east, the South China Sea on the west, the Luzon Strait on the north, and the Celebes Sea on the south. It has three major geographical divisions—Luzon, Visayas and Mindanao islands. Manila, which is located in Luzon, is the capital of the Philippines and identified by the World Bank as one of the 120 largest cities in the world. The economy's total population in 2012 reached 96.7 million, a 1.7% increase from 2011 levels. The economy is the twelfth most populated in world population ranking and seventh in Asia (WB IBRO-IDA, 2014).

In 2012, the Philippine economy posted a GDP of USD 569.5 billion (USD 2010 Price and 2010 PPP), registering a 6.8% increase from the previous year and outpacing the growth of its neighbouring countries. Such impressive growth was due to robust performance of the service and industry sectors, which grew by 7.4% and 6.5%, respectively, as well as to favourable macroeconomic environment. Government spending also exhibited a huge growth, specifically in public construction, which was up by 32.0% (Navarro and Yap, 2013), (PSA-NSCB, 2012). In view of the sturdy growth of the economy, per capita GDP (USD 2010 PPP) also improved by 5.0% from 2011 level of USD 5 609 (EDMC, 2014).

The economy is also blessed with indigenous energy resources with modest proven reserves of around 126.1 million barrels of oil (includes condensate), 87.6 billion cubic meters (3,092 billion cubic feet) of natural gas and 438.8 million metric tonnes of coal. The Philippine government's policy is to continue harnessing domestic energy resources, such as fossil fuels, to reduce dependence on imported energy, as well as to increase the economy's energy self-sufficiency level. On the other hand, the economy's renewable energy sources contributed a significant share of 28.5% to the total power generation in 2012. Hydro and geothermal provided a 14.0% share each to the generation mix, while biomass, wind and solar added a combined share of less than 1.0% (DOE, 2013c).

Table 1: Key Data and Economic Profile, 2012

Key data[a]		Energy reserves[b]	
Area (thousand sq. km)	300	Oil (billion barrels)[c]	126.1
Population (million)[a]	96.7	Gas (billion cubic metres)[c]	87.6
GDP (USD (2010) billion at PPP)[b]	569.5	Coal (million tonnes)[c]	438.8
GDP (USD (2010) per capita at PPP)[b]	5 889	Uranium (kilotonnes U)	–

Sources: a. (WB, 2014); b. (EDMC, 2014); c. (DOE, 2013).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

In 2012, the total primary energy supply stood at 42 668 kilotonnes of oil equivalent (ktoe), up by 7.3 from the 2011 supply level of 39 756 ktoe (EDMC, 2013). Of the total, 55.0% came from indigenous energy sources and the remaining were imported. The economy's energy self-sufficiency level declined from 58.0% in 2011 due to reduced contributions of natural gas as a result of a maintenance shutdown and from the decreased percentage share of renewable energy. Natural gas registered a 7.4% share of total primary energy, lower than its 2011 share of 8.3%, while the share of renewable energy also decelerated from 40.4% to 38.0% for the same period. Oil and coal, which are mostly imported, contributed 32.4% and 21.8% shares, respectively (DOE, 2013b).

FOSSIL ENERGY

To meet the growing energy demand of the economy, its net imports increased by 8.5% from 18 100 ktoe in 2011 to 19 632 ktoe in 2012. About 70.0% of the total energy imports were oil and oil products, and the remaining was coal (29.0%) and biofuels (1.0%).

The surge on energy imports was due mainly to increased coal demand for power generation. Demand for imported coal went up by 32.8% in 2012 from its previous year's level. Domestic coal

production likewise improved by 6.8%, of which more than 90.0% of coal production came from Semirara Mining Corporation as the major coal producer. On the other hand, oil imports grew by 10.7% in the same year to compensate for decreased share of indigenous fuels (DOE, 2013b).

RENEWABLE ENERGY

The economy's renewable energy sources contributed substantially to the supply mix portfolio, specifically for power generation, providing 38.0% share to total primary energy supply in 2012. Geothermal, which being used primary for power generation, has been a major renewable energy source accounting for about 36.5% share to total indigenous primary energy supply. The Philippines still remains the second-largest producer of geothermal energy in the world, next to the United States, with a total installed capacity of 1 848 MW. Hydro and biomass resources registered a combined share of 30.6% to the total indigenous energy supply.

As a government priority policy, greater private sector involvement will be promoted and intensified for the development and utilisation of the economy's vast renewable energy potentials. As stipulated in the National Renewable Energy Program (NREP), the economy intends to triple the 2010 renewable energy base installed capacity, as an aspirational target, for power generation, as well as its contribution to non-power application to increase renewable energy share to the primary energy mix by 2030 (DOE, 2013).

ELECTRICITY GENERATION

The economy's total electricity generation in 2012 grew by 5.6% from 69 050 GWh in 2011 to 72 921 GWh. Power generation from coal-fired power plants contributed the largest share at 38.8%, followed by natural gas-fired at 29%. Hydro and geothermal both exhibited 14.0% shares of the total power generation mix. Electricity generated from hydro demonstrated an improvement of 5.7% from its 2011 level. For the other renewable resources, biomass posted a remarkable increase at 58.6%. Solar registered an increase in electricity generation by 8.9%, while wind declined by 14.6%. Contribution from oil-based thermal plants went up by 25.0% providing additional power requirements for the economy, specifically in Luzon and Mindanao grids. Self-sufficiency in power generation in 2012 stood at 58.8% (DOE 2013c).

Table 2: Energy Supply and Consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	23 435	Industry sector	5 845	Total	72 921
Net imports and other	19 632	Transport sector	8 108	Thermal	52 160
Total PES	42 668	Other sectors	9 549	Hydro	10 252
Coal	9 316	Total FEC	23 502	Nuclear	-
Oil	13 826	Coal	1 897	Geothermal	10 250
Gas	3 159	Oil	11 556	Others	259
Other	16 367	Gas	1		
		Electricity and other	10 048		

Sources: (EDMC, 2014).

FINAL ENERGY CONSUMPTION

In 2012, the total final energy consumption of the economy reached 23 502 ktoe, posting an increase of 2.4% from 2011 level of 22 961 ktoe. The transport sector remained the most energy-intensive sector accounting for the largest share of 34.5% of total final energy demand. Its energy consumption also grew by 4.1% as compared to last year's negative growth. Meanwhile, the industry sector recorded a share of 25.0%, becoming the third biggest energy consumer next to transport and residential sectors. However, the sector's energy consumption slightly dropped by less than 1.0% coming from a negative growth in 2011. The other' sectors energy consumption accounted for an aggregate share of 40.0% in 2012. The residential sector displayed a declining growth pattern in its energy consumption, which may be attributed to a reduction in biomass and kerosene demand due to shift in more efficient fuel like LPG (DOE, 2013b).

As for fuel type, petroleum products continued to be the dominant fuel for the economy accounting for nearly half (49.2%) of total energy demand, and recorded a growth rate of 2.3% from 11 296 ktoe in

2011 to 11 556 ktoe in 2012. Electricity and others (biomass) registered an aggregate contribution of 42.7% share to the total. Electricity demand expanded by 5.5% from last year's level of 4 824 ktoe, while biomass consumption reduced by 1.4%. On the other hand, coal consumption showed an increase of 3.21% from the previous year's level, and natural gas consumption remained relatively the same over the same period.

ENERGY INTENSITY ANALYSIS

Table 3: Energy Intensity Analysis, 2012

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	74.6	74.9	0.5
Final Energy Demand	43.1	41.3	-4.2
Industry	11.0	10.3	-6.4
Transportation	14.6	14.3	-2.5
Others	17.5	16.8	-4.1

Sources: (EDMC, 2014).

Overall, the GDP growth rate of 6.8% in 2012 (USD 2010 Price and 2010 PPP) resulted in 7.3% improvement in the economy's total primary energy supply. This could be translated to an economy-wide primary energy intensity level of 74.92 tonnes of oil equivalent per USD million GDP (toe/USD million) with a nil increase of 0.5% from last year.

For final energy demand, intensity level decelerated by 4.0% from 2011 level. Among the sectors, the industry sector registered the largest reduction in energy intensity at 6.4% from last year's levels. Such a drop in energy use, despite the increase in production, may be credited to applying more energy-efficienct production processes and technologies. On the other hand, the transport sector posted a lower intensity at 14.24 toe/USD million, a decrease of 2.5% from its previous year's level as a number of vehicle owners are becoming judicious in fuel use and adopting more fuel efficient vehicle due to continuous increase in petroleum prices.

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

The Philippine Energy Plan (PEP 2012-2030), which was launched by the Department of Energy (DOE), is the central policy framework set forth in ERA. The Plan aims to ensure the delivery of secure, sustainable, sufficient, affordable and environment-friendly energy to all economic sectors. To pursue the goal, the government will accelerate private sector participation, as well as involve other stakeholders (DOE, 2013). The Plan has the following policies:

- Expand energy access;
- Promote a low-carbon economy;
- Climate-proof the energy sector;
- Develop regional energy plans;
- Promote investments in the energy sector; and
- Identify and implement energy sector reforms.

In support of these policy thrusts, the Plan also set quantifiable targets to be attained by 2030 as follows:

- Triple renewable energy capacity by 2030;
- Complete 90.0% household electrification by 2017 and 100.0% local electrification level for sitios (an administrative-territorial category in the Philippines) by 2015;

- Achieve 30.0% of all public utility vehicles running on alternative fuels;
- Implement a higher blend of biofuels; and
- Attain 10.0% energy savings on total energy demand.

ENERGY MARKETS

OIL AND GAS

The government has been aggressively pursuing the exploration and development of indigenous oil and gas resources through the conduct of Philippine Energy Contracting Round (PECR). PECR is a bidding process started in 2003 to encourage both local and foreign companies to engage in exploration activities for the economy's 16 sedimentary basins. These sedimentary basins have a combined potential of 4,777 million barrels of oil equivalent (Mboe) (or 689.8 Mtoe) of oil and gas reserves (DOE, 2013).

The DOE has been supervising and monitoring 29 existing petroleum service contracts (SCs), which include the three newly awarded SCs as a result of the PECR4 held in June 2011 (DOE, 2013). Of note, the government received 20 bid proposals for the 15 prospective offered areas under PECR4 (DOE, 2013a). Investment road shows were even conducted in other APEC economies (i.e. Australia, Singapore and USA) to invite foreign exploration companies to join the energy contracting round.

In 2012, the economy's existing oil and gas fields yielded a production of 1.64 million barrels (mmb) of oil, 137.77 billion cubic feet (bcf) of natural gas, and 4.75 mmb of condensate. The reduction of oil production by 28.7% from last year's level of 2.3 mmb was due to unavailability of Galoc field for three months as a result of technical problem on the vessel used of production (DOE, 2013a).

Malampaya is the largest producing gas field in the economy and its primary source for natural gas with an estimated daily production capacity of 11.7 million cubic metres (399 million cubic feet) in 2012. Libertad is the other natural gas field with estimated daily capacity of only 0.211 mmcf. The contribution of natural gas to total indigenous energy supply in 2012 was at 13.3%. However, production was down by 1.8%, which was attributed to the preventive maintenance of the shallow water platform (SWP) of Malampaya. This also caused a reduction of 4.6% from electricity generated by natural gas (DOE, 2013b).

COAL

The economy has domestic coal resources, which is endowed with 13 coal basins. These coal basins have an estimated total potential resource of 2.4 billion metric tonnes. Among the basins, Semirara in Antique (Visayas) has the largest coal resource potential at 570 million metric tonnes (MMmt). In-situ reserve is estimated at 438.8 MMmt. The economy's total coal production in 2012 was recorded at 7.3 MMmt at 10 000 BTU/lb, a minimal improvement of 5.8% from 2011 level of 6.9 MMmt. Semirara Mining Corporation contributed 94.0% to the total coal production. Domestic coal production was around 41.6% of the total coal requirement (DOE, 2013b).

From the results of the PECR4, 11 new Coal Operating Contracts (COCs) were awarded in 2013 (DOE, 2013). The DOE accepted 57 proposals of the 67 submitted proposals for the 38 prospective coal areas offered under PECR4. As regards the development of small-scale coal areas, the DOE awarded 26 small-scale coal mining permits in different parts of the member economy in 2012. To prevent proliferation of illegal mining and trading activities, the DOE issued *Guidelines on the Accreditation of Coal Traders and Registration of Coal End-Users* (DOE, 2013a).

As of 2012, the DOE has supervised and monitored 53 COCs composed of 31 COCs under the development and production stage, and 22 COCs in the exploration phase.

MARKET REFORMS

ELECTRICITY

The current administration is keen on pursuing the remaining reforms of the Electric Power Industry Reform Act (EPIRA) of 2001 to include the effective implementation of the Retail Competition and Open Access (RCOA). RCOA is seen to improve competition in the generation and supply sector that would lead to competitive tariff for electricity. Public consultations were conducted to gather comments and suggestions from the industry stakeholders on the general policies and guidelines that will govern the implementation of RCOA (DOE 2012).

The DOE and the Energy Regulatory Commission (ERC) issued a joint resolution setting the date for the initial implementation of RCOA on 26 December 2012, which will be on a phase-in and partial implementation program. It is envisaged that the initial implementation will be for a period of six months as transition period to ensure smooth transition to full implementation 26 June 2013. The transition period will be expended for registration and discussions, trainings and simulations among suppliers, contestable customers and other stakeholders. During the transition, distribution utilities will still be allowed to serve the contestable customers (markets) located within their respective franchise areas. Contestable customers are those with an average load requirement of one (1) MW in the last 12 months. Further, the contestable customers may also enter into supply agreements with suppliers, but will only take effect at the end of the transition period (DOE, 2013a).

In January 2013, the DOE issued a Department Circular promulgating the Retail Rules for the Integration of RCOA to the Wholesale Electricity Spot Market (WESM). This is to provide the rules for the integration of the retail competition in the operations and governance processes of WESM, management of the transactions of suppliers and contestable customers, as well as the operations of the Central Registration Body (CRB) (DOE, 2013).

On the privatisation of the remaining generating assets of the National Power Corporation (NPC), the Power Sector Assets and Liabilities Management Corporation (PSALM) has to privatise a total of 1,913 MW of generating assets composed of power barges, thermal plants, and hydro plants. More than half of these generating capacities are located in Mindanao, which are mostly hydro power plants (DOE, 2014).

As of April 2013, the privatisation proceeds already reached USD 21.76 billion with actual collections amounted to USD 6.37 billion. About 70% of the collection was utilised for prepayments of NPC debts and regular debt service. The sale of sub-transmission assets (STAs) involved 131 sale contracts with 107 interested distribution utilities, mostly Electric Cooperatives (ECs). The STAs covered 6 200 ckt-km of transmission line, majority of which is comprised of 69 kV lines, and 1 600 MVA of substation capacity. For the same period, the National Transmission Corporation (TransCo) signed 106 contracts with the 76 DUs/ECs/consortia with a total of PhP 5.75 billion. The assets include 3,900 ckt-kms of sub-transmission lines, 35 600 sub-transmission structures, 865 MVA of substation capacity. Out of the signed sale contracts, 45 contracts with total sale price of PhP2.3 billion were already approved one contract disapproved by ERC. The remaining contracts (60 contracts) are still for ERC filing and approval (DOE, 2013d).

To immediately a provide solution to the looming power crisis in Mindanao, the DOE directed the Philippine Electricity Market Corporation in January 2013 through a Department Circular to develop and implement an Interim Mindanao Electricity Market (IMEM). The IMEM shall be a mandatory program for all generating capacities, DUs, and customers with embedded generation to address the deficiency of supply in the Mindanao grid. It will serve as a venue to efficiently utilise all available capacities in the grid to provide additional supply capacities (DOE, 2014).

Another measure being implemented in Mindanao grid is the Interruptible Load Program (IPL). In this program, customers of a DU will be compensated for voluntarily de-loading itself from the grid by operating its generation facility for its own use during peak demand hours. The DU will then charge and collect from the customers within its franchise area the corresponding energy 'freed up' (in kilowatt-hours) by the ILP customers, which will be used to pay the said ILP customers based on the ERC-approved ILP rates (DOE, 2013).

By the end of December 2012, the economy's barangay (a village, district or ward, i.e. the basic political unit) electrification level already stood at 99.9% with only six (6) barangays left, all in Mindanao, to be provided with electricity. For sitio and households, the energisation levels had already reached 72.8% and 77.9%, respectively (DOE, 2013a). It has been a challenge for the government to provide access to electricity in some areas due to geographical landscape of the Philippines. With this, the government has devised a mechanism to energise areas isolated from the grid through decentralised RE system like photovoltaic solar home system (PV-SHS) and the Qualified Third Party (QTP) program. The QTP opens the unviable areas for private sector investment, which will provide an integrated power generation and distribution service to the households.

OIL

The DOE is mandated under the Downstream Oil Industry Deregulation Act of 1998 to closely monitor the various activities of the industry and the price levels to ensure continuous and stable supply, and reasonable price of petroleum products in the economy. As of December 2012, a total of 1,908 players are not engaged in different activities of the oil industry (e.g., marketing, distribution and storage) after 14 years of the implementation of the Act with total accumulated investment of PhP42.6 billion (DOE, 2013a).

To address the risks from supply-related problems such as geopolitical uncertainties and calamities, the government has still enforced the Minimum Inventory Requirement (MIR) on oil companies, bulk and LPG suppliers. For refiners, the MIR is 30 days for total in-country-stocks of crude and finished products. Meanwhile, bulk marketers and LPG players are required to maintain 15 days and 7 days MIR, respectively.

The DOE likewise conducted regular inspection and sampling of petroleum products for compliance to quantity and quality standards at the refineries, depots/terminals, gasoline stations, and LPG establishments in the member economy. As a statutory mandate of the DOE, monitoring of oil price movements for both international and domestic markets has been consistently undertaken to prevent unreasonable adjustments and abuses.

An Independent Oil Price Review Committee was established in 2012 for the review of Oil Deregulation Act with a primary focus on pricing to determine if there is accumulation of excessive profits and unfair pricing. The final report of the review was submitted to DOE. Some of the major findings were:

- Fair price is been achieved under the Oil Deregulation Act;
- Pump price movements to changes in world oil prices have been symmetrical; and
- Oil companies' profits are reasonable (DOE, 2013a).

DOWNSTREAM NATURAL GAS

The government has considered the development of natural gas as an important component of fuel diversification and a priority industry of the energy sector. Natural gas is seen as one of the feasible alternatives to oil-based energy for power generation, transport and industrial uses.

The Malampaya Gas-to-Power Project (MGPP) in 2001 paved the way for the birth of the natural gas industry in the Philippines, and contributed significantly in the economy's primary energy supply and power generation mix reducing energy imports. However, the industry confronted a major challenge, which is putting in place the necessary infrastructure development to further promote the use of natural gas, specifically for non-power processes. Several concerns caused the delay of infrastructure development, among which were supply availability and sustainability and the issue of the anchor market needed to justify private investments. Despite these challenges, the government has put forward measures and strategies for the expansion of natural gas industry. Proposals from the private sector to engage into different business prospects of the gas value chain have been received by the government. The government is also cognisant that natural gas imports to supplement local production from Malampaya gas field will be necessary to meet the projected demand from the potential market, if there are no new natural gas discoveries.

The government likewise is aware of the urgency of establishing a clear and comprehensive policy regarding the regulatory framework as a requisite for the development of the downstream natural gas industry. In light of this, a Natural Gas Bill has been drafted and filed to both Houses of Congress. The Department Circular issued by the DOE in 2002 on the 'Interim Rules and Regulations Governing the Transmission, Distribution and Supply of Natural Gas' serves as an interim policy governing the natural gas industry.

The 2002 Master Plan Study for the Development of the Natural Gas Industry in the Philippines has been updated in March 2012 through the technical assistance of the Japan International Cooperation Agency (JICA). A complementary study was done by the World Bank (WB) for the supply of natural gas in Luzon and Mindanao, which covered aspects on current and existing LNG transportation, receiving, storage and regasification approaches, and the analysis of a suitable LNG terminal site in the region. A parallel study was also undertaken by the WB for the 'Mindanao Natural Gas Market Development Strategy.' The study pre-identified that a power plant project (around 500 MW) will justify the investment for the proposed Floating Storage Regasification Unit (FSRU) facility in Mindanao (DOE, 2013).

The DOE entered into an agreement with Pilipinas Shell Petroleum Corporation (PSPC) to conduct a technical feasibility study on a Floating Storage Regasification Unit (FSRU), which will be placed in the province of Batangas. For pipeline development, the Philippine National Oil Company (PNOC) commissioned the Public-Private Partnership (PPP) Center and JICA for the detailed feasibility study of the 105-km Batangas-Manila pipeline (DOE, 2014).

ALTERNATIVE FUELS

As the economy confronts the growing energy demand, coupled with the global issue on climate change, the government has embarked on implementing policies and programs on alternative fuels for the transport sector, which is the largest energy-consuming sector. The government recognises the critical role of both alternative fuels in reducing the economy's dependence on the highly volatile oil market and the diversification of energy resources so as to include indigenous and more environment-friendly alternative fuels. With the passage of the Biofuels Act of 2006 and the developments in other alternative fuels such as Compressed Natural Gas (CNG), auto-LPG and e-vehicles, the government will ensure sustainability in the development and utilisation of these alternative forms of energy sources.

In the Biofuels Act, the government mandates the use of 2.0% biodiesel and 10.0 bioethanol blends with diesel and gasoline, respectively, harnessing domestic feedstock. The DOE has entered into partnership with various academic institutions and other stakeholders for the continuous conduct of research and development on other potential feedstocks for biodiesel and bioethanol, as well as for the proposed increase in biodiesel blend from 2.0% to 5.0%, and testing for the application of higher biodiesel blend to 'jeepney' as a common public utility in the Philippines (DOE, 2013).

In support of the campaign to promote the use of cleaner and alternative fuels, the Land Transportation Franchising and Regulatory Board (LTFRB) through the Department of Transportation and Communications (DOTC) granted preferential approval of franchise applications for CND-fed buses. In addition, the exemption of CNG-buses from the Unified Vehicle Volume Reduction Program has been extended (DOE, 2013a).

For auto-LPG, the LTFRB extended the number of years of franchise granted for taxis that converted to auto-LPG by two (2) years, which now provided 15 years franchise contract (from the original 13 years contract) to promote new players in the program. To ensure the safety of the conversion of taxi fleets, the DOE together with the Bureau of Product Standards (BPS) of the Department of Trade and Industry developed and promulgated the Philippine National Standards for auto-LPG. The Development Bank of the Philippines (DBP) offers reasonable financing package for the acquisition of auto-LPG vehicles and other related activities as part of its Clean Alternative Transport Fuel Financing Program (DOE, 2013).

Another initiative of the government is the electric vehicle program, which is seen to contribute to reducing petroleum consumption and achieve lower emission level. Under the Asian Development Bank (ADB) Loan Assistance Program, 100 000 electric tricycle or e-trike (a motorcycle with an attached passenger sidecar—a three-wheeled vehicle—used as local-based public utility vehicle) will be purchased to replace the two-stroke tricycle. It is estimated that the shift to 100 000 e-trike will result in reduction of annual petroleum consumption by 89 million liters. A contest was even conducted nationwide for the 'Best E-Trike Design' for the local fabrication of the said e-trike (DOE, 2013a). The program has been promoted with the local government units (LGUs) nationwide. The e-trike is set to be deployed by 2014.

ENERGY EFFICIENCY

Energy efficiency and conservation program is a crucial component of the economy's energy plan to temper the growing demand for energy. The government has been implementing several initiatives and still finding ways to efficiently manage energy use to support a growing economy and bring down greenhouse gas (GHG) emission. In achieving the benefits from energy efficiency and conservation program, technology development and lifestyle change have been aggressively pursued by the government.

With the launching of the National Energy Efficiency and Conservation Program (NEECP) in 2004, the government in partnership with the stakeholders continuously works on the development and introduction of new efficient technology, and on the promotion on the changing energy consumption practices in homes, business and vehicles. To further strengthen the NEECP, the DOE developed a new branding for its campaign with a theme 'Bright Now! Do Right, Be Bright' in 2011, which intends to promote efficient use of energy, and educate and empower the public to be smart energy users. The promotion of the branding for the new campaign started in 2012 (DOE, 2013).

The NEECP is comprised of several measures, programs and projects catering to different sectors and/or entities, which include, among others:

- Social Mobilisation and Information, Education and Communication (IEC) Campaign;
- Energy Efficiency Standards and Labelling Program;
- Government Energy Management Program (GEMP);
- Energy Management Services/Energy Audits;
- Voluntary Agreement Program;
- Recognition Award Program;
- Fuel Conservation and Efficiency in Road Transport (FCERT):
    - Fuel Economy Run Program (part of IEC to establish significant data for a vehicle labelling program in the future);
- Power Conservation and Demand Management (Power Patrol); and
- Other programs/projects with technical assistance from donor institutions such as:
    - The Philippine Industrial Energy Efficiency Project (PIEEP), a United Nations Industrial Development Organisation-Global Environment Facility (UNIDO-GEF) assisted and funded project. The project aims to: promote and introduce energy management and industrial energy systems optimisation; building capacity of the stakeholders—enterprises, equipment suppliers, engineering/energy service companies, financial institutions and government planners to implement system level efficiency improvement, and integration of energy efficiency into management systems of industrial enterprises through energy management standards. The PIEEP is expected to generate energy savings from its five-year project implementation (2012-2016) estimated at 2 058 GWh and GHG reduction of 1 459 133 tonnes of CO_2 (DOE, 2012a);
    - The Philippine Energy Efficiency Project (PEEP) is a project funded from the Asian Development Bank (ADB) loan with the primary objective of promoting and implementing energy efficiency and conservation in residential, public and commercial sectors through the introduction of energy efficient lighting system such Compact Fluorescent Lamp (CFL). The project is likewise designed to establish sustainable business models for large-scale implementation of energy efficiency programs, and a certification process for energy and environmentally efficient commercial buildings, among others; and
    - Development Study on Energy Efficiency and Conservation, a Japan International Cooperation Agency (JICA) technical assistance project. The project intends to assist the DOE in designing the Energy Conservation Bill, which would institutionalise energy efficiency and conservation measures. The sub-components of the projects include the IEC campaign, training and certification program for energy auditors and energy managers, and a National Energy Consumption Database and System Application Tool (DOE, 2013).

The Energy Efficiency Standards and Labelling Program covers household appliances and lighting products such as room air conditioners, refrigerators (with storage volume of five cubic feet to eight cubic feet), and compact and circular fluorescent lamps including ballasts. In the future, the coverage of the program will be expanded to include other household electric appliances and industrial equipment, such as electric fan, washing machine, television and industrial fan and blowers, and even vehicles. As part of the 'Do Right, Be Bright' campaign in 2012, the DOE in partnership with ADB launched the 'Watt Out!' TV Olympics to display to the public the most energy efficient technologies in the market. It also seeks to show the appliance's power consumption and its effect on the monthly electricity bill (DOE, 2013a).

The GEMP mandates all government offices to lower down their monthly consumption of electricity and petroleum by at least 10.0%, which will reduce the public sector's electricity bill and fuel expenses. The program generated accumulated savings from September 2005 to December 2012 of PhP 1.77 billion of electricity bill and PhP 276 million of fuel expenses, equivalent to 231.8 GWh and 7.47 million litres of electricity and fuels, respectively. In 2012 alone, GEMP obtained savings of 47.63 GWh of electricity and 0.64 million litres of fuel amounting to PhP 287 million of electricity bill and PhP 26.5 million of fuel expenses (DOE EUMB, 2014).

Meanwhile, the Don Emilio Abello Energy Efficiency Award (DEAEEA) is being conferred to private entities in recognition of their initiatives in implementing energy efficiency and conservation measures. In December 2012, 43 establishments and 25 energy managers were recognised under the

DEAEEA. The aggregate savings reached 56 million litres of oil equivalent amounting to PhP 2.2 billion, and 90 million kilograms of CO_2 avoidance (DOE EUMB, 2014).

For the PEEP, the project has six components, namely:

- National Residential Lighting Program—Distribution of 8.6 million compact fluorescent lamps (CFLs);
- Retrofit of government office buildings—retrofitting of lighting systems of government buildings nationwide;
- Public Lighting Retrofit Program—Public lighting retrofits of mercury vapor lamps to more efficient lighting fixtures;
- Energy Efficiency Testing and Lamp Waste Management—Expansion of the capacity of the DOE's testing laboratory to conduct efficiency testing on a wider range of appliances and the accreditation of the laboratory to ISO 17025. Procurement of Lamp Waste Management facility and the establishment of a business model for collection of lamp waste;
- Efficient Building Initiative—Establishment of an efficient building rating system that include a Rating Scheme for Green Buildings; and
- Communication and Social Mobilisation—Production and distribution of information materials for the campaigns on 'Communication for Efficient Lighting' and 'Promoting Efficiency in Everyday Life' (APERC, 2012).

The project has already completed the distribution of 8.6 million CFLs to the residential sector in 2012. The estimated electricity savings from the distribution of CFLs to the residential customers would be 264 GWh annually, including a CO_2 avoidance of 143 000 tonnes per year (DOE, 2013).

On the other hand, the JICA Development Study Team completed the 5th and last mission in 2012 with a draft proposed Energy Conservation Bill. Said proposed Bill already gained endorsement from a Congresswoman and a Senator of the Philippines in both Houses of Congress (DOE, 2013). From the NEECP various programs and projects, the economy was able to save around 4.35 million tonne of oil equivalent (Mtoe) of fuel and electricity consumption, half of which (2.65 Mtoe) was realised from the Energy Labelling Program (DOE, 2013a).

RENEWABLE ENERGY

Pursuant to the passage of the Renewable Energy Act of 2008 and the adoption of the NREP (2012-2030) in June 2011, the government has continuously and aggressively pursued the development andutilisation of renewable energy to increase its contribution to the energy mix. The NREP aims to:

- Increase the utilisation of indigenous RE resources to help ensure the member economy's energy security and independence, as well as minimise the adverse impact of modern energy use;
- Institutionalise a comprehensive approach to address the challenges and gaps hindering the wider application of RE technologies in a sustainable manner;
- Assist the stakeholders including donor institutions to maximise market penetration of RE resources in the energy sector; and
- Outline the action plan necessary to facilitate and encourage greater participation of private sector.

To fully implement the RE Act, other policy mechanisms have to be formulated and implemented, which include:

- Renewable Portfolio Standards (RPS);
- Feed-in Tariff (FiT);
- Green Energy Option Program; and
- Net- Metering for Renewable Energy.

The draft Renewable Portfolio Standard (RPS) has already been formulated and being reviewed. The RPS sets the minimum percentage of generation from eligible RE resources provided by the generators, distribution utilities and electric suppliers. An initial installation target has been set at 760 MW for the first three years (2013-2015) of implementation broken down as follows:

- Solar– 50 MW
- Run-of-river hydro – 250 MW

- Wind – 200 MW
- Ocean – 10 MW
- Biomass – 250 MW

The initial Feed-in-Tariff (FiT) was already approved by the ERC in July 2012 covering run-of-river hydro, biomass, wind and solar. FiT is a guaranteed payments on a fixed rate per kWh on RE generation, but excluding generation for own use. ERC deferred the FiT rate for ocean since further study and analysis must be undertaken. Following are the FiT rates for RE resources:

- Hydropower
- Wind
- Biomass
- Solar

The National Renewable Energy Board (NREB), which was created by virtue of the *RE Act*, endorsed the enabling rules for the Net Metering Program on RE to ERC. The Net Metering Program is a consumer-based incentive scheme wherein the electric power generated by the end-users from eligible onsite RE-generating facility, and delivered to the distribution utility, may be used to offset electric energy provided by the DU to the end-user during the applicable period (DOE, 2013a).

- In 2012, a total of 101 RE service contracts were awarded by the DOE with an aggregate capacity of 2 566 MW as follows:

- Geothermal – 8
- Wind – 6
- Hydro – 53
- Solar – 27
- Biomass – 7

Of the total, five service contracts are for conversion (with total installed capacity of 1 061 MW) to avail of the incentives under the RE Act. For the period 2010-12, the DOE already awarded 258 service contracts—215 new service contracts and the remaining for conversion (DOE, 2013).

As of 2012, the total installed power generating capacity from RE on the grid stood at 5 521 MW. Hydro contributed the biggest share of 3 521 MW (197 MW capacity is on off-grid areas), followed by geothermal with 1 848 MW. The biomass resource, which is a site-specific generating facility, has a total installed capacity of 117 MW, while wind has a generating capacity of 33 MW and solar with 1 MW in on-grid capacity (DOE, 2013c). Solar is also being used to provide access to electricity in off-grid areas through PV-SHS.

NUCLEAR

As a policy, the government has been receptive to all available energy resources to ensure that the economy has a secure, reliable and stable energy supply with due consideration to the environment. As such, nuclear energy for power generation has still remained as a long-term energy option with its merits on supply security and environmental considerations, specifically in terms of CO_2 emissions. The economy may embrace a clear nuclear energy policy in the future with preconditions on advancement in nuclear technology and improvements in safety and safeguards standards

After the International Atomic Energy Agency (IAEA) Mission Review in 2008 on the *Development of Infrastructure to Support a Nuclear Power Program in the Philippines and the Feasibility of Rehabilitating the Bataan Nuclear Power Plant,* a Joint Department Order between the DOE and the Department of Science and Technology (DOST) was issued for the creation of an Inter-Agency Core Group on Nuclear Energy was created in 2009 with the primary tasks of developing, managing and formulating policies and strategies on nuclear power generation, as well as study the 19 infrastructure requirements for a nuclear energy program. The Core Group is also envisioned to serve as the interim Nuclear Energy Program Implementing Organisation (NEPIO). The Core Group conducted a series of Information, Education and Communication (IEC) in major cities nationwide to provide information and educate the people on the benefits of nuclear energy application in the areas of medicine, research, industry and even in power generation, as well as the disadvantages. Nuclear regulations on safety, security and safeguards were also discussed. The result of the public perception survey undertaken during the IEC activities revealed that more than 60.0% of the participant-respondents expressed support for a nuclear power program.

For the BNPP, a Memorandum of Understanding (MOU) was signed between the National Power Corporation (NPC) and Korea Electric Power Corporation (KEPCO) in 2008 for the conduct of a

feasibility study on the possible rehabilitation of the 650 MW BNPP, a Pressurised Water Reactor (PWR). The KEPCO study concluded that the BNPP rehabilitation is technically feasible at a cost of US$1 billion.

However, further undertakings were debilitated after the Fukushima incident in 2011. Despite the setback in nuclear initiatives, some sectors have still recommended a nuclear power development program in the member economy and even approached the Congress about a resolution/law supporting the program. In April 2012, the Mindanao Power Summit (Southern of the Philippines) suggested as one of their recommendations the establishment of a nuclear power plant to provide long-term solutions to the region's power supply requirement. On the other hand, as a manifestation of interest of some local government units, local resolutions were issued allowing the national government to look at the feasibility of hosting a nuclear power facility in their respective areas (ERIA, 2013).

CLIMATE CHANGE

By virtue of the Philippine Climate Change Act of 2009 (RA 9729), the Climate Change Commission has been created as a policy-making body attached to the Office of the President with the same status as that of a national government agency. The Commission is tasked to coordinate, monitor and evaluate programs and action plans relating to climate change. The President of the Philippine will serve as the Chairman of the Commission and with three-member commission, one of whom will be the Vice-Chair (CCC). The President of the Philippines also established a Cabinet Cluster on Climate Change Adaptation and Mitigation and increased the budget to address the impact of climate change (Philippine Country Statement, UNFCCC). A People's Survival Fund has been put up as a special fund that will be used for climate change adaptation programs and projects with an initial fund of PhP 1 billion (CCC).

Mindful of the fact that the energy sector is the largest contributor to GHG emission and its role to mitigating the impact of climate change, the DOE puts a premium on formulating a government plan with significant contribution towards low carbon economy—that is, with minimal GHG emissions. The PEP 2012-2030 supports the global initiatives on addressing climate change and responsive to the Philippine President's Social Contract with the Filipino people on 'Integrity of the Environment and Climate Change Mitigation and Adaption' with accelerated policies, plans and programs on energy efficiency, renewable energy and alternative fuels (DOE, 2013).

NOTABLE ENERGY DEVELOPMENTS

ENERGY REFORM AGENDA

The 2012-2030 Philippine Energy Plan is anchored on the policy framework specified in the Energy Reform Agenda with an overall vision of 'Energy Access for More.' After its launching in 2012, the DOE started drafting the regional energy plans to address specific local energy issues and concerns. First to be formulated is the Mindanao Energy Plan (MEP), which contains policies and programs to provide sustainable and long-term solutions to the region's power supply problem. The MEP was presented to the Mindanao stakeholders in a series of consultations to gather additional inputs and comments. A draft of the MEP has already been completed. Next on the drawing board is the Visayas Energy Plan (VEP) and to be followed by the Luzon Energy Plan (LEP). As a parallel effort, the DOE in partnership with the local stakeholders is also formulating the Power Development Plan for the provinces, particularly those in missionary areas or not connected to the main grid. The Palawan, Mindoro and Bohol (a province island but interconnected to the Visayas grid) Provincial Power Development Plans are being drafted, which will be for adoption by the Provincial Council/Board.

RENEWABLE ENERGY

In support of the Renewable Energy Act, the RPS has been finalised and being reviewed for endorsement by the DOE, while the FiT was already approved by the ERC in 2012. Likewise, the initial installation target has been set to 760 MW for the next 3 years of implementation. As for the other mechanisms, the Net Metering policy was also promulgated and adopted. The ERC issued a resolution titled *Resolution Adopting the Rules on Net-Metering Program for Renewable Energy*. Meanwhile, the Philippine Electricity Market Corporation (PEMC) conducted a study with technical assistance from the World Bank entitled *Renewable Energy Market (REM) Development and Draft Market Design Document*. REM serves as a sub-market under the Wholesale Electricity Spot Market (WESM) for trading of RE certificates corresponding to energy generated from the eligible RE facilities. Such RE Certificates shall be credited in compliance with any obligation under the RPS.

A Department Circular was issued by the DOE in May 2013 titled the *Guidelines for the Selection Process of Renewable Energy Projects under the FiT System and the Awarding of Certificates for FiT Eligibility*. Under the Circular, the RE developer will have to inform the DOE on the date of successful commissioning of a RE plant, which will be validated by the DOE. In the event that the validation is successful on the date of commissioning, the DOE will issue a Certificate of Endorsement (COE) for FiT Eligibility to the ERC on a first-come-first-serve basis. The DOE will issue the COE until the maximum installation target per technology is fully subscribed (DOE, 2013e).

The National Renewable Energy Program or NREP is the economy's roadmap for renewable energy development. Its long-term goal is to increase the RE-based power generation capacity to 15 304 MW by 2030, which is to triple the 2010 RE capacity, as well as expand its contribution for non-power uses. To attain such a goal, the following targets were clearly established in the program:

- Increase geothermal capacity by 75.0%;
- Increase hydropower capacity by 160%;
- Deliver an additional 277 MW in biomass power capacities;
- Attain wind power grid parity with the commissioning of 2 345 MW of additional capacity;
- Mainstream an additional 284 MW of solar power capacity and pursue the achievement of a 1 528 MW aspirational target; and
- Develop the first ocean energy facility for the economy.

The DOE has been receiving several applications from the private sector for grid connection, off-grid and own-use RE service contacts. As of 2012, the total service contracts awarded by the DOE already reached 256 with an aggregate estimated potential and installed capacity of around 6 000 MW (includes existing capacities for conversion) (DOE, 2013).

PENDING ACTIONS

A number of legislative agenda is being pursued by the DOE to further strengthen the economy's energy plans and programs. Relevant bills have been filed in both Houses of Congress, which are intended to put in place a regulatory framework policy for specific energy sub-sectors, or improve the exiting framework, and provide or enhance existing incentives to encourage more private investments to come in. Among the energy bills are:

- Energy Efficiency and Conservation Act;
- Downstream Natural Gas Industry Development Act;
- Liquefied Petroleum Gas (LPG) Industry Regulation and Safety Act;
- Amendments to the Electric Power Industry Reform Act of 2001 or Republic Act No. 9136;
- Amendments to the Petroleum Act of 1949 or Republic Act No. 387; and
- Amendments to Presidential Decree (PD) 87 or the Oil Exploration and Development Act of 1972.

MARKET REFORMS

In connection with the implementation of the EPIRA is the R.A.10150, otherwise known as 'An Act Extending the Implementation of Lifeline Rate' was signed into law in June 2011. Said Act extended the provision of subsidised rate given to low-income end-users (or market) who cannot afford to pay at full cost for another ten years, unless the provision is further extended by law.

Several Department Circulars were issued for the commercial operation of RCOA on 26 June 2013. Some of these Circulars were:

- Transparency requirements to all generators, distribution utilities and electricity suppliers to submit quarterly relevant information on contracted capacities and duration, rates, customers and sources of supply, among others; and

- Supplemental policies to empower contestable customers under RCOA with wider option on their supply contracting by allowing them to directly contract with prospective generators and removal of early termination clause in the Retail Supply Contract (RSC).

The government will also be establishing a WESM Reserve Market, which will operate in March 2014, as a trading market for ancillary services in the Luzon and Visayas grids. It is envisioned that the power industry will benefit from the market through co-optimisation of energy and reserves, which will achieve greater competition among energy and reserve providers and lead to competitive energy prices.

The National Electrification Administration (NEA) Reform Act of 2013 was enacted in May 2013 with the objectives of:

- Promoting sustainable development in rural areas through rural electrification;
- Empower NEA to pursue electrification program; and
- Empower electric cooperatives to cope with the changes on the restructuring brought by EPIRA (DOE, 2014).

The Household Electrification Development Plan (HEDP) has been finalised and approved to provide a holistic national plan and program for the attainment of total electrification of all households in a least-cost, equitable and efficient manner. The government is steadfast in its commitment to achieve its targets of 100.0% sitio electrification level by 2015 and 90.0% household electrification level by 2017.

CLEAN TECHNOLOGY FUND PROJECT

The DOE is revisiting and enhancing the Energy Efficiency and Conservation Roadmap through the EU-Switch Asia Policy Support Program in the Philippines. The overall objectives of the program are to promote sustainable development in the Philippines, and to support the government in implementing a sustainable consumption and production policy-related framework. One of the program's outputs is the implementation of policies and regulation related to clean energy and energy efficiency. The updated EE&C Roadmap intends to enhance and accelerate the implementation of EE&C programs, as well as provide long-term policy direction for the economy on EE&C initiatives.

GOOD GOVERNANCE AND TRANSPARENCY INITIATIVES

To support the transparency seal and good governance initiatives of the present administration, the DOE has pursued data and information transparency and exchanges among the energy stakeholders like contract applications in energy resources development. The DOE has created significant websites such as kuryente.org.ph and wattmatters.org.ph to provide the public with vital information on specific energy concerns. The kuryente website allows electricity consumers access to information on all distribution utilities in their respective franchise areas on electricity rates broken down by components, system losses, collection efficiency and liabilities, among others. On the other hand, the wattmatters website has information for energy consumers, especially residential sector, on energy consumption of household appliances, energy conservation tips, and on the best and more efficient appliances available on the market. The DOE aiming to expand these services by developing additional websites on petroleum demand and supply, including pump prices, and on renewable energy projects.

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USEFUL LINKS

Asian Development Bank—www.adb.org

Climate Change Commission (CCC)— climate.gov.ph/

Department of Energy, Republic of the Philippines (DOE)—www.doe.gov.ph

Department of Science and Technology (DOST)—www.dost.gov.ph/

Department of Transportation and Communication (DOTC)/Land Transportation Franchising and Regulatory Board (LTFRB)—www.dotc.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. It is the only APEC economy located in both Europe and Asia, bordered by the Arctic and the North Pacific oceans. Its territory 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. The Russian Federation has a vast natural resource base that includes major deposits of coal, natural gas, oil and other minerals. Despite its land area advantage, the economy lacks an optimal climate for agriculture—most of its area has a continental climate, and is either too cold or too dry. Central heating is common for up to 6 to 8 months of the year, while cooling during the summer is not widely used.

According to EDMC (2014), from 1990 to 2009, the Russian population declined from 148.3 million to 141.9 million. However, from 2009 to 2012, there was an increase of 1.3 million in total population from 141.9 million to 143.2 million. Shares of urban and rural population remain unchanged, at 74.0% and 26.0% respectively. Russia's average population density of only 8.4 people per square kilometre is very low, with the majority of the population living in the European part of the economy (Rosstat, 2014).

The Russian Federation's economy continued to develop strongly, achieving 3.4% growth in 2012 and an average growth rate of 4.7% for the period 2000–2012. In 2009, the global economic and financial crisis affected the Russian economy, with the GDP declining by 7.8% in 2009 from the 2008 level. The recovery in 2010–12 was driven by soaring world prices for oil and natural gas.

Table 1: Key data and economic profile, 2012

Key data		Energy reserves[a]	
Area (million sq. km)	17.1	Oil (billion barrels)	93.0
Population (million)	143 18	Gas (trillion cubic metres)	31.3
GDP (USD (2010) billion at PPP)	3 145.27	Coal (billion tonnes)	157.0
GDP (USD (2010) per capita at PPP)	22 030	Uranium (kilotonnes U)[b]	181.4

Source: a. Proven reserves at the end of 2013 (BP, 2014); b. Reasonably assured resources (NE, 2010). All other sources (EDMC, 2014).

The Russian Federation's major industries include oil and gas production, petroleum refining, mining, iron and the steel, chemicals, machinery and motor vehicles industries. In particular, Russia maintained its place in the top three automobile markets in Europe, following Germany and the UK. Vehicle production in 2012 was almost 2 million units. The energy sector's output accounts for about 30.0% of Russia's GDP, which is more than 50.0% of the tax and custom duty payments, 70.0% of total export, and 30.0% of the total investment in the economy, and is important not only to Russia's economic development but to the survival of its population during harsh winters.

In terms of proved reserves, in 2013 the Russian Federation holds 17.6% of the world's gas, 5.5% of its oil reserves, 17.6% of its coal reserves, and about 14.0% of its uranium ore reserves (BP, 2014). Even more resources remain to be discovered, but the formidable obstacles of climate, terrain and distance hinder their exploitation.

Russia's oil resources in the traditional oil producing regions are believed to be heavily depleted, as more than 50.0% of the economically-recoverable resources have already been produced. In the Urals and Volga regions, resource depletion is thought to exceed 70.0%. The share of remaining resources that are more complex to recover is constantly growing. Nearly 80.0% of Russia's oil production comes from large fields with remaining lives of 8 to 10 years. Newly developed resources are often concentrated in medium- and small-size deposits (ME, 2014).

Russia's gas industry is in a more favourable resource situation than its oil industry. The proved natural gas resources in Russia, estimated at 31.3 trillion cubic metres, should be adequate to meet both domestic market and export demands for the foreseeable future.

The remaining proved reserves of coal in Russia amount to more than 157 billion tonnes, or 17.6% of the world reserves. At current rates of coal consumption in the economy, these reserves should be sufficient for 800 years.

The refining industry in Russia includes about 30 major refineries with a total capacity for the primary processing of about 277.3 million tonnes of crude oil per year (ME, 2014).

Russia has the world's largest and oldest district heating system, with centralised heat production and distribution networks in most major cities. The system has a high number of combined heat and power (CHP) installations. Given the obsolescence of this heating infrastructure, a considerable amount of energy can be saved through relatively accessible technologies and cost-effective energy saving practices. The energy sector is very important to the security of the global energy supply. The economy is the world's largest exporter of energy overall, the largest exporter of natural gas and the second largest exporter of oil. In addition, Russian-labelled nuclear fuel is used at 74 commercial reactors (17.0% of the global market) and 30 research reactors in 17 economies worldwide, and the economy provides over 40.0% of the world's uranium enrichment services (ME, 2014).

In 2013, exports of crude oil, petroleum products and natural gas accounted for two-thirds of the total economy's exports. The Russian Federation holds leading positions in each of the world's energy markets: 40.0% of uranium enrichment, about 20.0% of natural gas trading, almost 20.0% of reactor construction, 15.0% of spent nuclear fuel conversion, more than 10.0% of crude oil and petroleum products trading, and about 10.0% of coal trading.

In 2013, the Russian Federation exported 234 million tonnes of crude oil, 205.6 billion m3 of natural gas (including LNG) and 142.9 million tons of coal.

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

The Russian Federation's total primary energy supply in 2012 was 756.4 million tonnes of oil equivalent (Mtoe), comprising natural gas (51.2%), crude oil and petroleum products (22.3%), coal (17.8%) and others, including nuclear and hydro (8.7%).

By destination, more than 90.0% of Russia's total energy exports are directed to Western and Eastern Europe, including the Commonwealth of Independent States (CIS). To secure its future energy exports, since 2008 the Russian Federation has actively been 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 Northeast Asia.

The Russian Federation produced 521.3 million tons of crude oil and gas condensate in 2012. The oil heartland province of West Siberia accounted for about two-thirds of the total production. Refiners consumed 277.2 million tonnes of crude oil as feedstock, producing 258 Mtoe of petroleum products, including 40.7 million tonnes of gasoline and 70.65 million tonnes of diesel oil, 71.72 Mtoe of fuel oil, 20.99 Mtoe of nafta.

Oil exports declined from 248.81 Mtoe in 2011 to 241.15 million tonnes in 2012. Petroleum products export amounted of 105 million tons in 2012, a 2.8 Mtoe increase from 2011 level. There are prospective onshore oilfields in the Timano–Pechora and East Siberia regions and offshore in the Arctic and Far East seas, and on the North Caspian shelf.

Natural gas production decreased from 552.9 Mtoe in 2011 to 540.8 Mtoe in 2012. Net exports of natural gas in 2012 accounted for 152.2 Mtoe (157.8 Mtoe in 2011) or 28.1% of production. Nearly all natural gas exports were destined for Western and Central Europe, including Turkey, with small amounts piped to the Transcaucasian states. Huge but undeveloped reserves of natural gas are located in remote regions, where the lack of infrastructure prevents the start-up of upstream operations.

The Russian Federation produced 200.7 Mtoe of coal in 2011. Coal exports reached almost 83.53 Mtoe. From 2000 to 2012, the proportion of the total coal production volume that was exported increased from 17.1% to 41.0%, despite the fact that the main coal-producing areas (the Kuznetsky and Kansko–Achinsky basins) are landlocked in the south of Siberia, some 4 000–6 000 kilometres 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.

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	1 331 435	Industry sector	131 434	Total	1 069 300
Net imports and other	–564 986	Transport sector	93 630	Thermal	725 383
Total PES	756 374	Other sectors	223 492	Hydro	165 898
Coal	134 727	Total FEC	448 556	Nuclear	177 535
Oil	168 844	Coal	13 251	Geothermal	–
Gas	387 119	Oil	117 187	Others	482
Other	65 684	Gas	128 064		
		Electricity and other	190 055		

Source: (EDMC, 2014).

The Russian Federation produced 1 069 TWh of electricity in 2012, of which 67.8% was from thermal power plants, 15.5% from hydropower and 16.6% from nuclear energy. Geothermal and others represent only 0.05% of the total electricity generation. The economic potential of hydropower is estimated at 852 TWh per year, but only 20.0% of this has been developed. The Russian Federation has enormous technical potential for renewable energy production, such as hydro and biomass in Siberia, wind along its Arctic and Pacific shores, and geothermal in Kamchatka and the Kuril Islands. However, the use of this potential is constrained by the huge distances over which the renewable energy would have to be delivered to consumers.

FINAL ENERGY CONSUMPTION

In 2012, the total final energy consumption in the Russian Federation was 448.6 Mtoe, a decrease of 2.2% compared with the previous year. By sector, industry accounted for 29.3%, transport for 20.0% and other sectors for 50.7%. By energy source, coal accounted for 2.9%, petroleum products 26.2%, natural gas 28.6% and electricity and others, including heat, 42.3%. Because of Russia's extremely cold climate, the most important energy use is for space heating, about one-quarter of the 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, increase the share of less energy-intensive services, and improve the efficiency of the heat supply to the residential and commercial sectors will have a significant impact on energy policy. Estimates suggest that the Russian Federation has a huge untapped technical potential for energy savings, ranging from one-third to almost half of its total final energy consumption.

ENERGY INTENSITY ANALYSIS

The growth of Russian GDP of 3.4% in 2012 resulted in 1.0 percent improvement in the economy's total primary energy supply. This could be translated to an economy-wide level of 239.8 tonnes of oil equivalent per USD million GDP.

For final energy demand, energy intensity level decelerated by 5.4% from 2011 level of 150.390 toe/USD million GDP to 142.2 tonnes of oil equivalent per USD million GDP in 2012.

On a per sector analysis, the industry registered the largest reduction of 1.0% in energy use per USD million of GDP from a year ago level of 42.1 tonnes of oil equivalent per USD million GDP to 41.7 tonnes of oil equivalent per USD million GDP. Such a minimum drop in energy use shows the necessity to apply more energy-efficienct production processes and technologies in the Russian industry sector.

Table 3: Energy Intensity, 2012

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	242.1	239.8	-1.0
Final Energy Demand	150.4	142.2	-5.4
Industry	42.1	41.7	-1.0
Transportation	32.3	29.7	-8.0
Others	76.0	70.9	-6.8

Source: (EDMC, 2014).

The transport sector posted a lower intensity at 29.7 tonnes of oil equivalent per USD million GDP, a decrease of 8.0% from its previous year's level. It can be explained by the fact that new, more efficient vehicles were introduced into the Russian market during 2012.

The other sectors' energy intensity also went down by 6.8% from 2011 level, respectively, which could be attributed to being concious on energy utilisation as contributed by improvements in energy efficieny and availability of energy efficient technology, especially in the heat sector.

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

The adoption in August 2003 of the Energy Strategy of Russia for the period up to 2020 (IES, 2010) 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 was adopted by the government in November 2009—the Energy Strategy of Russia for the period up to 2030 (Energy Strategy 2030) (IES, 2010). The new version of the strategy was updated to take into account new realities and priorities in the energy sector as affected by the global recession. The strategy is a framework within which more detailed industry-oriented medium-term and short-term programs can be developed.

In 2014, the Russian government continues to work on the revised version of the Russian energy strategy and will continue to do so until 2035. But the strategic objective of Russia's external energy policy is unlikely to change. That objective will continue to be the use of Russia's energy potential in a way that will effectively maximise its integration into the world's energy markets, strengthen Russia's position in those markets and maximise the benefits of energy resources to the economy.

To achieve this, Russia will implement a number of measures to improve the security of domestic energy consumption and energy export obligations, and will make efficiency improvements along the entire energy supply chain. This will include the development of new hydrocarbon provinces in remote areas and offshore. It will also include the rehabilitation, modernisation and development of an energy infrastructure, including the construction of additional trunk oil and gas pipelines, to enhance the economy's energy export capacity. Furthermore, to better integrate Russia into the world energy markets, export delivery markets will be diversified. It is anticipated that at least 27.0% of Russia's total energy exports in 2030 will be delivered to the Asia–Pacific region (IES, 2010).

Russia's nuclear energy industry remains a priority of Russia's development despite the Fukushima nuclear accident that occurred in Japan in 2011. Nuclear energy will comprise a larger share of the power generation domestically, while the industry sector as a whole will expand abroad. Russia will remain a key player in the practical implementation of improved nuclear fuel technology. Particularly and in spite of the existing programmes for renewable energy development outlined in the Energy Strategy 2030, the economic potential of renewable energy in Russia is low. Fossil fuels in Russia are so abundant that renewables have difficulty competing.

The Energy Strategy 2030 calls for a 40.0% reduction in the energy intensity of the economy by 2030 (IES, 2010). Lowering Russia's relatively high energy intensity (about 335 tons of oil equivalent per million USD PPP in 2009) needs to be one of the main objectives of Russian energy policy. Without significant

progress in this area some industries may not be globally competitive, thus impeding Russia's economic development.

Perhaps the most important measures in the Energy Strategy 2030 are directed towards developing energy market institutions, such as fair pricing mechanisms and transparent trading principles, and making sure there is a sufficient energy transportation infrastructure. State participation in energy sector development will consist mainly of supporting innovative developments in the energy sector, as well as providing a stable institutional environment for the effective functioning of the sector (IES, 2010).

Under the general framework of the Energy Strategy to 2030, medium- and long-term programmes 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 of electric energy objects placement—a scheme relating to electricity network infrastructure and electricity plant locations—to 2020, approved by the federal government in February 2008 and currently being amended to extend it to the year 2030.

On 12 April 2011, at a meeting of the Governmental Commission on the fuel and energy complex and development of mineral resources and the energy efficiency of the economy, a general scheme for the development of the oil industry up to 2020 was approved. This provides for the comprehensive development of all subsectors of the oil sector—exploration and utilisation of associated petroleum gas, crude oil and petroleum products, crude oil refining, and transportation infrastructure.

The general scheme for the development of the gas industry up to 2030 was reviewed and approved on 11 October 2010 at the meeting 'About the Master Plan for Gas Industry Development up to 2030' under Prime Minister Vladimir Putin. The document represents a complex project, which defines a path for Russian gas industry development in the long term. This strategic document covers all the components of the industry: exploration, drilling, production, storage and transport of gas supply to consumers of hydrocarbons, and refined products.

In 2007, the federal government approved the East Gas Programme 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 programme and is responsible for conducting long-term sales contracts for natural gas deliveries.

In November 2011, the Ministry of Energy sent to the Russian Government the second phase development plan for the economy's gas and petrochemical industry to 2030. The working group for this plan included relevant government authorities, industry representatives, research and consulting companies, and input from the people of the Russian Federation. The second phase includes an updated general plan for the development of key oil–gas investment projects, an updated programme for the positioning of petrochemical capacities into six clusters, including pipeline transportation projects, projects to build new facilities and upgrade existing ones for the primary processing (pyrolysis) and further processing of raw materials, and activities for the scientific and educational support of the industry.

In January 2012 the Government Presidium of the Russian Federation approved a long-term program for developing the coal industry to 2030. This document specifies the basic provisions of the energy strategy to 2030 relating to the coal industry. The main task of the program is to realise potential competitive advantages for Russian coal companies while implementing the government's long-term energy policy.

In November 2010 the Federal Targeted Program on Energy Saving and Energy Efficiency Improvement to 2020 (FTP) was approved by the government, which is concerned with energy policy formulation. 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. In addition, 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 region, maximum loads, generation capacity reserves, power exchange, retirement of old facilities, maintenance, retrofitting, and commissioning of new generation and transmission facilities with more than 5 MW capacity/110 KV and higher voltage, respectively.

LAWS AND REGULATIONS

The basic laws on specific energy-related industries are either being implemented or developed. This set of acting laws include:

- Subsoil (since February 1992);
- Price Control for Electricity and Heat Supply (since April 1995);
- Natural Monopolies (since August 1995);
- Production Sharing Agreements (since December 1995);
- Energy Conservation (since April 1996);
- Gas Supply (since March 1999), Power Industry (since March 2003);
- Nuclear Industry (since February 2007);
- Heat Supply (since July 2010); and
- Energy Conservation and Increase of Energy Efficiency (since August 2010).

The latter is the logical extension of the Power Industry law, due to the fact that the major source of heat supply in the Russian Federation is from 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, the draft of the oil law is still being developed in light of its international influence and the growing domestic economic and social challenges.

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:

- Ministry of Energy;
- Ministry of Natural Resources and Environmental Protection:
  - Federal Subsoil Resources Management Agency;
  - Federal Water Resources Agency; and
  - Federal Supervisory Natural Resources Management Service;
- Ministry of Industry and Trade;
- Federal Antimonopoly Service;
- Federal Customs Service; and
- Federal Tariff Service.

ENERGY SECURITY

The Russian Federation considers issues related to energy security 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 Russian Federation has made a proposal to develop a Convention on International Energy Security that would cover all aspects of global energy cooperation, taking into account the balance of interests of all actors in the international market.

The infrastructure projects, including new oil and gas export trunk lines from the Russian Federation to its European and Asian markets, provide a solid contribution to improving global energy security. The development of an international infrastructure for the reliable maintenance of the nuclear fuel cycle, under strict International Atomic Energy Agency (IAEA) supervision, is another Russian contribution to the improvement of global energy security.

ENERGY MARKETS

MARKET LIBERALISATION

One of the main issues in the Russian Federation is the gradual move from state-regulated energy pricing to free market institutions for natural gas and electricity pricing. Coal and petroleum prices have already been 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, and 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 the Russian Federation to 2030 is to complete the full liberalisation of domestic energy markets, where at least 20.0% of energy should be traded on commodity exchanges.

In December 2006, the government approved the liberalisation of natural gas and electricity prices to take place 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 70.0% of the thermal power plants' fuel mix is provided by natural gas, while more than 40.0% 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 even after 2014.

The oil market in the Russian Federation 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 storage plays an important role in establishing fuel markets. The government intends to make up to 25.0% of the 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 over coal pricing was removed in the early 1990s and the coal market was liberalised, with similar institutions to the crude oil and petroleum product markets.

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.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.

OIL AND GAS

The oil and gas industry was privatised in the 1990s. However, the state still has a controlling stake in the major oil companies, crude oil and petroleum trunk pipelines, and it owns 50.002% of Gazprom's shares.

The oil sector is heavily controlled by the Russian Government and this control increased after the state-owned Rosneft takeover of TNK-BP. The USD 55 billion merger in 2013 created the world's largest listed oil company with a daily output of 4.6 million barrels in oil-equivalent terms (Reuters, 2013). As of 2012, the oil industry in the Russian Federation consisted of nine large producing companies with more than 90.0% of the crude oil output, and more than 300 small-scale enterprises, along with operators of three production-sharing agreements. The refining sector consists of 27 large and more than 83 small refineries. fter the merger of the crude oil and petroleum products pipeline companies Transneft and Transnefteprodukt, the state controlled 75.0% 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 Russian Federation and in Siberia.

The federal government remains the key shareholder in the economy's gas monopoly, Gazprom, which is the extractor of 84.0% of the natural gas in the Russian Federation and owner of the economy-wide gas pipeline system. Independent companies produce the other 16.0% and supply about 25.0% 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 the Russian Federation through their stake in state and private companies, and produce at least 14.0% of the economy's crude oil and 7.0% 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 16.0% in 2010 to about 30.0% 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 the European Arctic, like those on the Yamal Penisula, are considered an important means of delivering natural gas to international markets.

COAL

The Russian coal sector was restructured in the 1990s, and foreign participation in the sector is practically absent. Unlike the oil and gas sector, the coal industry has no large state-controlled company and is almost 100.0% privatised.

As of 2013, 202 coal enterprises operate in the Russian coal industry (84 mines and 118 open-pit mines), with a total annual production capacity of around 400 million tonnes of coal. Coal processing is carried out by 56 processing plants and mechanical installations.

Industry development is based two-thirds on equity and one-third on loans. In recent years, there has been an active renewal of the fixed assets of the coal industry. There are no restrictions on exporting coal, but the geographical size of Russia's vast economy requires coal be transported over long distances. Coal is the single largest commodity transported by Russia's railway network, accounting for almost 30.0% of its total freight.

ELECTRICITY

The Russian Federation 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 the Russian Federation 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 were 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 provided 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 20.0% 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; and
- 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, increase the efficiency of power generation and consumption, and 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 100.0% state ownership exercises technological control within the power grids and provides

dispatching services to wholesale market participants. The Federal Grid Company, which was established in 2002, with 77.7% state control, owns and operates the transmission lines, provides 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 48.0% of electricity sales, 47.0% of power sales and 5.0% 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. 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 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 the Russian Federation. Historically, the heat supply industry was subsidised by local budgets and thus has room for considerable efficiency improvements. The Law on Heat Supply was introduced in July 2010 to create investment opportunities, minimise energy losses and subsidies, and provide business incentives. A transparent market for the heat supply will provide additional incentives to develop 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.

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, the 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 the Russian Federation, 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 16.0% of the world's market for new nuclear energy plant construction, and is affiliated with Tenex (40.0% share of the world's uranium enrichment services market), TVEL (17.0% share of the world's nuclear fuel market) and Atomredmetzoloto (9.0% share of the world's uranium mining).

TRANSPORT

Russia's economy faces challenges due to the underdevelopment of its transport infrastructure. In particular, the current condition of Russian airports and air transport facilities provides insufficient capacity for and slows the performance of air transportation services. Further modernisation of air and rail transport is planned in connection with Russia's programs for hosting the 2014 Winter Olympic Games, the 2018 Football World Cup and the 2020 World Expo.

The total length of Russian roads in 2012 was 982 626 kilometres (km), 79.0% of which were paved. The member economy had only 30 146 km of high-speed divided highways connecting big cities (GKS, 2012). Further development of highways will be necessary if big cities are to be connected.

Russia has a state railway system with a total length of 85 641 km, but only some cities have high-speed train services. Almost all towns in Russia, regardless of size, are served by regional bus services. Subway systems have been introduced in seven of Russia's major cities, and all cities have extensive city bus systems.

Russia's pipeline transport is underdeveloped relative to the potential oil and gas supply. The total length of the pipeline system in the economy was 232 981 km in 2010, 167 868 km of which was gas pipeline, 49 240 km was oil pipeline and 15 873 km was oil products pipeline.

FISCAL REGIME AND INVESTMENT

In 2007, dozens of oil 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 licenses, 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-intensive 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 was prepared in 2011 as a part of the development of the new Law on Oil. On 1 October 2011, a new tax regime for the oil industry called the '60-66' came into force in the Russian Federation. Under the new rules, the duty on oil exports decreased by 7.4% to USD 411.4 per tonne, and fees for light and heavy petroleum products were set at 66.0% duty on crude oil. For a number of fields in Eastern Siberia and the North Caspian, there will be a preferential export duty, which, as of October 2011, is set at USD 204.5 per tonne. A reduced duty on crude oil is achieved by changing the formula for calculating the duty. According to the norms of the '60-66', from now on duty on crude oil will be at 65.0% and 60.0% of the difference between market price and a standard price of oil at a rate of USD 182.5 per tonne.

The size of the duty on exports of gasoline is set at 90.0% of the duty on crude oil. Before May 2011, the duty on exports of gasoline was 60.0% of the duty on oil, but because of the sharp rise in home prices and gasoline shortages in some regions, it was increased to 90.0%. It is believed that such new fees will allow oil companies to obtain additional funds for the exploration of new fields and will thus increase current oil production. In addition, the unification of tariffs on exports of petroleum products at 66.0% will make exports less competitive for dark petroleum products and more profitable for light petroleum products; it will also encourage companies to increase the refining depth at existing plants.

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 that the energy savings from improvements in Russia's energy intensity could exceed 300 Mtoe, including more than 160 Mtoe from the energy extraction, transformation and transportation industries alone.

EE has become a critical factor in the government's energy policy since 2008, when a presidential decree set a target to reduce by 2020 the energy intensity of Russia's GDP by 40.0%, compared with 2005. Improving EE and energy savings has become one of the priority areas of the Energy Strategy that extends 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 were drafted. The new federal law sets a legal framework and targets for the use of energy resources in the Russian Federation 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 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, etc.).

In addition to the new federal law, on 27 December 2010 the federal government adopted the State Program on Energy Saving and Energy Efficiency Improvement to 2020 (FTP). The Program will be carried out in two stages: from 2011–15, and from 2016–20. The energy intensity of Russia's economy is 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 40.0%' 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 programmes; 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 Program, all regions are required to prepare their own respective regional programmes on energy efficiency improvements. The implementation of these programmes 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 these measures and policies for strengthening the EE legal framework, the federal government launched the following six pilot Presidential energy efficient projects in several regions:

- metering (installing metering devices and automation);
- EE in the budget sector (piloting energy performance contracting in schools and public buildings);
- energy efficient districts (targeting the residential sector);
- energy efficient lighting (replacing street lighting and other measures);
- small-scale cogeneration; and
- new energy sources (renewable and other non-carbon energy resources).

Upon their successful completion, these projects are expected to be applied across all regions. In addition, technical potential exists to save almost half of Russia's primary energy demand through energy conservation. However, a major impediment for businesses to improve their energy efficiency is the absence of appropriate financial mechanisms.

The regulatory framework described in the FTP on Energy Saving and Energy Efficiency Improvement to 2020, adopted in January 2011, estimates that the total investments into energy efficiency up to 2020 will be approximately RUB 9.3 trillion (USD 320 billion), with 8.0% coming from governments and 92.0% from private investments. The economic effect of such investments 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 the Russian Federation is estimated at 4 400 Mtoe per year, or almost eight times more than Russia's current total final energy consumption. However, the economic potential is much smaller (about 240 Mtoe/year, less than 1.0% of the total electricity production). In 2010, the renewable energy capacity totalled 2 200 MW; of this, less than 25 MW was hydro.

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 the electricity in the Russian Federation 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 bringing together renewable energy generators, transmission lines and guarantor suppliers of energy.

In October 2010, the government published a ruling on federal subsidies for connecting renewable energy generators to the power grid that would encourage 'green' energy production in Russia. Conditions of the ruling include that the nominal capacity of renewable energy generators should not exceed 25 MW, and that 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 40.0% of the United States', 23.0% of Western Europe's, and 16.0% of the Asia–Pacific region's nuclear fuel requirements.

In the Global Nuclear Infrastructure Initiative, announced by the Russian Federation in early 2006, the Russian Federation 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 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 the Russian Federation 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 programme for the IUEC's expansion at Angarsk to 2015 was developed. The programme 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; and
- Full internationalisation with the involvement of many customer economies under the IAEA's auspices.

The Russian Federation also announced that guaranteed reserves of low-enriched uranium hexafluoride—the equivalent to two 1 000 MW reactor loads—would be created at the IUEC as a fuel bank available under the IAEA's control. The first phase of the capacity enhancement was scheduled for 2011, when 1 million separation work units were expected to be commissioned, with a target of 5 million expected to be achieved in 2017.

In November 2009, the IAEA's Board of Governors adopted a resolution supporting a Russian initiative to establish and maintain in the Russian Federation a stock of low-enriched uranium, 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 the proliferation of sensitive nuclear technologies. It was suggested that 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, which has become a key agenda item after the Fukushima accident in Japan. The Russian Federation 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 waste, the laws on environmental protection and on the use of nuclear energy were amended in June 2010. Since

2007, the expired contracts for depleted uranium hexafluoride enrichment/conversion have not been extended.

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 mixed oxide fuel. In the period 2020–2025, fast neutron reactors will play an increasing role in Russia. The improved design will lead to an extended operating life of up to 60 years, a shorter construction period of up to 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 to 25 years, three core reactor technologies have been chosen for nuclear energy development in Russia:

- water reactors, VVER type, and their modification and advanced development;
- sodium fast neutron reactors; and
- high-temperature helium reactors.

CLIMATE CHANGE

In November 2004, the Russian Federation 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 '55.0%' clause and brought the Kyoto Protocol into force, effective from 16 February 2005.

The Russian Federation 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 greenhouse gas (GHG) 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 in December 2009, the Russian Federation pledged to reduce its GHG emissions by 25.0% from 1990 levels by 2020, a figure comparable to the targets of the European Union member states, and by 50.0% from 1990 levels by 2050. These emission reductions are contingent on these conditions: 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.

In December 2012, the Russian Federation refused to endorse extended pollution limits under the Kyoto Protocol at the United Nation's climate change conference in Doha, since the biggest polluters—US, China and India—have not joined it.

NOTABLE ENERGY DEVELOPMENTS

PROGRAM ON ENERGY SAVING AND ENERGY EFFICIENCY IMPROVEMENT TO 2020

The main objective of the State Program on Energy Saving and Energy Efficiency Improvement to 2020 is to reduce the energy intensity of the gross domestic product of the Russian Federation by 13.5%. This is expected to combine with other factors to provide an overall reduction of 40.0% in the energy intensity of the GDP in the period 2007–2020. Other expected results of the programme are savings of 330 bcm of natural gas over the life of the program, energy savings of 630 billion kWh, heat savings of 1 550 million Gkal and petroleum product savings of 17 million tonnes.

The program also aims for a significant reduction in energy costs and to ensure the competitiveness and financial stability of the Russian economy, the provision of high quality energy services at affordable prices and the lowering of greenhouse gas emissions, thereby strengthening the health of the population. The funding of the program is split between RUB 70 billion from the federal budget, RUB 625 billion from budgets of the regions of the Russian Federation and RUB 8.8 trillion from extra budgetary sources.

Gazprom has adopted the FTP on Energy Saving and Energy Efficiency Improvement to 2020, which should lead to a 1.2% annual decline in energy consumption by this giant energy company to 2020. Gazprom's current energy demand for natural gas extraction, processing and transportation is close to 10.0% of the total economy's extracted energy. The major share of improvements will come from measures related to its pipeline operations (estimations are up to 85.0%).

POWER MARKET DEVELOPMENT

The Ministry of Energy presented concepts for a programme of power sector modernisation for the period up to 2020. The central theme of the modernisation is to introduce new technologies, both domestic and imported, increasing the reliability of the electricity supply and energy security.

OIL AND GAS DEVELOPMENT

In May 2014, OAO Gazprom and China National Petroleum Corporation (CNPC) inked a historic agreement on Purchase and Sale Agreement for the Russian gas supply via the eastern route. The 30-year contract provides for gas supplies in the amount of 38 billion cubic meters of gas per year.

As part of the APEC summit in Beijing in November 2014, a number of documents related to the Russian-Chinese cooperation in the energy sector were signed in the presence of Russian President Vladimir Putin and Chinese President Xi Jinping.

OAO Gazprom and CNPC signed a Framework Agreement on gas supplies via the western route. In particular, the document reflects such conditions as the volume and terms of supply, the take-or-pay level and the location of the gas delivery point on the border. The Framework Agreement defines the schedule of compiling a gas purchase and sale agreement, a technical agreement and an intergovernmental agreement on the western route. In addition, Alexey Miller and Wang Yilin, Chairman of the CNOOC Board of Directors signed a confidential Memorandum of Understanding for cooperation in the oil and gas sector (Gazprom 2014).

COAL INDUSTRY DEVELOPMENT

In the framework of the Russian strategy for developing the coal sector through 2030, as mapped out by the Russian Energy Ministry, Rostech, the Russian state-controlled technology corporation, signed an agreement with China's Shenhua Group, the largest producer of coal in the world, to explore and develop coal deposits in Russia's Siberia and Far East.

The Russian strategy for developing the coal sector through 2030 foresees transferring the centre of the coal production to Russia's eastern regions to supply in Asian markets, which now total 80.0% of the world's consumption.

NUCLEAR AND RENEWABLE ENERGY DEVELOPMENT

Russia will join the International Renewable Energy Agency (IRENA). Accession to IRENA will give the Russian Federation wide access to the existing practice of using and implementing renewable energy sources, results of the latest studies, and will allow Russia to participate in the elaboration of international a standards, as well as influence the renewable energy sector's development worldwide.

ENERGY SECURITY IMPROVEMENTS

The Ministry of Energy approved a joint statement of the Russian Federation and the International Energy Agency, agreeing on regular bilateral consultations. Those consultations will strengthen their collaboration in an effort to maximise the contribution of the energy sector in reconstruction and economic development, enhance energy security in the world, and reduce the environmental impact of energy production and consumption.

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Reuters http://www.reuters.com/article/2013/03/21/us-rosneft-tnkbp-deal-idUSBRE92K0IZ20130321

USEFUL LINKS

OFFICIAL BODIES OF THE RUSSIAN FEDERATION

Structure of the Government of the Russian Federation— http://government.ru/en/

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 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— http://www.russian-customs.org/

Federal Tariff Service—www.fstrf.ru/

ENERGY-RELATED NON-PROFIT AND STATE-OWNED BUSINESS INSTITUTIONS

AtomEnergoProm—www.atomenergoprom.ru/en/

Federal Power Grids—www.fsk-ees.ru/

Non-commercial Partnership of the Wholesale Power Market—www.np-ats.ru/

Gazprom—www.gazprom.ru/

Rosneft—www.rosneft.ru/

RusHydro—www.rushydro.ru/

Transneft—www.transneft.ru/

Transnefteprodukt—www.transnefteprodukt.ru

STATE ENERGY-POLICY-RELATED RESEARCH CENTRES

Institute of Energy Strategy—www.energystrategy.ru/

Centre for Energy Policy—www.cenef.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

MAJOR ENERGY-RELATED MEDIA IN 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 a Southeast Asian economy located south of the Malaysia Peninsula between the Strait of Malacca and the South China Sea. The economy's total land area was 715.1 square kilometres in 2012 when its population was about 5.3 million of whom around 1.5 million were non-residents (SingStat 2014).

Singapore is one of the most highly industrialised and urbanised economies in Southeast Asia with a highly developed and vibrant free-market economy, notwithstanding its small land area and population and lack of domestic energy and mineral resources. Added to its strategic geographical position, the contributing factors include its significant role in international cargo and fuel shipping and thus its shipping ports' intense activity, its growing role as a regional petroleum hub and supplier of equipment for the oil and gas industry, its emerging leadership in the biotechnology industry, and its growing involvement in high tech and solar energy.

In 2012, its gross domestic product (GDP) of USD 388.7 billion and per capita of USD 73 157 (both at 2010 price and PPP) registered increases by 2.5% and 0.02%, respectively, from those of 2011. Services producing industries, goods producing industries and ownership of dwellings accounted for 64.9%, 25.1%, and 4.1% of its GDP, respectively. The first sector's largest sub-sector was manufacturing with a share of 19.2% while that of the second one was wholesale and retail trade having a share of 17.6% (SingStat, 2014).

The value of Singapore's exports in 2012 was USD 510.3 billion of which the share of domestic exports (USD 285.2 billion) was 55.9% leaving the rest for re-exports (USD 225.2 billion). The export items' shares of the total exports were as follows: machinery and equipment (45.2%), mineral fuels and lubricants (25.7%), chemicals and chemical products (13.2%), miscellaneous manufactures (7.8%), manufactured goods (3.8%), miscellaneous (1.5%), beverages and tobacco (0.9%), crude materials (0.6%), and animal and vegetable oils (0.1%) (SingStat, 2014).

Table 1: Key data and economic profile, 2012

Key data		Energy reserves	
Area (sq. km)	714.3	Oil (billion barrels)	–
Population (million)	5.31	Gas (billion cubic metres)	–
GDP (USD (2010) billion at PPP)	388.72	Coal (million tonnes)	–
GDP (USD (2010) per capita at PPP)	73 172	Uranium (kilotonnes U)	–

Source: (EDMC, 2014).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Singapore relies almost entirely on energy imports to meet its domestic energy needs. Its total primary energy supply (TPES) in 2012 was 25 184 kilotonnes of oil equivalent (ktoe). Natural gas supply grew by 38.6% between 2011 and 2012 to 9 157 ktoe, which was the largest rate of growth since 2003 when the economy experienced a major increase of 45.5% in its gas supply to 4 039 ktoe from 2 776 ktoe in the previous year. Oil supply increased by 9.1% to 15 117 ktoe from 13 862 ktoe in 2011. For the first time, the economy imported a small amount of coal (25 ktoe) equal to 0.1% of its TPES in 2012.

In 2012, the economy's total imports of energy, including petroleum products, was 157 455 ktoe, which included supplies to meet its energy requirements as well as those to feed its oil refineries whose bulk of their refined products are exported (EGEDA, 2014). Of these imports and their produced refined products, 53.5% were exported amounting to 84 311 ktoe leaving the shares of 26.7% and 4.3% for marine bunkering (41 998 ktoe) and aviation bunkering (6 847 ktoe), respectively (EGEDA, 2014).

Singapore generated 46 915 gigawatt-hours (GWh) of electricity in 2012, a 2.0% increase over its 2011 generation (45 999 GWh) (EDMC, 2014). Its peak demand for electricity was 6 639 megawatts (MW) in that

year compared with 6 570 MW in 2011 (EMA, 2014). As evident in its 2012 performance, the economy's power generation is mainly based on thermal power plants (43 207 GWh) with a relatively significant contribution of the waste-to-energy generators (3 708 GWh) accounted for 7.9% of the economy's generation in 2012; grid-connected photovoltaic installations make a very small contribution to the economy's power generation. The thermals power plants experienced slight decrease in their power generation of -4.76 over the previous year while the waste-to-energy generators registered an impressive growth of 485.8% (EDMC, 2014).

In 2012, the licensed power generation capacity of thermal power plants was 10 119.6 MW. This was a major increase of 9.5% over the previous year (9 239.4 MW). Of the total mentioned capacity, the share of the combined cycle gas turbine power plants was 7 081.8 MW and those of others were as follows: steam turbine plants (2 061.0 MW), open cycle gas turbine plants (180.0 MW) and waste-to-energy plants (256.8 MW) (EMA, 2014).

Singapore had residential and non-residential grid-connected solar photovoltaic systems installations in 2012 with a total capacity of 9.8 megawatt peak (MwP) consisting of 0.7 MwP of residential and 9.1 MwP of non-residential capacity (EMA, 2014).

In 2012 natural gas dominated the economy's fuel mix for power generation at 84.3%, followed by petroleum products at 13.0% and other fuels, mainly waste, at 2.7% (EMA, 2014).

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	886	Industry sector	8 595	Total	46 915
Net imports and other	73 143	Transport sector	1 773	Thermal	43 207
Total PES	25 184	Other sectors	2 137	Hydro	–
Coal	25	Total FEC	12 505	Nuclear	–
Oil	15 117	Coal	0	Geothermal	–
Gas	9 157	Oil	7 588	Others	3 708
Other	886	Gas	1 256		
		Electricity and other	3 661		

Source: (EDMC, 2014).

FINAL ENERGY CONSUMPTION

The economy's total final energy consumption (FEC) was 12 505 ktoe in 2012, an increase of 0.5% from 2011. Oil (7 588 ktoe) accounted for about 60.7% of such consumption leaving the rest for electricity (29.3%; 3 661 ktoe), and natural gas (1 256 ktoe; 10.0%). The energy consumption share by sector was 68.7% (8 595 ktoe) for industry, 17.1% for other sectors (2 137 ktoe), and 14.2% for transport (1 773 ktoe) (EDMC, 2014).

ENERGY INTENSITY ANALYSIS

Singapore has taken major steps to contribute to APEC's objective of a 45.0% intensity reduction by 2035 (2005 as base year) as set by the APEC leaders in 2011. Yet, the economy's efforts to reduce its energy intensity began prior to the latter as, in 2009, it set for itself an ambitious 35% target reduction by 2035 when APEC's target was 25% by 2030 (APEC, 2014). The latter was declared in the Sustainable Singapore Blueprint launched in 2009 by Singapore's Inter-Ministerial Committee on Sustainable Development (IMCSD) as a national strategy for its sustainable development (MEWR, 2014).

The economy enhanced its efforts to meet APEC's more ambitious target of 2011 through various measures. As a recent example, it enacted the Energy Conservation Act 2013 (ECA). The ECA seeks a range of inter-related energy issues, including improving energy conservation, efficiency and intensity while reducing CO_2 emissions. It aims to help Singapore achieve its intensity reduction target by seeking to improve the energy performance of the economy's companies (EMA, 2012).

Singapore reduced energy intensity in major relevant sectors in 2012 (Table 3). Its final energy demand in 2012 reflects a significant energy intensity reduction of 2.0% over the preceding year. This achievement is clearly evident in its two major sectors accounting for its bulk of economic activities and thus GDP, namely

industry and others, registering energy intensity reductions of 1.1% and 14.7%, respectively, compared to 2011. A significant increase in its transportation sector's energy intensity in 2012 (13.6%) was not large enough to affect its overall energy intensity reduction achievement demonstrated in its final energy demand. The large increase of its primary energy's energy intensity (19.3%) is mainly due to the economies' role as a major regional petroleum hub, as it imports a large amount of crude oil for its refineries and petrochemical industries whose bulk of their products are exported.

Table 3: Energy Intensity Analysis, 2012

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	54.3	64.8	19.3
Final Energy Demand	32.8	32.2	-2.0
Industry	22.4	22.1	-1.1
Transportation	4.0	4.6	13.6
Others	6.5	5.5	-14.7

Source: (EDMC, 2014).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

In 2010, the Economic Strategies Committee's (ESC) Subcommittee on Ensuring Energy Resilience and Sustainable Growth released a report recommending the following key strategies for Singapore to meet its energy policy objectives (ESC, 2010):

- **Strategy 1: Diversify Energy Supplies.** A diversified energy portfolio is essential to safeguard Singapore's energy security. Singapore's Liquefied Natural Gas (LNG) terminal, which commenced operations in May 2013, helps diversify energy sources as it allows the import of LNG globally. Singapore is also studying other medium- to long-term energy options such as electricity imports and renewables to further diversify its energy mix.
- **Strategy 2: Enhance Infrastructure and Systems.** Singapore continues to improve the liberalisation of its electricity and gas markets to achieve greater competition in energy prices and improve efficiency. Investing in critical energy infrastructure ahead of demand and enhancing existing infrastructure has helped make its energy markets more efficient, open new areas for economic development and strengthen energy security. Singapore is currently conducting an Intelligent Energy System (IES) pilot that is testing and evaluating smart grid technologies and related applications that will enable consumers to manage their electricity use more efficiently.
- **Strategy 3: Improve energy efficiency.** Energy efficiency (EE) underpins Singapore's efforts to reduce its energy and carbon footprint. Businesses and households can benefit from energy and cost savings through various EE measures. However, market barriers such as lack of awareness and limited financing schemes are impeding EE implementation and investments by businesses. To address these barriers and promote more efficient energy use among consumers, the Government administers several programs coordinated by the Energy Efficiency Program Office (E2PO) to help companies reduce their energy costs and improve their competitiveness, while reducing the economy's carbon footprint.
- **Strategy 4: Strengthen the Green Economy**. To meet the economy's energy challenges and facilitate the growth of the clean energy sector, Singapore will continue to invest in research, development and demonstration, facilities and manpower development as key enablers. This effort is through inter-agency collaborations on energy research, development, and demonstration (RD&D) such as the Energy National Innovation Challenge (NIC) and the Energy Innovation Program Office (EIPO), and also through private-public partnership initiatives to enhance manpower capabilities for the power utilities sector.

- **Strategy 5: Pricing Energy Right.** Price signals influence energy consumption and investment decisions to achieve efficiency and conservation. Singapore does not subsidise consumption of energy as such subsidies lead to the inefficient use of a scarce and precious resource. This is to ensure that the economy is able to adapt to the rising cost of energy and to a carbon-constrained world.

ENERGY SECURITY

Singapore has taken steps to enhance its energy security within the framework of its geographical realities limiting its options by excluding all types of renewables excluding solar energy as feasible and/or viable ones. Singapore has sought to increase the share of gas of its energy requirements and diversify its sources and thus their suppliers and supply routes as detailed below. It has also undertaken major projects for building underground and floating storage facilities for its required hydrocarbons.

Natural gas has now become the major fuel for electricity generation in Singapore. Four offshore natural gas pipelines supply Singapore's piped natural gas needs. The first gas pipeline, located in the northern part of the main island, was commissioned in 1991 and supplies the economy with 4.2 million cubic metres per day (150 million cubic feet per day (MMcf/D) of natural gas from Malaysia. Senoko Energy Ltd (formerly known as Senoko Power Ltd) imports Malaysian gas for its power generation plant. Since January 2001, the second pipeline, from the West Natuna gas field in Indonesia, has supplied the economy with 9.2 million cubic metres per day (325 MMcf/D) of natural gas. The third pipeline, from South Sumatra, Indonesia, started supplying gas to Singapore in September 2003, and the fourth pipeline, from Malaysia, began its operation in 2007, supplying since that year 3.1 million cubic metres per day (110 MMcf/D) of natural gas, mainly for power generation. Keppel Gas Pte Ltd is the importer of natural gas for the fourth pipeline.

PowerGas Ltd the licensed gas owns and manages the gas pipeline network for conveying natural gas and town gas. It provides open and non-discriminatory access to the gas pipeline network. SP PowerGrid Ltd conveys gas and manage the gas pipeline network. SP PowerGrid Ltd is licensed by EMA as the gas transport agent.

With gas representing a large share of electricity production, the diversification of its supply has become an important issue. Following a feasibility study, the Singapore Government, in 2006, announced a plan to import LNG and build the first LNG receiving terminal to meet the rising demand for electricity generation and diversify its sources of natural gas. 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.

On 7 May 2013 Singapore completed and commenced commercial operations of a terminal, with an initial capacity of 3.5 million tonnes per annum (Mtpa), located at an approximately 40-hectare site on the south-western part of Jurong Island. This capacity increased to 6 Mtpa in January 2014 when the third LNG tank, the fourth Open Rack Vaporiser and two High Pressure Booster Pumps were completed and brought into service. As well, the Secondary Berth and the Gas Engine Generator achieved Mechanical Completion at that time (SLNG, 2014).

The terminal's capacity will further rise to 11 Mtpa when the fourth tank and additional regasification facilities are constructed. Its development and that of additional regasification facilities is now underway and to be completed by 2018. The LNG terminal is designed to have the scalability to provide new services such as LNG trucking, industrial gas manufacturing and LPG import and export in the future (SLNG, 2014a).

Beside the LNG terminal, Singapore initiated a project to build a floating storage facility for oil and petrochemical products to enhance its energy security. The initiative, known as the Very Large Floating Structure (VLFS), comprises two rectangular modules, each with a storage capacity of 150 000 cubic metres. The VLFS will occupy only seven hectares of foreshore space as compared to 20 hectares of land for the same storage capacity. This 'mega-float' platform, coupled with the utilities and amenities support, will boost the Singapore industry's competitiveness in providing additional logistic capacity for the refining and petrochemicals, and oil trading sectors. The project is scheduled for completion in 2014 (EMA, 2011a).

Finally, Singapore has embarked on a project to build Southeast Asia's first underground liquid hydrocarbon storage facility called the 'Jurong Rock Caverns,' which is located at a depth of 130 meter under the Banyan Basin on Jurong Island. This project can also be used for other higher value-added petrochemical processes. Phase One of the project with a storage capacity of approximately 1.5 million cubic metres was completed in September 2014 (SGC, 2014a).

ENERGY TECHNOLOGY/R&D

Singapore has actively sought to promote energy research and development (R&D) which is motivated by two considerations: 1) developing capabilities to support the clean energy sector as a key growth area, and grow a viable industry that will create jobs; and 2) meeting Singapore's energy challenges and its sustainable development objectives. To this end, the National Research Foundation (NRF) has allocated SGD 170 million in 2007 and another SGD 195 million in 2011 to the Energy Innovation Program Office (EIPO), formerly known as the Clean Energy Program Office.

The Energy Innovation Research Program (EIRP), co-led by EDB and EMA, is a competitive R&D grant call initiative under EIPO that aims to strengthen Singapore's R&D capabilities and address our energy-related challenges. Since 2012, 10 grant calls have been launched in areas such as solar, green buildings, power generation, energy storage, smart grids and gas, and over $70 million awarded to various Singapore-based institutes of higher learning, research institutes, and the industry.

Under EIPO, the government has supported the establishment of Research Centres for Clean Energy. For example, the Solar Energy Research Institute of Singapore ('SERIS') was established in 2008 to conduct industry-oriented R&D in solar energy technologies, focusing on materials, components, processes and systems for solar photovoltaic (PV) electricity generation and energy-efficient buildings.

EIPO has also supported the establishment of the Energy Research Institute at Nanyang Technological University (ERI@N), with the objective of advancing research aimed at improving the efficiency of the current energy systems and maximising the use of alternative energy sources. In a related effort, the Agency of Science, Technology and Research (A*STAR) set up the Experimental Power Grid Centre (EPGC), a program that undertakes R&D activities in areas such as intelligent and decentralised power distribution, control and management of distributed energy resources, and smart and interactive energy utilisation. It features a 1 MW experimental power grid, which is designed to create various power network configurations at near grid-like conditions. This facility acts as a platform for researchers, industry and public agencies to develop energy technologies before bringing them to larger-scale test-beds or commercialisation.

To meet Singapore's long-term energy challenges, the government allocated SGD 300 million to the first National Innovation Challenge on 'Energy Resilience for Sustainable Growth' or 'Energy NIC'. The Energy NIC aims to develop cost-competitive energy solutions for deployment within 20 years to help Singapore improve energy efficiency, reduce carbon emissions and increase energy options.

Solar energy is the most viable renewable energy in Singapore, given the location in the tropical sunbelt. A key player in this field is the SERIS (Solar Energy Research Institute of Singapore), which conducts world-class industry-oriented R&D and trains manpower for the solar energy sector. It has attracted world-renowned talent in the solar industry and is now home to some 160 researchers. Singapore is now a prime location for major solar companies such as Phoenix Solar, Renewable Energy Corporation (REC), Trina Solar and Yingli, which aim not only to improve the economy's market, but that of Asia. Moreover, Singapore also houses a range of key wind technology players, such as, Keppel and Vestas (EDB, 2014).

ENERGY MARKETS

ELECTRICITY

Singapore commenced the restructuring of its energy sector in 1995 by corporatising its electricity and gas industries as vertically integrated companies. Notable milestones since mid-1995 have included corporatisation and industry structural 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.

Singapore's government undertook further reforms in 2000. 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 government formed EMA 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 half-hourly intervals 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 currently under review (EMA, 2014b). This phase covers the remaining non-contestable consumers, mainly small businesses and household consumers—about 1.3 million in number—that represent 25.0% of total electricity sales. EMA is continuing to study how best to introduce retail competition to leverage smart meter technology.

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 12–18 months. 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 that began with the restructuring of Temasek's generating assets into three independent operating companies in 1995.

GAS

Singapore started restructuring its gas industry after passing the Gas Act (Act 11 of 2001) in 2001. The Gas Act sets the legal basis for the separation of the contestable part of the gas industry, namely, gas retail and gas imports, from the monopolistic part, i.e. gas transportation. A gas grid company owns the gas transmission and distribution network, which provide market players with open and non-discriminatory access to the network.

PowerGas Ltd divested its contestable businesses of gas import, production and retail in January 2002. 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 would be regulated.

The economy's newly restructured gas market became operational with the Gas Network Code (GNC) coming into effect from 15 September 2008. 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 (EMA, 2008).

On 15 September 2008, Sembcorp Gas, which had diversified interests in gas transportation, import and retail businesses, exited 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.

The introduction of LNG to Singapore's gas market in May 2013 when the economy's LNG terminal

became operational has since made a major contribution to the diversification of its gas market and increasing its security (EMA, 2014c).

TRANSPORT

Singapore promotes the use of public transport in the interests of fuel efficiency and conservation. Towards this end, it has innovative policies to discourage car ownership and usage, such as a vehicle quota system and electronic road pricing. Since 2001, the Singaporean 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 20.0% of the open market value to 40.0% of the open market value, to offset the additional registration fee.

An inter-agency Electric Vehicle Taskforce (EVTF), co-led by EMA and LTA, launched the EV Test-bed from June 2011 to December 2013 to determine feasibility of EVs in Singapore. Findings from the test-bed have shown that EVs are technically feasible in Singapore, but are still limited by issues such as high EV costs.

In December 2014 the EDB and LTA announced the next phase of the EV test-bed. This test-bed will focus on vehicle fleets such as EV car-sharing and E-taxis

ENERGY CONSERVATION

On 9 April 2012, the Parliament passed the Energy Conservation Act 2012 (ECA) to be jointly administered by the Ministry of the Environment and Water Resources and the Ministry of Transport (GBS, 2014).

The ECA, which came into force in 2013, requires large users of energy to implement energy management initiatives. Companies which consume more than 15 GWh or 1.29 ktoe of energy annually will be required to appoint an energy manager to monitor and report their energy use and greenhouse gas emissions, and to submit plans for energy efficiency improvement to the relevant agencies.

The Act will also consolidate energy efficiency related legislation currently found in different Acts, including the Mandatory Energy Labelling Scheme, Minimum Energy Performance Standards, and the Fuel Economy Labelling Scheme for passenger cars and light goods vehicles under the Environmental Protection and Management Act.

ENERGY EFFICIENCY

Singapore promotes energy efficiency for a variety of reasons, including curbing unnecessary consumption of fossil energy for environmental, financial and health considerations, as well as improving competitiveness of its industries. Thus, Singapore's key strategies in mitigating greenhouse gas emissions, for example, are to switch to less carbon-intensive fuels and to improve its energy efficiency. The economy adopted measures to improve its energy efficiency and to reduce the energy use of various sectors of its economy. The government established the Energy Efficiency Program Office (E^2PO), a multi-agency committee led by the National Environment Agency (NEA) and the Energy Market Authority (EMA), to implement energy efficiency. Together, the EMA, the E^2PO, and the NEA actively promoting energy efficiency in the industry, households and public sectors through legislation, incentives and providing information (NEA, 2014).

- The E2PO promotes and facilitates the adoption of energy efficiency in Singapore under the following five strategic goals (E2PO, 2014):
- Promote energy efficiency through regulation and standards, incentives and open information.
- Develop human and institutional capabilities by developing local knowledge base and expertise in energy management and collaborating with Institutes of Higher Learning (IHLs).
- Promote emerging energy efficient technologies and innovation through supporting the research development and demonstration of new energy efficient technologies, innovations and business process improvements.
- Profile and promote energy efficiency internationally through various platforms such as Singapore International Energy Week (SIEW), Asia-Pacific Economic Cooperation (APEC) and East Asia Summit (EAS).

- Benchmark Singapore's energy efficiency initiatives against other countries and international framework.
- The energy efficiency efforts are targeted at various sectors, such as 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 39.0% to 44.0% over the 2001–12 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 E^2PO 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):** EASe encourages and helps companies identify potential energy efficiency improvement opportunities. Under the EASe, up to 50.0% of the cost of appraisals for buildings and facilities will be co-funded.
- **The Investment Allowance Tax Scheme:** This program encourages 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):** Introduced in 2008, it encourages investors to incorporate energy and resource efficiency considerations into their facilities' development plans early in the design stage. Under the DfE, up to 80.0% of the cost to conduct design workshops will be co-funded.
- **The Grant for Energy Efficiency Technologies (GREET):** GREET is a co-funding scheme launched in 2008 to incentivise owners or operators of industrial facilities to invest in energy- efficient technologies or equipment.
- **The Singapore Certified Energy Manager (SCEM) training program and grant**: This program provides a thorough understanding of the key energy issues facing the building and industry sectors. It helps participants develop the technical skills and competencies needed to manage energy issues of the organisations that they serve. A training grant is also offered to cover about 80.0% of the training costs.
- **Energy Efficiency National Partnership (EENP) Program:** This is a voluntary outreach program to assist companies in improving their energy efficiency and reducing energy wastage. The EENP promotes the adoption of energy management systems such as ISO50001 at the organisational level and provides a platform for training and sharing best practices under the EENP Learning Network. EENP partners who have implemented excellent energy management practices and demonstrated tangible results will be recognised through the EENP Award.

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 road use. In addition, the Singaporean 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 trials of green technologies such as diesel hybrid buses and electric vehicles.

- **Carbon Emissions-Based Vehicle Scheme (CEVS):** The CEVS was introduced in January 2013 to improve the take-up of green vehicles, with cars enjoying rebates for having low carbon emissions, while those with high carbon emissions have to pay a surcharge. Replacing the green vehicle rebate (GVR), the results of CEVS has been encouraging with more than 50.0% of the new cars registered in 2013 received CEVS rebates while about 10.0% paid the surcharge. The CEVS will be extended till July 2015 to observe the full impact of the scheme before refining it.

- **Fuel Economy Labelling Scheme (FELS):** From 2009, passenger cars and light goods vehicles that are sold in Singapore must be affixed with the Fuel Economy Label. With the fuel economy information, car buyers are able to make better-informed decisions on fuel efficiency when purchasing new cars.
- **Green Mark for Rapid Transit System:** The Rapid Transit System (RTS) is the backbone of Singapore's public transport system and is also the most energy-efficient means of transporting a large number of commuters. By 2020, the RTS network will be doubled to 278 km. The objectives of the Green Mark for RTS framework are to promote sustainable and environmentally friendly RTS design, as well as to provide guidance in the formulation of engineering standards for conceptualisation, design and construction of new RTS lines. The framework has three key pillars—i.e. the effective use of energy, water conservation, and environmental protection and sustainable development—and covers various aspects of an RTS line (rolling stock, electrical and mechanical systems, civil works, station design, as well as operational considerations).
- **Trial of diesel hybrid buses:** LTA and public transport operators are collaborating on a trial of diesel hybrid buses. Diesel hybrid buses have been found to be effective in other cities in bringing down both the carbon emissions and particulate matter (PM) emissions of the bus fleet. If the trial is successful, more diesel hybrid buses may be deployed in the future.
- **Facilitating Cycling:** Cycling does not consume external energy. To facilitate cycling as an alternative mode of transport for short-distance intra-town trips, program are progressively being rolled out to design and construct dedicated cycling paths in seven selected Housing Development Board (HDB) towns (Tampines, Yishun, Sembawang, Pasir Ris, Taman Jurong, Bedok, and Changi-Simei), as well as Marina Bay. More and better-designed bicycle parking facilities are being provided near MRT stations to help cyclists transfer to the public transport system for longer distance travel. Foldable bicycles are allowed on buses and trains during off-peak hours.
- **Park and Ride (P&R) Scheme:** The scheme allows people who have vehicles to park their vehicles at designated car parks located near an MRT station, bus interchange or bus stop, and continue their journey hassle-free by bus, MRT or LRT. The purpose of this scheme is to allow motorists to switch to the more energy efficient public transport for part of their journeys in a convenient way.

BUILDINGS

Sustainable development remains a key priority for Singapore. Energy efficiency is one of the main considerations for achieving a sustainably-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.
- **Singapore Certified Energy Manager (SCEM) for buildings:** This initiative, consisting of both a program and grant, is available to professionals who wish to build their careers as energy managers in the building sector.
- **BCA Green Mark Scheme:** Launched in January 2005, the BCA Green Mark Scheme is a green building rating system that promotes the adoption of green building design and technologies to improve energy efficiency and reduce the impact of buildings on the environment. Under the BCA Green Mark Scheme, buildings are assessed for energy efficiency, water efficiency, indoor environmental quality and environmental protection as well as other green features and innovations. 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 2 000 square metres to achieve the minimum Green Mark Certified level.
- **Green Mark Gross Floor Area (GM GFA) Incentive Scheme:** To encourage the private sector to develop buildings that attain higher tier Green Mark ratings (i.e. Green Mark Platinum or Green Mark Gold^{PLUS}), BCA and URA introduced the Green Mark Gross Floor Area Incentive Scheme on 29 April 2009 for a period of five years. For developments attaining Green Mark Platinum or Gold^{PLUS}, URA will grant additional floor area over and above the Master Plan Gross Plot Ratio (GPR) control.

Green Mark Incentive Scheme for New Buildings (GMIS-NB): On 15 December 2006 A sum of SGD 20 million was set-aside for the Green Mark Incentive Scheme for New Buildings (GMIS-NB) for a period of three years. The scheme offered cash incentives to developers, building owners, project architects and engineers who made efforts to achieve at least a BCA Green Mark Gold rating or higher in the design and construction of new buildings. The fund was 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 29 April 2009 for a period of five years. The GMIS-EB provides a 'cash incentive for an upgrading and retrofitting' scheme that co-funds up to 35.0% (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 a building's air-conditioning plants. BCA co-funds 50.0% of the cost for conducting this health check; the remaining 50.0% 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. The developments must aim to exceed the Green Mark Platinum standards, demonstrating energy savings of at least 40.0% better than the current base code or equivalent.

- **Building Retrofit Energy Efficiency Financing (BREEF) Scheme:** In September 2011, BCA announced a new pilot scheme called the Building Retrofit Energy Efficiency Financing (BREEF), which provides loans to building owners and energy services companies to enable them to carry out energy retrofits. BCA and participating financial institutions commited to sharing the risk of any loan default. The pilot scheme took effect from 1 October 2011 for a period of two years.

- **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 GoldPlus) for projects developed on government sales sites, the higher Green Mark standards will be set as part of the 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 committed to environmental sustainability and takes a long-term view of resource efficiency. Public sector agencies have put in place environmental sustainability measures that encompass energy efficiency, water efficiency and recycling. New public sector buildings with an air-conditioned area of greater than 5 000 square metres must attain the Green Mark Platinum rating, while existing public sector buildings with an air-conditioned area of greater than 10 000 square metres must attain the Green Mark Gold^{Plus} rating by 2020.

HOUSEHOLDS

Households account for about a sixth of the electricity consumed in Singapore. Households are encouraged to purchase energy-efficient appliances and adopt energy-efficient habits. Programs for households include:

- **10.0% Energy Challenge:** To increase public awareness of ways to be more energy efficient, the 10.0% Energy Challenge was launched in April 2008. Households are taught simple energy saving habits to reduce their energy use by 10.0% and save money. By doing so, they also help fight climate change.

- **Mandatory Energy Labelling Scheme (MELS) and Minimum Energy Performance Standards (MEPS):** To assist households in making better energy choices, the MELS was introduced for the two most energy intensive appliances, namely air conditioners and refrigerators, in January 2008. The scheme was extended to clothes dryers in 2009. Under the Environmental Protection and Management Act, all household refrigerators, air conditioners and clothes dryers that are sold in Singapore must be affixed with an Energy Label.

In addition, MEPS were introduced in September 2011 for household air-conditioners and refrigerators. The MEPS remove the most inefficient appliance models from the market by prohibiting the sale of models that fall short of specified minimum energy efficiency levels, and encourage suppliers to bring in more energy-efficient appliances as technology improves.

- **Residential Envelope Transmittance Value Standard:** As set in place in 2008, residential buildings with a gross floor area of 2 000 square metres or more must comply with the BCA Residential Envelope Transmittance Value standard.

RENEWABLE ENERGY

Singapore is pursuing growth opportunities in clean and renewable energy, mainly solar, while continuing its use of waste for power generation, as part of its strategy to meet its energy policy objectives. Several renewable energy initiatives are underway to deal with the economy's energy challenges.

Singapore's modern, electricity-generating incineration plants make use of renewable waste-to-energy technologies, annually consuming about 2.7 million tonnes of waste, which generate a growing amount of green energy from four incineration plants (Tuas IP 46 MW, Senoko WTE Plant two x 28 MW, Tuas South IP 80 MW, and Keppel Seghers Tuas WTE Plant 22 MW). These plants generated 3 508 ktoe of electricity in 2014 (EDMC, 2014).

In terms of solar power, Singapore has embarked on R&D and test-bedding initiatives to help companies and researchers advance the development of solar technologies. Singapore's test- bedding efforts seek to improve the understanding of the best practices for optimising the performance of solar PV systems in tropical, urbanised environments.

The Housing Development Board (HDB) has test-bedded solar PV systems at two existing public housing precincts in Serangoon and Wellington, generating 220kWh of electricity per day for each precinct in the process. As of the second quarter of 2014, there were 468 grid-connected PV installations with the total capacity of 19 MwP of which the share of residential and non-residential ones were 164 (1.6 MwP) and 304 (17.4 MwP), respectively (EMA, 2014). Under a solar leasing model, a private company will design, finance, install, operate and maintain 2 MWp of solar PV systems. The Pasir Ris-Punggol Town Council will pay Sunseap for solar power generated and consumed at a rate that is not higher than the retail electricity tariff rate.

The Economic Development Board (EDB) and Public Utilities Board (PUB) will pilot a SGD 11 million floating PV project at Tengeh Reservoir, which aims to assess the feasibility of installing floating solar PV systems as an alternative to rooftop-based installations.

The 'Handbook for Photovoltaic (PV) Systems' has been published by EMA and BCA to facilitate the implementation of solar PV systems in Singapore. The handbook provides information on licensing, market and technical requirements, and building and structural issues relating to solar installations.

In November 2010, the Finnish oil refining and marketing company Neste Oil opened its 800 000 tonnes per year renewable diesel refinery in Singapore, currently the world's largest of its kind at the cost of EUR 550 million. The refinery uses Neste's proprietary NExBTL technology to produce a renewable diesel product superior to regular biodiesel and fossil-based diesel. Renewable diesel reduces greenhouse gas emissions by over 50.0% compared to fossil-based diesel (Neste Oil 2012).

SUSTAINABLE DEVELOPMENT

On 27 April 2009 Singapore's Inter-Ministerial Committee on Sustainable Development (IMCSD) unveiled its Sustainable Development (SD) Blueprint by the. 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 enhance 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, even as Singapore continues to grow and develop. Targets have been set to measure the progress in these areas. The blueprint

has a 20-year timeframe, with identified key goals for 2030. The blueprint's goal for the energy sector is to reduce energy intensity (consumption per dollar of GDP) by 35.0% from the 2005 levels by 2030, with an intermediate goal of 20.0% from the 2005 levels by 2020.

As part of its sustainable development objective, Singapore has taken steps to increase the share of solar of its electricity generation as the only viable type of renewable for the specific situation of Singapore by facilitating its growth. Among others, EMA has taken measures towards this end, including setting a policy of proactively enhancing the required market and regulatory framework to facilitate the deployment of solar units (EMA, 2014a).

NUCLEAR

Singapore currently does not have a nuclear energy industry. In 2010, the economy embarked on a pre-feasibility study of nuclear energy to objectively evaluate the opportunities, challenges and risks of nuclear energy, and its feasibility as a long-term energy option for Singapore. The study, finalised in 2012, concluded that nuclear energy technologies presently available, though safer than the older designs still in use in many countries, were not suitable for deployment in Singapore given the economy's small size and high population density (MTI, 2012).

CLIMATE CHANGE

Singapore is a small and highly urbanised city-state with no rural hinterland, accounting for less than 0.2% of the global emissions. It has taken serious measures to decrease its carbon footprint, and has made major progress in reducing its CO_2 emissions although for geographical reasons, its options for renewables are mainly limited to solar energy, apart from waste. Thus, the economy has limited access to emission-free or low-emission energy sources as hydro, wind, tidal and geothermal energy are not an option given its lack of hydro resources, its low wind speeds and mean tidal range and economic non-viability of geothermal (EMA, 2014a). Nuclear energy is not an option either, as discussed earlier. As a result, it is an alternative-energy disadvantaged economy, and its options for non-fossil and renewable energy are mainly limited to solar. However, as a responsible global citizen, Singapore continues to play its part in addressing climate change by reducing emissions. Hence, in 2009, Singapore pledged in the context of the United Nations Framework Convention on Climate Change negotiations to reduce emissions by 16.0% from 2020 business-as-usual (BAU) levels in the event of a legally binding global agreement under which all countries will implement their commitments. The economy set up the National Climate Change Secretariat on 1 July 2010 as a dedicated agency under the Prime Minister's Office to coordinate its domestic and international policies, plans and actions on climate change (NEA, 2014).

Ahead of the pending conclusion of a legally binding global agreement, the economy has begun to implement measures that are expected to lead to a 7.0%-11.0% reduction in emissions from BAU levels. While seeking to increase the share of solar of its power generation energy mix currently very small (19 MWp in 2014), it has significantly reduced its grid-generated emissions through greater use of natural gas for electricity generation by increasing its share of the respective energy mix. Singapore has switched from fuel oil to natural gas as the main energy source for such generation as its produces the least carbon emissions per unit of electricity generated amongst fossil fuel-fired power plants. By increasing the share of natural gas used in electricity generation from only 19.0% in 2000 to about 80.0% in 2014, Singapore has substantially reduced its emissions growth over the last ten years (NEA, 2014). Singapore's efforts have resulted in improving its average Operating Margin Grid Emission Factor from 0.49 kg CO_2/kWh in 2012 to 0.45 kg CO_2/kWh in 2013.

NOTABLE ENERGY DEVELOPMENTS

ENERGY STORAGE PROGRAM

In Oct 2014, EMA announced a SGD 25 million Energy Storage Program to support the development and integration of large scale, cost-effective Energy Storage Systems (ESS) for Singapore's power system. In Singapore, ESS could be used to reduce demand during peak periods; as reserves for frequency regulation; and to support the deployment of intermittent generation sources like solar energy.

SEMBCORP-EMA ENERGY TECHNOLOGY PARTNERSHIP

EMA has partnered Sembcorp in a SGD 10 million initiative to encourage the translation and commercialisation of energy research into technologies and solutions to address Singapore's energy needs.

Through this partnership, researchers and companies have the opportunity to develop new technologies that could potentially be test-bedded at Sembcorp's facilities, and leverage on Sembcorp's strong business networks for commercialisation. A joint R&D grant call is scheduled for launch by mid-2015.

PULAU UBIN MICRO-GRID TEST-BED

EMA is conducting a micro-grid test-bed on the island of Pulau Ubin to assess the impact of intermittent energy sources, such as solar, on grid operations. Phase 1 of the test-bed was successfully completed and launched by Minister S. Iswaran on 10 Oct 2013 to supply electricity to end-users at the Pulau Ubin jetty area. Under Phase 2, the micro-grid will offer companies and research organisations a platform to develop and pilot innovative, close-to-market energy technologies for Singapore (in areas such as energy analytics, energy storage and grid asset management). Awarded projects will be announced by the second half of 2015.

BIOMASS CLEAN COAL COGENERATION PLANT

Currently, Tuas Power operates the Biomass Clean Coal (BMCC) cogeneration plant, as part of the Tembusu Multi-Utilities Complex that serves the industries on Jurong Island. The increased efficiencies of cogeneration and the use of biomass help reduce the carbon emissions of the plant per unit of electricity and steam generated. Further to ensure that environmental sustainability is not compromised, low-sulphur and low-ash coal is used in the BMCC plant to substantially reduce the emissions of sulphur dioxide and the amount of waste generated. The bulk of the fuel used in the plant is renewable biomass, natural gas, and diesel. The facility has been in use since 2013 and will be fully operational in 2017 to generate 160 MW of electricity in addition to steam EDB (2014a).

NEW GENERATION CAPACITY

Singapore's major electricity-generating companies are Senoko Energy, YTL Power Seraya, Tuas Power Generation, SembCorp Cogen, Keppel Merliamu Cogen and PacificLight Power (SGC, 2014). PacificLight Power started operations in June 2014 and is Singapore's first fully LNG operated power plant. This state-of-the-art 800MW plant was built at a cost of $1.2 billion.

Keppel has entered into an agreement with Singapore's National Environment Agency (NEA) to provide additional incineration capacity to the Senoko Waste-to-Energy (WTE) plant. Thus, the plant will undergo upgrading, currently planned to take place between the third quarter of 2015 and the third quarter 2016, to increase by up to 10.0% its current capacity of 2 100 tonnes per day (Keppel, 2014a).

Keppel completed the expansion of its co-generation Keppel Merlimau Cogen Plant located at the Tembusu sector of Jurong Island in 2013. Being in operation since 2007, its total generation capacity has now increased to 1 300 MW. It supports the needs of its surrounding industries with electricity, steam supply and demineralised water requirements (Keppel, 2014).

Keppel secured financial closure in 2011 for its two 420 MW combined cycle power plant project at Jurong Island in Singapore. The engineering, procurement and construction contract, as well as the associated long-term service agreement, were signed in 2010. The power plants entered into commercial operation in 2013 (Keppel, 2011).

Sembcorp completed the construction of the first phase of a gas-fired combined cycle co-generation power plant in July 2014. Being located in the Tembusu sector of Singapore's Jurong Island, the plant's total generation capacity is 815 MW while that of the first phase is of 400 MW with a steam production capacity of 200 tonnes per hour (Sembcorp, 2014). Its second phase is due for completion in the near future.

Senoko Energy announced in late 2009 the commencement of its Stage 2 repowering project to convert three 30-year-old 250 MW oil-fired steam plants into two 431 MW LNG/gas-fired combined cycle plants that are technologically modern and environmentally friendly. The plants, which make extensive re-use of the existing equipment and infrastructure entered commercial operation in 2012 (Senoko, 2012).

Tuaspring Pte Ltd, a subsidiary of Hyflux, was awarded the contract in late 2011 for a new 411 MW natural gas-fired combined cycle power plant to supply electricity to the Tuaspring Desalination Plant in Tuas, Singapore; its excess power will be sold to the power grid. Tuaspring signed a Water Purchase Agreement to supply the Public Utilities Board (PUB) with 318 500 cubic metres per day of desalinated water over a 25-year period from 2013 to 2038, under a Design, Build, Own, and Operate (DBOO) model. The Tuaspring Desalination Plant is Singapore's second and largest seawater reverse osmosis desalination plant (Hyflux, 2012).

Keppel Seghers won the 25-year construct and operate contract for Singapore's fifth incinerator, which began commercial operations in October 2009. The plant can generate up to 22 MW of power for Singapore's grid. It is the first incineration plant to be built and operated by the private sector. It is also smaller than its predecessors, with a capacity of 800 tonnes per day of solid waste. Previously all of Singapore's incinerators have been constructed and operated by the National Environmental Agency (NEA). The plant was built under the NEA's Public Private Partnership (PPP) initiative through a DBOO contract. With the operation of this incinerator, Singapore's waste incineration capacity is 3.28 million tonnes a year (Keppel Seghers, 2010).

In addition, EMA is exploring the import of 600 MW of electricity from other economies (EMA, 2012b). With this, Singapore would be able to further diversify its energy mix by tapping into new energy options that would have been unavailable or economically unfeasible in Singapore, thereby reducing the demand for valuable land to build power plants.

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Ministry of the Environment and Water Resources—www.mewr.gov.sg

Ministry of National Development— http://app.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, mainly comprised of Taiwan, Penghu, Kinmen and Matsu, is a chain of islands stretching from the bottom of Japan in the north to the top of the Philippines in the south. With an area of around 36.2 thousand square kilometres, and located just 160 kilometres off the south-eastern coast of China, Chinese Taipei represents a natural gateway to East Asia. Although only one-quarter of the land is arable, the subtropical climate permits the multi-cropping of rice and the growing of fruit and vegetables all year round.

In 2012, Chinese Taipei's gross domestic product (GDP) was USD 784.7 billion, and its per capita income was USD 33 656 (USD 2010 at PPP). GDP increased at an average growth rate of 3.7% from 2000-12. Chinese Taipei's rapid economic development over the past decade has substantially changed the economic structure of the economy, shifting the emphasis from industrial production to the services sector. In 2012, the services sector contributed 61.6% of GDP, followed by the industrial sector (37.0%) and the agriculture sector (1.3%) (BOE, 2013). Chinese Taipei is one of the most densely populated areas in the world, but its rate of population growth has been relatively sedate. The economy's population of 23.3 million grew at a rate of 0.4% in 2012 compared with 2011. This was higher than the average annual population growth rate of 0.4% between 2000-12 (EDMC, 2014).

Chinese Taipei has very limited domestic energy resources and relies on imports for most of its energy requirements. There are no coal reserves in Chinese Taipei, but the economy has oil and gas reserves of around 2.4 million barrels and 6.23 billion cubic metres respectively (EIA, 2014). In 2012, installed electricity generation capacity totalled 41.67 gigawatts (GW) (EIA, 2014).

Table 1: Key data and economic profile, 2012

Key data		Energy reserves[b]	
Area (sq. km)[a]	36192.8	Oil (million barrels)	2.
Population (million)	23.3	Gas (billion cubic metres)	6.2
GDP (USD (2010) billion at PPP)	784.7	Coal (million tonnes)	–
GDP (USD (2010) per capita at PPP)	33 656	Uranium (kilotonnes U)	–

Source: (EDMC, 2014); a. (DGB, 2013); b. (EIA, 2014).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

Traditionally, a lack of domestic energy and mineral resources has forced Chinese Taipei to import nearly all of its energy requirements, with imports accounting for 97.8% of its primary energy supply in 2012 (BOE, 2012a). The dependent nature of its energy supply systems has resulted in fragile energy security for the economy. Improving self-reliance with respect to energy supply is thus an important goal for energy security. In addition, Chinese Taipei's energy supply structure is highly dependent on fossil fuels such as coal, oil and natural gas. Its primary energy supply grew at an average rate of 4.1% between 1992 and 2012.

This growth has mainly been concentrated in fossil fuels such as coal, oil and gas, which have increased from 86.5% of the primary energy supply in 1985 to more than 89.8% in 2012 (BOE, 2012b). In 2012, Chinese Taipei's total primary energy supply was 10 7457 kilotonnes of oil equivalent (ktoe), a decline of 0.2% from the previous year. By fuel, oil contributed the largest share (38.8%), followed by coal (33.5%), natural gas (15.3%) and other fuels (12.4%) (EDMC, 2014).

In 2012, Chinese Taipei imported almost its entire crude oil requirements. The Middle East represents its major supplier, accounting for 80.8% of the total oil imports of a million tonnes of crude oil in 2012. To prevent supply disruption, the Petroleum Administration Act 2001 requires Chinese Taipei's refiners to maintain stocks of more than 60 days of sales volumes. Chinese Taipei also imported almost its entire coal requirement. Australia and Indonesia are its major suppliers, accounting for 81.6% of the total coal imports in 2012. In 2012, Chinese Taipei imported 64.6 million tonnes of coal. Most coal (72.8%) was used for power generation (BOE, 2012a; BOE, 2012b).

Since Chinese Taipei's natural gas resources are also very limited, its demand is met almost entirely by imports of liquefied natural gas (LNG). Indonesia, Qatar and Malaysia are its major suppliers, accounting for 83.9% of the total natural gas imports in 2012. LNG imports in 2012 amounted to 12.5 million tonnes, a 4.2% increase from 2011 (BOE, 2014).

Table 2: Energy supply and consumption, 2012

Primary Energy Supply (ktoe)		Final Energy Consumption (ktoe)		Power Generation (GWh)	
Indigenous Production	13 610	Industry sector	22 262	Total	250 390
Net Imports and Other	96 365	Transport sector	11 789	Thermal	194 686
Total PES	107 457	Other sectors	31 972	Hydro	8 609
Coal	35 993	Total FEC	66 022	Nuclear	40 462
Oil	41 740	Coal	6 921	Other	6 633
Gas	16 397	Oil	37 201		
Others	13 327	Gas	2 661		
		Electricity and other	19 240		

Sources: (EDMC, 2014).

In 2012, electricity generation in Chinese Taipei reached 250 390 gigawatt-hours (GWh). Of the total electricity production, Taiwan Power Company's (TPC) hydro power comprised 3.37%, thermal power 49.2% (coal shared 27.0%, oil 2.3%, LNG 20.0%), nuclear power 16.1%, wind power 0.3%, cogeneration 14.9%, and independent power producers (IPP) 16.1%. In terms of the generating capacity, TPC dominates Chinese Taipei's electric power sector with 66.6% and IPPs account for 17.0% 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 100.0% of an IPP. Currently, two 1 350 MW Advanced Boiling Water Reactor (ABWR) units in the fourth nuclear energy project are under construction to boost electricity generation (EDMC, 2012; BOE, 2012b).

FINAL ENERGY CONSUMPTION

Final energy consumption in Chinese Taipei was 66 023 ktoe in 2012, 0.3% higher than in 2011. The industry sector consumed 33.7% of the total energy used, followed by the transport sector (17.9%). The other sectors, including residential and services consumed 48.4% of the total energy used. By energy source, petroleum products accounted for 56.4% of total final energy consumption, followed by electricity (29.1%), coal (10.5%) and gas (4.0%).

In 2012, energy used in the industry and transport sectors decreased by 1.4% and 2.0% due to the global economic recession, while energy consumption in other sectors increased by 2.4% (EDMC, 2012).

ENERGY INTENSITY ANALYSIS

Table 3: Energy Intensity Analysis

Energy	Energy Intensity (toe/million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	139.18	136.94	-1.6
Final Energy Demand	85.13	84.14	-1.2
Industry	29.18	28.37	-2.8
Transportation	15.55	15.02	-3.4
Others	40.40	40.74	0.9

Source: (EDMC, 2014).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

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 1981 and the electricity laws; regulating natural gas utilities and petroleum and liquefied petroleum gas (LPG) 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 Bureau of Energy released the Framework of Taiwan's Sustainable Energy Policy in June 2008 (BOE 2008). The framework includes:

- Policy objectives—to create a win-win-win solution in energy, the environment and the 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 two-part strategic framework—a cleaner energy supply and rationalised energy demand;
- Follow-up work—for government agencies to formulate concrete action plans, which clearly set carbon-reduction targets, to build monitoring and follow-up mechanisms to regularly review the effectiveness and performance of the action plans, and to establish quantitative objectives for each task to measure its performance and to facilitate implementation;
- Targets for energy conservation—reduce energy intensity 20.0% by 2015 (based on 2005), with a further reduction of 50.0% by 2025 through technology breakthroughs and proper administrative measures;
- CO2 emissions could drop back to the 2008 level between 2016-20, and be further reduced to the 2000 level in 2025; and
- A secure energy supply system to meet economic development goals.

Chinese Taipei established the year 2010 as the 'Year for Energy Conservation and Carbon Reduction.' In order to push forward the Framework of Taiwan's Sustainable Energy Policy, Chinese Taipei has set up a Committee of Energy Conservation and Carbon Reduction in the Executive Yuan (the executive branch of government) as the highest authority for and monitor of the State Energy Conservation and Carbon Reduction Projects. The committee is chaired by the Vice Premier of the Executive Yuan with members from each ministry. The State Energy Conservation and Carbon Reduction Projects cover 10 major fields and 35 landmark projects to emphasise and implement key energy policies.

In response to the nuclear disaster in Fukushima, Japan in 2011, on 3 November 2011 Chinese Taipei released a New Energy Policy to 'Ensure Nuclear Security, Steadily Reduce Nuclear Dependence, Create a Low-carbon Green Energy Environment & Gradually Move Towards a Nuclear-free Homeland'. The major strategies concerning nuclear power are (BOE, 2011):

- Conduct a comprehensive safety examination of nuclear power plants to ensure nuclear safety;
- Steadily reduce nuclear energy dependence by actively reducing electricity demand and peak loads, and promote alternative energy sources to ensure a stable power supply;
- No extension to the life spans of existing plants, with the decommissioning plan launched as planned;
- Ensure the security of the 4th Nuclear Power Plant prior to its commercial operation; and
- Early termination of operations at the First Nuclear Power Plant, if the two reactor units of the 4th Nuclear Power Plant have steadily operated before 2016.

In April 2012, the Bureau of Energy also released an Energy Industry Technology White Paper. The white paper sets up a roadmap for the development of the energy industry. It addresses the important policies and strategies established in the Framework of Taiwan's Sustainable Energy Policy 2008, the conclusions of the 2009 National Energy Congress and action plans for the promotion of the green energy industry (BOE 2012c, BOE 2009).

Reducing its excessive dependence on conventional energy imports is crucial to enhancing the safety and stability of Chinese Taipei's energy supply. In order to secure the energy supply and meet demand in the future, in October 2012 Chinese Taipei released the 'Guideline on Energy Development' (BOE 2012d). It readdresses issues of security, efficiency and clean policies for the future energy supply and demand in Chinese Taipei. Apart from diversifying the sources and methods of acquiring energy and enhancing the rate of its own energy production, Chinese Taipei is promoting energy development and proliferation via new technologies. High costs and the stability of supply are the two problems that remain to be solved through the development of new energy technologies. The development of accessible and affordable clean energy domestically has become a major challenge for technological research and will require new technology breakthroughs.

ENERGY SECURITY

As Chinese Taipei is almost completely dependent on fossil fuel imports, the government has been working to secure supply. To stabilise the oil supply, private oil stockpiling is expected to satisfy the Petroleum Administration Act' 2001's requirement that refiners and importers maintain 60 days of sales volumes (calculated from the average domestic sales and private consumption over the preceding 12 months). Using the Petroleum Fund to finance the storage of oil, the government is also responsible for stockpiling 30 days of oil demand. Under the Act, the LPG stockpile should be more than 25 days of supply (BOE, 2012a).

For many years, the Chinese Petroleum Corporation (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 the rising cost of oil in recent years, CPC has made strenuous efforts to develop upstream exploration to secure oil sources. In line with the government's policy of deepening energy supply safety mechanisms 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. As of the end of 2013, CPC had engaged with international oil companies in cooperative exploration in 25 fields spread over ten economies. Within Chinese Taipei, in 2013 CPC completed geological survey of 48 square kilometres and three-dimensional seismic surveys covering 156.8 square kilometres in western Chinese Taipei, repaired one well and drilled a new one. There are currently 41 producing oil and gas wells in the Tiezhenshan, Qingcaohu, Jinshui, Chuhuangkeng and Guantian fields, yielding 500 million cubic meters of natural gas and 10 000 kiloliters of condensate annually.

In its future strategic deployment, CPC will seek to leverage its situation in overseas exploration and production by optimising the value of its existing overseas oil and gas field assets, establishing core areas with high rates of growth, participating actively in bidding for open blocks, seeking opportunities to take over fields from major oil companies, and pursuing opportunities for mergers and acquisitions in new oil and gas fields so as to add further reserves (CPC, 2014a).

ENERGY MARKETS

ELECTRICITY MARKETS

The Chinese Taipei Government aims to have a total electricity supply that provides a reserve capacity of 15.0% (BOE 2012a), based on peak demand. During the 1990s, some of the 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 the required reserve capacity between 1990 and 2004. Reserve capacity was only about 50.0% between 1990 and 1995. In 1995, to stabilise the power supply, Chinese Taipei's electricity market was opened to the IPPs when the reserve capacity fell below 16.0%. Electricity produced by IPPs is sold to TPC through TPC's transmission lines. TPC provided 66.6% of power generation capacity in 2012, with 17.0% from IPPs and 16.4% from cogeneration plants.

In order to enhance the stability of the electricity supply, TPC continues to improve its transmission and distribution system. In 2012, the substation and transmission facilities that underwent retrofitting were 121 units of transformers, 308 transmission towers, 88.347 ckt-km of overhead transmission lines, 149.652 ckt-km of ground lines, and 47.613 ckt-km of overhead transmission lines that were changed to underground cables. In terms of the distribution system, the number of newly expanded feeders reached 500. At the end of 2012, the total number of feeders being automated reached 19 657(45.0% of the total coverage). These improvements are expected to greatly reduce the duration of forced power outages. The SAIDI (System Average Interruption Duration Index) was 19.1 minutes/customer-year and the SAIFI (System Average Interruption Frequency Index) was 0.298 freq./customer-year in 2012. Despite the

increase in power supply from the south to the north, the line loss was controlled at a high standard of 4.4% (TPC, 2012, 2013).

To comply with the schedule for privatising TPC and promoting the liberalisation of the domestic power market, the Ministry of Economic Affairs (MOEA) has completed a program for the liberalisation of the electricity industry. Based on this program, a draft amendment to the Electricity Act was submitted to the Legislative Yuan for review. The implementation strategy of liberalisation included:

- The generator sector, which will be able to set up and sell power to consumers directly;
- An independent system operator (ISO), which is in charge of dispatching power will be set up; and
- Transmission and distribution, which will not be operated by the public or private sectors.

FISCAL REGIME AND INVESTMENT

Chinese Taipei has limited indigenous energy resources and thus has no formal policy on investment in upstream assets. However, in order to secure new energy sources, Chinese Taipei has invested in oil exploration both in the Taiwan Strait and abroad through state-owned CPC. Chinese Taipei also welcomes the participation of foreign investors in bidding in the IPP electricity market.

ENERGY EFFICIENCY

In 2012, the total energy consumption classified by sector are as follows: the energy and industrial sectors consumed 45.3%; transportation sector, 11.9%; agriculture, forestry and fishery sectors, 0.9%; services sector, 11.0%; residential sector, 10.9%; non-energy uses, 20.1%. The government considers it important to improve the energy efficiency of all industry sectors, especially energy management in energy-intensive industries and among major energy users. It amended the Energy Management Act 1981 to establish an energy development and utilisation evaluation mechanism to foster gradual improvements in energy efficiency in newly constructed or expanded factory plants via advanced management mechanisms (BOE 2012a, 2012b).

Major activities and achievements of Chinese Taipei as the economy sought to reduce its energy intensity and reach government targets included (BOE, 2012a):

- Carried out energy audits of the major energy users and helped them to set up internal energy auditing systems and reported the results to the government. A total of 4 685 high-energy users (3 261 manufacturers and 1 424 non-manufacturers) were audited by the government in 2012. The audits showed energy savings of 55 million litres of oil equivalent (MLOE) for the 3 261 manufacturers and 3.37 MLOE for the others.
- Established an energy service team and provided energy technology services to help energy users diagnose their energy systems and improve their energy efficiency. A total of 1 114 companies were visited in 2012, which potential energy savings of 18 MLOE, with 9.1 MLOE being achieved.
- Since 2001, promoted the voluntary accreditation of high energy-efficient products and an energy labelling system. A total of 38 product categories were included in the energy labelling system, with 373 manufacturers and 6 639 brands gaining accreditation by the end of December 2012. In addition, more than 130 million labels were issued in 2012.
- Since July 2010, enforced a mandatory multi-level energy efficiency labelling mechanism. Four product categories were included in this first stage—air conditioning units, refrigerators, vehicles and motorcycles. Humidifiers were included from March 2011 and fluorescent lamps in July 2011. The programme was scheduled to be expanded to gas stoves and instantaneous gas water heaters in December 2012. There were 6 727 air conditioner models, 1 019 refrigerator models, 209 dehumidifier models and 1 585 CFL models for which mandatory energy label applications were completed in 2012.
- Chinese Taipei began to employ LED signalised traffic lights to replace existing incandescent traffics light from 2005. By the September 2011, all the traffic lights (about 696 700 sets of traffic lights across Chinese Taipei) had been replaced by the LED type. It is estimated that the energy saving from this move amounts to 247 million kWh per year. Another application of LED streetlights was also promoted by Chinese Taipei to replace existing mercury vapour streetlights from 2008. Fifty thousand streetlights were replaced by December 2012 with a further 234 000 across all counties replaced by the end of 2013.

- Two rounds of the Energy Efficient Appliance Rebate Programme have provided residents with a rebate of TWD 2 000 on each purchase of an energy-efficient appliance in 2012. It covers air conditioners and refrigerators with energy rating labelling grades of 1 or 2, energy conservation-labelled clothes washers, and TVs and monitors above 32 inches. The total budget is about USD 45 million. Through the rebate program, the economy expects to save 387 million kWh per year, promote sales totalling TWD 36.6 billion, and maintain or create more than 200 jobs.
- Promoted energy service companies (ESCOs) by supporting the operations of the Taiwan Association of Energy Service Companies and the Taiwan ESCO Business Association. An office to promote the ESCO industry was established in 2006. A total of 87 projects were conducted under the Energy Saving Performance Contract (ESPC) mechanism by the end of 2011, with an average energy savings of up to 53.2% compared with the pre-improvement performance. Since 2010, Chinese Taipei has also expanded subsidies to cover the development of a low-carbon community.
- Continued to focus on technology research and development (R&D) programs. The major programs and achievements included (BOE 2012a):
    - Key technologies for smart energy-saving network systems: This program integrates energy management technology, sensing and monitoring technology and information communication technology to develop the key technologies, products and components for smart energy network systems. The technology can be employed in existing systems without changing any equipment to enable more flexible management of energy-efficient living environments and efficiency in the industrial manufacturing process. By 2012, this system was already employed in 1 245 convenience stores in Chinese Taipei and is ready for export or technology transfer to other economies. There are a total of 91 manufacturers involved in this area, with revenue at TWD 140 billion in 2012.
    - Air conditioning and refrigeration technology: This technology development involves the gradual integration of the capacities of different industries. It includes upstream magnetic materials and IC (integrated circuit) chips, middle stream motors, compressors, and inverter controllers, and downstream heat pumps, air conditioning and refrigeration products. R&D efforts have focused on patent ideas, prototype designs, manufacturing capabilities, and systems testing and analysis. The programme gradually established industry capabilities in inverter-fed technology and products, and improved the energy efficiency of air conditioning and refrigeration systems in Chinese Taipei. The major achievements in 2012 were:
        - Completion of the prototype testing of an inverter centrifugal chiller with a capacity of 500RT (refrigeration tonne) using environmental refrigerant R-134a, achieving a target of COP (coefficient of performance) larger than 6.2 and integrated part load value (IPLV) COP larger than 9.7. Completion of the prototype testing of a centrifugal compressor water chiller with a capacity 80RT using magnetic bearings, achieving a target of COP equal to 5.3 and IPLV COP equal to 8.5.
        - Development of the first prototype of a CO_2 heat pump (employing its own CO_2 compressor) with COP = 4.25 at rated conditions and COP = 3.76 at winter condition.
        - Establishment of manufacturing capability and a key-components supply chain for inverter-fed air conditioning units (both single and multi-unit systems). The domestic parts for this unit comprise more than 90.0% of the total. The improvements mean that the new system exceeds Chinese Taipei's 2011 energy standards. This technology can also be deployed in DC inverter-fed cranes.
- Combustion and heat recovery technology: The key R&D effort here is to develop industrial energy-saving technologies and products to reduce energy consumption by and the environmental impact of the industry sector. It will also help the domestic industry to increase its global market competitiveness. The major achievements in 2012 were:
    - Development of oxygen-rich combustion technology and its use in heavy-oil combustion systems. This can reduce NOx gases to lower than 200 parts per million and increase efficiency more than 10.0% due to the lower exhaust temperature.
    - Completion of reliability testing for an inverter-fed air-fuel control system. The system can reduce the electricity consumption of a combustion system by up to 80.0%, compared with a traditional control system.

- Advanced lighting technology: The new generation of lighting systems emphasises energy savings, environmental protection and user-friendliness. To respond to global developments in advanced solid-state lighting and to keep pace with domestic industrial development to exceed the current lighting limit, the R&D effort focuses on developing long-life LED lighting products and modules in a variety of styles. The objective is to replace traditional lighting systems, with their high levels of environmental pollution and energy consumption. The major achievements in this area in 2012 were:
    - Development of a smart lighting control system with a digital addressable lighting interface (DALI) mechanism. This offers a graphical user interface to allow effective and user-friendly operation of the lighting control system.
    - Establishment of LED testing and verification laboratories, including three National Voluntary Laboratory Accreditation Program (NVLAP) international accreditation laboratories, six Energy Star accreditation laboratories, and 10 Taiwan Accreditation Foundation (TAF) accreditation laboratories. There were a total of 60 Chinese National Standards (CNS) by the end of 2012, of which two are harmonised with international IEC standards. The standards cover LED chips, components, modules, systems and lighting fixtures.

RENEWABLE ENERGY

The main three green energy industries for renewable energy in Chinese Taipei are photovoltaic power, wind power and bioenergy. Chinese Taipei has chosen Penghu Island as a low-carbon demonstration site for the economy. The government's major efforts to promote renewable energy industries in 2012 included solar, wind and bioenergy as detailed below (BOE, 2012a, 2012b).

PHOTOVOLTAIC (PV) SYSTEMS

After the Renewable Energy Development Act was passed in 2009, a feed-in tariff mechanism replaced the subsidies formerly used to promote renewable energy. The new mechanism has attracted more private sector investment to install PV systems. At the end of 2012, the total installed capacity was 222.4 MW with electricity generated reaching 173.1 GWh.

Chinese Taipei's PV industry is based on crystalline silicon solar cell materials and components, combined with upstream semiconductor materials and downstream industrial power systems. In 2012, there were about 257 companies with total revenue of about TWD132.2 billion. To increase the value and competitiveness of its PV industry in the global market, the government has provided partial subsidies for the application of a building integrated photovoltaic (BIPV) demonstration system.

WIND POWER SYSTEMS

The development of a wind power industry is mainly for the domestic market. TPC and private wind-energy developers continued to develop onshore wind turbine systems. By the end of 2012, Chinese Taipei had installed 290 sets of wind turbines economy-wide, with a total installed capacity of 571 MW, and an annual output of 1.414 billion kWh of electricity. This is sufficient to supply electricity for one year to 357 000 households. For offshore wind energy, a demonstration incentive program was announced in July 2012. By the end of December 2012, Chinese Taipei had selected three companies to receive subsidies to build demonstrative offshore wind farms with a generating capacity of 300 MW by 2020. The output value of the wind farms when completed in 2020 will be TWD 48 billion.

BIOENERGY

The bioenergy industry includes bio-diesel, bio-methane, and bio-heat and the power industries. Chinese Taipei has mandated an added 2.0% of biodiesel in its diesel for transportation vehicles from June of 2010. By the end of 2012, the consumption of biodiesel was 100 thousand kilolitres and 11 companies were approved as qualified biodiesel manufacturers with a production of about 84 thousand kilolitres. The biodiesel industry mainly uses waste cooking oil as its raw material (BOE, 2012a). Chinese Taipei also has a demonstration project for adding 3.0% of methane to gasoline for transportation vehicles in major cities. There were a total of 14 gasoline stations that can provide bio-methane in 2012.

In addition to the application of biodiesel in the transportation sector, Chinese Taipei has a total of 822 MW of power generation capacity employing bioenergy or waste as the input fuel with a total electricity generation of 349 million kWh in 2012.

RESEARCH AND DEVELOPMENT PROGRAMS

The Chinese Taipei Government will continue to focus on technology R&D programs. The major programs and achievements in 2012 were (BOE, 2012a):

The application of solar heating

Solar heating R&D priorities included continuous sputtering process performance, the small-scale development of solar thermal power generation systems, the design of large-scale solar hot water systems and optimisation, structural safety and anti-wind damage technology for solar water heating systems. The major achievements in 2012 were:

- A solar heat collection system with GPS and solar orbit-tracing mechanisms. Heat collection efficiency can reach more than 85.0% for power generation with a capacity of 300 W.
- The development of evaluation technology for large-scale solar hot water system designs.

Photovoltaic technology

The R&D focus included the development of high-efficiency silicon solar cells and thin-film devices, next-generation silicon solar cells and modules, and dye-sensitised solar cell technology. An international verification technology for PV modules and facilities was also set up in 2012. The major achievements in 2012 were:

- New high-efficiency hetero-junction solar cells were developed through the integration of interface processing technology, a p-type amorphous silicon layer to enhance conductivity and optimisation of the transparent conductive layer to improve solar cell efficiency to 19.0% and modules to 16.9%.
- A new generation of thin-film solar modules, 150 μm thick, was developed that can achieve 18.9% efficiency.
- A prototype of dye-sensitised solar modules with glass substrate was developed with an efficiency of 8.5%, and one with a flexible substrate was also developed with an efficiency of 5.4%.
- A copper indium gallium selenide (CIGS) was developed using vacuum technology and slurry print production technology. The conversion efficiency of the CIGS using vacuum technology can reach 16.0%, while the module efficiency with flexible stainless steel sheets can reach 14.2%.

Bioenergy

This R&D focus involved the development of key energy technologies, including microalgae oil production and biomass pyrolysis.

Wind power

This R&D focus included the development of offshore wind power engineering technology and equipment, and the establishment of a comprehensive systems analysis and integration design capacity. Chinese Taipei also focuses on the requirements for product differentiation and energy security to develop specific projects for enhancing the global competitiveness of the local wind power industry. The major achievements in 2012 were:

- Based on typhoon data from the APEC region and following the IEC specification to specify design loading conditions and parameters, a 5 MW wind power system simulation model was set up.
- Evaluations conducted on the potential for off-shore wind power systems along the Taiwan Strait revealed that the potential for a depth below 50 m is around 57 GW, while the potential for actual development is about 7.4 GW.

Fuel cell and hydrogen applications

To promote hydrogen and distributed power generation technologies, the first priority of R&D was the development of fuel cell applications using hydrogen, supported by advanced production and storage technologies for hydrogen. The major achievements in 2012 were:

- Continue the life testing for a 3 kW fuel cell cogeneration system. The overall system efficiency is 78.0% with power generation at 32.0% and heat recovery at 43.9%. Cumulative testing time reached 8,087 hours as of the end of 2012.

- Continue to put efforts into system integration for the application of fuel cells and enhancing capabilities for the development of key components, including the membrane electrode assembly, a gas diffusion layer/electrode, recombinant, etc. There were a total of 51 manufacturers with total revenue of about TWD 1 136 million in 2012.

NUCLEAR

To diversify the economy's electricity generation mix, the government encourages the development of nuclear energy. At the end of 2010, there were three nuclear power plants with six units and a total installed capacity of 5 144 MW. The Fourth Nuclear Power Project is adopting two 1350 MW Advanced Boiling Water Reactor (ABWR) units. GE-Hitachi Nuclear Energy Americas LLC supplies the two units (AEC 2013). However, in April, Chinese Taipei announced that unit one would be mothballed once safety checks were complete, and construction of unit two would be halted. TPC has submitted plans to the MOEA and Atomic Energy Council (AEC) for sealing unit one, meaning that equipment will be put into a protected condition which will allow future use, after the completion of safety checks. A referendum on the future of the plant would be held, but no date has been set (WNS, 2014).

CLIMATE CHANGE

GREENHOUSE GAS EMISSIONS

Chinese Taipei produces CO_2 emissions that account for about 1.0% of global emissions. Therefore, the government believes it has a moral obligation to reduce emissions even though the economy is not a member of the United Nations, and as a consequence is not eligible to sign the Kyoto Protocol or directly required to adhere to its emissions reduction requirements. Unlike other UN members, Chinese Taipei is unable to conduct carbon emissions trading in the international market to achieve cross-border cooperation in carbon reduction, or to seek carbon reduction plans that are cost-effective. It is thus necessary for Chinese Taipei to seek alternative ways to reduce the impact of its carbon emissions (BOE, 2008).

In 2011, Chinese Taipei established the 'Energy Conservation and Carbon Reduction Service Team,' which includes a 'Technology Service Group,' an 'Advocacy Group,' and a 'Volunteer Group' to provide technology consulting services to all the energy users and the public. By the end of 2011, the Service Team had acted on 2 860 calls for assistance in the field, organised 198 training workshops and seminars, and answered 12 128 remote help calls via the telephone or internet.

In 2008 and 2009, total CO_2 emissions showed negative growth for the first time in 20 years. Carbon intensity also showed a decrease of 3.6% for 2010 and 1.7% for 2011.

The potential cumulative carbon emissions reductions were estimated to be 37.5 million ton/CO2e with 17.8 million tonnes/CO2e verified by the end of 2012.

Emissions from fossil fuel combustion are the major source of greenhouse gas (GHG) emissions in Chinese Taipei. The economy emitted 248.7 million tonnes of CO_2 in 2012, down 1.9% over 2011. This is a reflection of efforts by Chinese Taipei toward energy conservation and carbon reduction over the past couple of years. It also shows that the average growth rate of CO_2 emissions has slowed significantly in the past decade. CO_2 emissions grew 1.2% annually after the year 2000, slower than the economic growth rate (3.1% annually), and the economy's CO_2 intensity has steadily declined since 2003. It appears that the rates of CO_2 emissions and economic growth have started to decouple in the economy over the past three years (2008–10). To reduce the environmental impact of its development, Chinese Taipei must seek the most advantageous development objectives for the economy from among the various policies on environmental protection, industrial development and energy supply (BOE, 2012a).

PROMOTION OF LOW-CARBON ENERGY TECHNOLOGY AND INDUSTRY

Chinese Taipei has a developing green energy industry. However, if it is to respond to future developments and competition, it will need to gain full access to key and innovative technologies. Faced with fierce competition globally, the economy is strengthening its R&D and innovation capabilities so that it can master niche technologies and enhance the economy's competitiveness. Chinese Taipei has been ranked sixth by the International Institute for Management Development in the area of creating competitive advantages in the green technology industry.

The development of emerging industries such as the green energy industry depends on the economy changing its focus from export processing, which was its previous focus, to an industrial model that involves the aggressive development of key technologies. This latter focus will compensate for the lack of independent intellectual property rights development in the past. Chinese Taipei has gradually changed its

mainstream industrial model from that of original equipment manufacturer (OEM) to that of *original design manufacturer* (ODM). The focus now is on enhancing the integration of the industrial chain and transforming development strategy from one of manufacturing key components into one that utilises vertical system integration. This will enhance the international competitiveness of the economy's green energy industry and help to promote the philosophy that value creation is worth more than production output.

To create an energy-efficient society and low-carbon economy, in 2009 Chinese Taipei selected seven green energy industries in which it sees development potential. These are based on its existing IT industry and human resources. Of those seven green energy industries, the PV and LED lighting industries are regarded as the pillar. Other promising industries include the wind power, biomass, hydrogen and fuel cell, Energy Information Communication Technology (EICT) and electric vehicle industries. The total revenue from these green energy industries was TWD 373.1 billion in 2012 with a growth of 133.0% compared with 2008. The cumulative new investment from 2009 to 2012 was TWD 237.7 billion, with the creation of new employment opportunities for 65 100 people from 2008 to the end of 2011.

NOTABLE ENERGY DEVELOPMENTS

MILLION SOLAR ROOFTOP PROGRAM

In responding to public concerns about nuclear safety after the Fukushima earthquake, Chinese Taipei comprehensively reviewed the possibility of expanding the development of renewable energy from mid-2011. Bureau of Energy established the promotion office of 'Million Rooftop PVs Program' on March 28, 2012 to administer the promotion businesses. The Million Rooftop PVs Promotion office administers two main missions, foster PV-friendly environment in Taiwan and assist governments and industries in promoting PV installed capacity of 6 200 MW by 2030 (BOE, 2014b).

The establishment of the promotion office is for the integration of related resources for harnessing renewable energy and providing professional assistance to resolve barriers which hindering the installation of renewable energy generation systems. The promotion office will provide total solutions for local renewable energy businesses, city and county governments, and system installation contractors in the utilisation of renewable energy.

In 2013, 392MW accumulated PV capacity had been established, and PV installation target will be revised to reach 602MW by 2014, 842MW by 2015, 2 120 MW by 2020, 4 100MW by 2025, and 6 200MW by 2030.

THOUSAND WIND TURBINES PROGRAM

Chinese Taipei has an estimated wind potential of more than 15 GW. To accelerate the development of wind industry, Chinese Taipei plans to shift the focus of wind energy from onshore to offshore, and set up more than 1 000 wind turbines by 2030. The accumulated capacity of wind will thus reach 4 200 MW (BOE, 2014c).

For onshore wind energy, superior wind farms will first be developed before harvesting secondary wind farms. As for offshore wind energy, a demonstration incentive scheme was announced to encourage developers to set up three pioneering offshore wind farms in shallow water area (depth below 20 m) by 2015. The capacity of each wind farm is 100-200 MW, and Chinese Taipei will provide TWD 250 million for the expense of wind farm development, as well as 50.0% equipment subsidy for the first 2 turbines of each wind farm. With experiences gained from the development of the pioneering wind farms, the next step is to exploit deepwater area (depth above 20 m) in mass production scale. By 2020, 450 onshore wind turbines of 1,200 MW are scheduled, and by 2030, 600 offshore wind turbines of 3 000 MW. The total accumulated capacity adds up to 4 200 MW, which makes up 33.0% of the renewable energy promotion target.

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Taiwan Power Company—www.taipower.com.tw

THAILAND

INTRODUCTION

Thailand is a Southeast Asian economy with an area of 513 115 square kilometres and a population of about 66.8 million in 2012. Thailand shares borders with Malaysia to the south and with Myanmar, the Lao People's Democratic Republic and Cambodia to the north and east. In 2012, Thailand's GDP reached USD 899.7 billion (USD 2010 at PPP), a 7.7% increase from USD 835.6 billion in 2011. In the same period, GDP per capita increased 7.3%, from USD 12 552 (USD 2010 at PPP) to USD 13 472 (USD 2010 at PPP).

At the end of 2012 Thailand had proved reserves of 427 million barrels of oil, 285 billion cubic metres of natural gas and 1 239 million tonnes of coal. Notwithstanding its resources, Thailand is highly dependent on energy imports, particularly oil, with more than 85.0% of its oil supply coming from imported stock in 2012 (DEDE, 2014).

Table 1: Key data and economic profile, 2012

Key data[a]		Energy reserves[b]	
Area (thousand sq. km)	513.1	Oil (million barrels)	427
Population (million)	66.8	Gas (billion cubic metres)	284.9
GDP (USD (2010) billion at PPP)	899.7	Coal (million tonnes)	1 239
GDP (USD (2010) per capita at PPP)	13 472	Uranium (kilotonnes U)	-

Source: a. (EDMC, 2014); b. Proved reserves (BP, 2014).

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

The total primary energy supply in 2012 was 111 011 kilotonnes of oil equivalent (ktoe), which represented an increase of 3.7% from 2011. Oil accounted for 41.0% of the total primary supply, while gas, coal and others accounted for roughly 41.0%, 8.0% and 10.0%, respectively. As most of Thailand's proved coal reserves are lignite coal with lower calorific values, imported stock is needed to meet energy demand for both electricity generation and the industry sector. In 2012, coal supply was 8 308 ktoe, down 1.8% from the previous year.

Natural gas supply in 2012 was 45,658 ktoe, a 0.4% decrease from 45,990 ktoe in 2011. Although natural gas is mostly used for power generation in Thailand, its use is also promoted in the transport sector, as a replacement for conventional petroleum products such as fuel oil, diesel and gasoline. As world oil prices have increased in recent years, more industries have switched from oil to natural gas and Thailand has followed suit, increasing its reliance on imported natural gas, both in the form of piped gas and liquid natural gas (LNG). The Thai Government has an ambitious plan to diversify the economy's energy sources. Under the Third Revision of Thailand Power Development Plan (PDP 2010), approved in 2010, renewable energy, nuclear power and coal (with clean coal technology) will be the main sources of energy diversification by 2030. The Ministry of Energy is preparing a new version of the Power Development Plan, which provides a more diversified energy mix by increasing the shares of coal and imported electricity.

However, following the damage to Japan's Fukushima Daiichi nuclear plant after the earthquake and tsunami of March 2011, the Thai Government has faced serious opposition to nuclear power plants from its citizens, and thus construction of these plants is pending.

In 2012, total electricity generation was 171,268 GWh. Thermal generation, mostly from natural gas and coal, accounted for nearly all of the power generation (85.0%), with hydropower and others accounted for the remainder. In addition to its domestic capacity, Thailand purchased power from the Lao People's Democratic Republic and Malaysia.

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	62 284	Industry sector	18 875	Total	171 268
Net imports and other	54 119	Transport sector	22 552	Thermal	144 931
Total PES	111 011	Other sectors	32 949	Hydro	8 641
Coal	8 308	Total FEC	74 376	Nuclear	–
Oil	45 829	Coal	6 643	Geothermal	1
Gas	45 658	Oil	47 158	Others	17 695
Other	11 215	Gas	6 703		
		Electricity and other	13 871		

Source: (EDMC, 2014).

FINAL ENERGY CONSUMPTION

Thailand's total final energy consumption in 2012 was 74 376 ktoe, an increase of 16.5% from the previous year. The transport sector was the largest energy-consuming sector, accounting for 22 552 ktoe, or 30.0% of the total final energy consumption. The second largest consumer of energy was the industry sector, which consumed 18 825 ktoe in 2012, an increase of 4.5% from 2011. By fuel type, oil accounted for a 63.0% share (47 158 ktoe) of the total energy consumption in 2011, followed by electricity and others (19.0%), coal (9.0%) and gas (9.0%).

Oil demand increased significantly by 26.0% from 37,400 ktoe in 2011 to 47 158 ktoe in 2012. Natural gas consumption increased by 4.5%. Coal consumption decreased by 9.0% from 7 267 ktoe in 2011 to 6 643 ktoe in 2012. Domestic electricity and other energy demand in 2012 increased by 8.7% from 12 759 ktoe in 2011 to 13 871 ktoe in 2012. The growth in demand was mainly due to increased consumption in the residential and commercial sectors.

ENERGY INTENSITY ANALYSIS

Thailand's energy intensity of primary energy in 2012 was 123.4 tonnes of oil equivalent per million USD, which decreased by 3.7% from 128.4 tonnes of oil equivalent per million USD in 2011. The energy intensity of final energy demand increased 8.2% from 76.40 tonnes of oil equivalent per million USD in 2011 to 82.7 tonnes of oil equivalent per million USD in 2012. The energy intensity of both the industry sector and transport sector decreased by 3.0%, while the energy intensity of other sector, which mainly includes commercial and residential sector, increased largely by 26.6%.

Table 3: Energy Intensity Analysis

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	128.1	123.4	-3.7
Final Energy Demand	76.4	82.7	8.2
Industry	21.6	21.0	-3.0
Transportation	25.9	25.1	-3.0
Others	28.9	36.6	26.6

Source: EDMC (2014).

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

The Ministry of Energy's aim is to support sustainable energy management that will ensure the economy has sufficient energy to meet its needs. The Ministry 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 and mitigating climate change.

Organisations also responsible for energy include the following:

- 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 (DEDE)—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 (EGAT)—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; and
- Energy Regulatory Commission (ERC) and the Nuclear Power Program Development Office—two independent organisations.

The government's energy policy seeks to:

- build an energy self-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 links with other economies in the region to harmoniously cooperate in energy and other sectors.

The current government, lead by Prime Minister Prayuth Chan-o-cha, stated to the National Legislative Assembly of Thailand on 12 September 2014 that energy price structure will be reformed to reflect actual costs and taxes for different types of fuels and different groups of consumers. This reformation of energy price structure would lead to energy efficiency, consumer awareness and behaviour changes. On the supply side, the government will proceed with new surveys and exploration for oil and gas both onshore and offshore. Also, the construction of new power plants using fossil fuels and all renewable energy by state-own enterprise and private sector will be continuously pursued through open consultation with the public, transparency and fairness, and accounting for environmental concerns. The

development of energy resources together with neighbouring countries is also one of the prioritised policies.

There are four pillars of energy policy in Thailand, which are discussed in more detail below. They are:

- energy security;
- renewable energy;
- energy efficiency; and
- energy price regulation.

At the present, Thailand's energy policy is driven by three energy policy plans namely, the Power Development Plan (PDP), the Energy Efficiency Development Plan (EEDP), and the Renewable and Alternative Energy Development Plan (AEDP).

ENERGY SECURITY

The government's energy security policy will intensify energy development for greater self-reliance, with a view to achieve 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 the 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 and renewable energy policy is to encourage the production and use of alternative energy, particularly biofuel such as gasohol—a mix of ethanol into gasoline in different percentages: E10, E20 and E85—biodiesel, biomass, 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, and by promoting research and development in all forms of alternative energy.

Six strategies to achieve the policy under the current 10-year Renewable and Alternative Energy Development Plan (AEDP) 2012–2021 are:

- Promoting the community to collaborate in broadening the production and consumption of renewable energy;
- Adjusting the incentive measure on investment from the private sector to be appropriate to the situation;
- Amending the laws and regulations that do not benefit renewable energy development;
- Improving the infrastructure as system of transmission lines, power distribution lines, including the development of a Smart Grid System;
- Public relations and building up comprehensive knowledge for the people; and
- Promoting research work as a mechanism to develop an integrated renewable energy industry.

FISCAL REGIME AND INVESTMENT

ENERGY PRICES

The government's energy price 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 that supports the development of energy crops and that best reflects actual production costs;
- managing prices through market mechanisms 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 involves supervising energy prices through market mechanisms to ensure that domestic energy prices are stable, fair and affordable, and to 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 refining and marketing margins to maintain them at appropriate levels. For LPG and NGV, prices will reflect the resolutions of the NEPC and Cabinet, which will not place a burden on consumers.

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 and gas rigs.

ENERGY EFFICIENCY

Thailand 20-Year Energy Efficiency Development Plan (EEDP) was launched in 2011 with a target to reduce energy intensity, that is, EI (energy consumption/GDP) by 25.0% in 2030, compared with that in 2010, or equivalent to a reduction of the final energy consumption by 23.5% in 2030 or 38 200 ktoe. The EEDP sets the targets of energy reduction for major economic sectors including transportation, industry, commercial and residential sectors with six strategic packages and 16 specific measures as follows:

- The application of a number of combined measures, i.e. mandatory measures via rules, regulations and standards, and promotional and supportive measures via incentive provision;
- The introduction of measures that will have a wider impact in terms of raising awareness and changing behaviour related to the energy consumption of consumers, including the decision-making behaviour of business operators, as well as market transformation;
- Support the potential and important role of the private sector in the public-private partnership to promote and implement energy conservation measures;
- Delegate tasks related to the promotion of energy conservation to public and private agencies/organisations that are readily equipped with resources and expertise, such as power utilities and industrial associations, with backup support from the Ministry of Energy;
- The use of professionals and Energy Services Companies (ESCO) as an important tool to provide consultancy and to implement energy conservation measures in which the use of more advanced technology is involved; and
- Increase in self-reliance in indigenously developed technology to reduce technological costs and to increase access to energy-efficiency technology, including promotion of highly energy-efficient product manufacturing processes.

To implement the plan, there are 16 specific measures under five strategic approaches, which will be introduced. The strategic approaches and measures are as follows:

MANDATORY REQUIREMENTS VIA RULES, REGULATIONS AND STANDARDS

- Enforcement of the Energy Conservation Promotion Act B.E. 2535 (1992), which would put in effect an energy management system based on energy consumption reporting and verification imposed on designated buildings and factories;

- Introduction of mandatory energy efficiency labelling to provide options for consumers to buy or use highly energy-efficient equipment/appliances, vehicles and buildings;
- Enforcement of the Minimum Energy Performance Standards (MEPS) for equipment/appliances, buildings and vehicles to prevent the distribution and use of low energy-efficient products;
- Determination of the Energy Efficiency Resource Standards (EERS), or the minimum standards for large energy businesses to implement energy conservation measures, encouraging their customers to use energy efficiently, which will be an important mechanism for providing both technical and financial assistance to small and medium enterprises (SMEs).

ENERGY CONSERVATION PROMOTION AND SUPPORT

- Promote a 'voluntary agreement' to save energy within the public and commercial/industrial sectors, especially various business associations and large-scale businesses;
- Support and incentive provision to encourage voluntary energy-efficiency labelling for highly energy-efficient equipment/appliances, buildings and vehicles;
- Promote travelling by mass transit systems, as well as goods transportation by highly energy-efficient logistics systems;
- Subsidise investment in the implementation of energy conservation measures by (a) providing subsidies for the amount of energy saved that can be verified, as per the project proposals approved under the DSM (demand-side management) Bidding scheme for large-scale businesses, and (b) providing subsidies for the amount of energy saved and/or reduction of peak load that can be verified or accurately assessed for SMEs, as per the project proposals submitted under the Standard Offer Program (SOP) scheme, which requires no bidding;
- Support for the operation of ESCO companies (e.g. the use of funding from the Energy Conservation Promotion Fund to increase credit lines given by the ESCO Fund) to alleviate the technical and financial risks of entrepreneurs wishing to implement energy conservation measures.

PUBLIC AWARENESS CREATION AND BEHAVIOURAL CHANGE

- Public relations and provision of knowledge about energy conservation to the general public, via the teaching/learning process in educational institutions, fostering youth awareness and other public awareness activities, such as eco-driving;
- Putting forth the concepts and promoting activities related to the development of a low carbon society and low carbon economy; this will bring about cooperation between local administration organisations and the business sector in the planning and implementation of activities that will lead to a reduction of GHG emissions and efficient use of energy;
- Determination of energy prices to reflect the actual costs and application of tax measures as an important tool to promote energy conservation with a view to fostering public awareness and changing their energy consumption behaviour.

PROMOTION OF TECHNOLOGY DEVELOPMENT AND INNOVATION

- Promote research and development to improve energy efficiency and reduce technological costs, particularly those related to equipment/appliances with large markets and manufacturing bases in Thailand, including the production process, materials as well as buildings and housing that are energy efficient;
- Promote demonstrations of energy-efficiency technologies that have been technically proven but have not been commercialised in the domestic market, including support for necessary preparation to implement wide commercial deployment of such technologies.

HUMAN RESOURCES AND INSTITUTIONAL CAPABILITY DEVELOPMENT

- Support the development of professionals in the energy conservation field so that they will be responsible for energy management and operation, verification and monitoring, consultancy and engineering services provision and the planning, supervision and promotion of the implementation of energy conservation measures;

- Support the development of the institutional capability of agencies/organisations in both the public and private sectors, responsible for the planning, supervision and promotion of the implementation of energy conservation measures.

Furthermore, the Energy Efficiency Action Plan (EEAP) has been developed under the strategic framework of the EEDP. The EEAP has been approved by the National Energy Policy Committee (NEPC) and was endorsed by the cabinet in early 2013. There are 67 major measures/projects under the plan. Most of measures are sector-wide. The rest are sector-specific measures that include 18 measures for the transport sector and five measures for each of industry sector, large commercial building sector, and small commercial building and residential sector. The total amount of energy saved by the plan is expected to be 38 845 ktoe, with 16 257 ktoe from the industry sector, 15 323 ktoe from the transport sector, 3 630 ktoe from the large commercial building sector, and 3 635 ktoe from the small commercial building and residential sector. Moreover, the EPPO has completely developed a 10-Year R&D master plan for energy efficiency to guide research and development directions in line with the EEDP and EEAP.

RENEWABLE ENERGY

The Ministry of Energy, by the DEDE is very keen to develop alternative and renewable energy to secure energy resources and provide affordable energy to all Thais. There were several revisions of the renewable and alternative development plan during the last decade. The 10-Year Renewable and Alternative Energy Development Plan 2012–2021 (AEDP), formerly the 15-Year Renewable Energy Development Plan 2008–2022 (REDP), sets a target to increase the share of renewable and alternative energy up to 25.0% of total energy consumption by 2021 (DEDE, 2011). The plan states the Thai government will encourage the use of indigenous resources including renewable and alternative energy (particularly for power and heat generation), and supports the use of transport biofuels such as ethanol-blended gasoline (gasohol) and biodiesel. The plan also strongly promotes community-scale alternative energy use, by encouraging the production and use of renewable energy at the local level, through appropriate incentives for farmers. It also rigorously and continuously promotes research and development in all forms of renewable energy.

To achieve these targets, Thailand has set up incentive programs and mechanisms to encourage investment, such as the Fund for Energy Services Companies, which act as special-purpose vehicles for renewable energy development projects, and investment grants from the Energy Conservation Fund. Some of successfully self-workable measures, such as the Revolving Fund that provides low interest rates, will be terminated.

The 2021 targets of the AEDP have been clearly allocated based on technologies related to power generation, heat generation and biofuels for transportation. The breakdown of those targets is as follows:

RENEWABLE ENERGY FOR POWER GENERATION

Solar power 3 000 MW

Power generation from solar will focus more on small system projects at the house and community level, including Solar PV Rooftop, for 1,000 MW within 10 years. To achieve the target, a Feed-in Tariff (FiT) system for the Solar PV Rooftop has been recently introduced. The Fit rate for residential units with less than 10kWp capacity is set at THB6.96/unit, while that of the small business buildings with less than 250 kWp capacity is set at THB6.55/unit. The Fit rate for medium- and large-scale business buildings/factories with less than 1,000 MWp is fixed at THB6.16/unit, while those with a capacity larger than 1MWp has yet to be determined. The subsidy period is set for 25 years.

Wind energy 1 800 MW

To do this, installing wind turbines in remote areas and non-electrified islands will be promoted. Promotion of private investment and development of the appropriated type of wind turbine for Thailand are crucial to achieving the target. There is also a need to enact amendments to regulations and acts regarding some issues such as land utilisation in restricted areas.

Small hydropower 324 MW

Support to construct hydropower plant projects at the community level and support the local administrative organisations so that they can collaborate as project owners and be capable of further self-management and maintenance.

Biomass 4 800 MW

The development will focus on promoting communities to collaborate in broaden production and consumption of renewable energy, the so-called Distributed Green Generation (DGG). The state utilities,

i.e., EGAT and PEA (Provincial Electricity Authority) are to extend transmission and distribution lines to support the development of biomass power plant projects, especially in areas with a high potential for feed stocks.

Biogas 3 600 MW

The target of 3 000 MW will be power generation from Napier Grass, the latest energy crop being promoted by the Thai government. DEDE has granted THB 350 million from its research budget for producing biogas from Napier Grass.

Municipal Solid Waste (MSW) 400 MW

The development will focus on promoting the production of energy from MSW in small communities including schools, temples and local organisations. There is also a need to enact amendments to laws and regulations that will allow government enterprise to co-invest with the private sector.

New energy 3 MW

The two types of new energy that will be promoted in Thailand by 2021 are power from geothermal energy (1 MW) and power from wave and tidal current (2 MW).

RENEWABLE ENERGY FOR HEAT GENERATION

Solar thermal 100 ktoe

This target will be achieved by promoting the installation of solar heating/cooling in government buildings, solar hot water for households, solar drying system for SMEs, and development of a compulsory mechanism such as a building energy code that will require large buildings to install solar hot/cool water system.

Biomass 8 500 ktoe

This target will be achieved by promoting the production system of biomass pellets and the co-generation system of combined heat and power for broaden use.

Biogas 1 000 ktoe

Municipal Solid Waste (MSW) 200 ktoe

BIOFUELS FOR TRANSPORTATION

Ethanol 9.0 million litre/day

This target will be achieved by increasing the national average production of cassava and sugarcane, as well as promoting other alternative crops, such as sweet sorghum, etc. For example, on the demand side, preparations will be made to terminate the use of 91 benzene and promote E20, and E85, along with introducing ED95 (95.0% Ethanol blended with 5.0% additives for modified diesel engines).

Biodiesel 7.2 million litre/day

This target will be achieved by increasing the yield from crude palm oil plantations, mandating B7 and introducing B10 and B20 for fleet trucks and fishery boats.

New fuels for future diesel substitution 3.0 million litre/day

This target will be achieved by introducing other alternative feedstock, such as Jatropha and seaweed-algae, in addition to new technologies, such as Bio-hydrogenated diesel (BHD), Biomass to liquid (BTL), etc.

Compressed biogas (CBG) 1 200 ton/day.

NUCLEAR

Nuclear power is one of the selected energy resources in the Thailand 20-Year Power Development Plan (PDP2010), which aims to ensure sufficient energy supply and diversify the power energy mix. The Second Revision PDP 2010 has postponed the scheduled commercial operation date (SCOD) of the first unit of the nuclear power project by three years from 2020 to 2023, after the Fukushima Daiichi Nuclear Power Plant disaster caused by the earthquake and tsunami in March 2011. Currently, the Third Revision PDP 2010 has again shifted the SCOD of the first unit to 2026 and scheduled the second unit to begin operations in 2027. By 2030, the last year of the plan, nuclear power will comprise 5.0% of the total generation capacity.

CLIMATE CHANGE

Thailand has a strong policy for protecting the environment from the impact of energy production and consumption, especially the impact of the transport sector. The government's environmental protection policy is to encourage energy procurement and consumption and to attach importance to the environment, along with public participation. It does this by setting relevant standards and promoting Clean Development Mechanism (CDM) projects to reduce social and environmental impact as well as greenhouse gas emissions. The strategies employed include the following targets and actions, which are designed to achieve the policies:

MONITOR THE ENVIRONMENTAL IMPACT OF ENERGY PRODUCTION, CONVERSION AND USE.

Set a target and develop a plan to boost the management of greenhouse gas (GHG) emission rates in the energy sector, with the aim of reducing Thailand's CO_2 emissions by at least 1 million tonnes per year. The actions proposed are:

- 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; and
- Devise a plan to reduce GHG emissions in the energy industry, e.g. determine the baseline and develop a clear response plan.

PROMOTE THE CDM IN THE ENERGY SECTOR TO REDUCE GREENHOUSE GAS EMISSIONS.

The objective is to enable Thailand to submit energy projects for certification under the CDM, at a total of 1 million tonnes of CO_2 per year, and enhance the economy's role as a leading exporter of carbon credits in Asia. The following actions are proposed:

- 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 into 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.

CONTROLING AND MONITORING VOLATILE ORGANIC COMPOUND (VOC) EMISSIONS FROM PETROCHEMICAL AND REFINING INDUSTRIES TO MINIMISE ENVIRONMENTAL IMPACT.

This measure strives to control the emissions of all factories to meet standards in force and to create low-cost 'appropriate technology' innovations that are environmentally friendly and easy to operate and that can be maintained at a rate of at least five innovations per year, with support from the Energy Conservation Promotion Fund. In order to achieve this objective, it will be necessary to further expand implementation of the policy on vapour recovery units from four provinces to an additional seven provinces in areas where a large number of oil reserve depots are located; and also to enforce the schedule for EURO 4 standards from 1 January 2012.

NOTABLE DEVELOPMENTS

Thailand is undertaking an on-going process to revise the three major energy policy plans:

- Power Development Plan (PDP);
- Energy Efficiency Development Plan (EEDP); and
- Renewable and Alternative Energy Development Plan (AEDP).

- The three plans will be revised under the same time period, from 2015 to 2036. The plans will be more consolidated, and the energy saving and renewable energy targets will be integrated in the PDP. The target for energy efficiency will be a 30.0% reduction of energy intensity by 2036, compared to the 2010 level. This new target is still in line with APEC's target of energy efficiency. The tentative target for the new long-term AEDP is to increase the share of renewable energy to 20.0% of power generation by 2036. The integration of these three plans would offer a more comprehensive approach to energy planning for Thailand.

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USEFUL LINKS

Department of Alternative Energy Development and Efficiency (DEDE)— http://www.dede.go.th/dede/

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)— http://www.energy.go.th/

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 11.7 trillion (USD 2010 at PPP) in 2012 (EDMC, 2014). In 2012, the US spans 9.8 million square kilometres and had a population of almost 314 million people. The economy's population has continued to slow down from the 2000 rate of 0.9% to 0.7% in 2012 (EDMC, 2014).

The US enjoyed a long economic expansion from 1990 through to 2000 with a growth of 3.5% in real terms, and then started to slow down to a rate of 1.8% from 2000-2012. In 2012, the economy bounced back with a 2.8% increase in its GDP (EDMC, 2014).

The US is the largest producer and consumer of energy in the world. It is also rich in energy resources. In 2012, the US had 44.2 billion barrels of proven oil reserves, 9.3 trillion cubic metres of natural gas reserves and 237 billion tonnes of coal reserves (BP, 2014).

Table 1: Key data and economic profile, 2012

Key data[a]		Energy reserves[b]	
Area (million sq. km)	9.8	Oil (billion barrels)	44.2
Population (million)	314	Gas (billion cubic metres)	9 300
GDP (USD (2010) billion at PPP)	15 658	Coal (million tonnes)	237 295
GDP (USD (2010) per capita at PPP)	49 886	Uranium (kilotonnes of U)[c]	472

Source: a. (EDMC, 2014); b. (BP, 2014); c. (NEA, 2012) recoverable at a production cost of less than 260 USD per kg.

ENERGY SUPPLY AND DEMAND

PRIMARY ENERGY SUPPLY

The total primary energy supply in the US in 2012 was 2 141 million tonnes of oil equivalent (Mtoe). In terms of fuel type, more than one-third of supply came from crude oil and petroleum products, 26.0% from natural gas, 20.0% coal and the rest from other fuels such as nuclear, hydro, geothermal and other fuels. Almost 20.0% of the economy's primary energy requirements in 2012 were from net imports (EDMC, 2014).

The economy's total primary energy output in 2012 declined by 2.3% percent compared to the 2011 level of 2 191 Mtoe. The decline was brought mainly by the 11.2% decrease of coal production as well as other fuels and oil production by 2.4% and 1.9%, respectively. A substantial reduction in the net imports of the economy was likewise recorded in 2012 with an almost 20.0% reduction from the previous year. The economy has showed constant reduction in import dependency since 2000 with an average of 4.0% decline over last twelve years. This decline was brought by the increasing crude oil production from North Dakota and Onshore Texas. Much of the increase in crude oil production is coming from shale and other tight (very low permeability) formations (EIA, 2013a). The US maintained its position in 2012 as the third-largest crude oil producer in the world, including natural gas liquids and condensates, with production averaging 8.9 million barrels per day (BP, 2014). Increased production from smaller-volume producing states, such as Oklahoma, New Mexico, Wyoming, Colorado and Utah, is also contributing to the rise in domestic crude oil production (EIA, 2013a).

The US primary natural gas supply totalled 596 Mtoe in 2012. While the US natural gas supply has grown modestly from 1990 to 2000 with an annual growth rate of 0.7%, the primary natural gas supply including net imports in 2012 surge by 4.7% from the 2011 levels (EDMC, 2014).. In recent years, rapid production of cheap unconventional gas reserves from tight geological formations has resulted in an abundant supply and low wellhead prices. Relatively low natural gas prices and the substitution of gas for coal by power producers has resulted in lowering emissions.

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	1 806 939	Industry sector	246 625	Total	3 946 987
Net imports and other	374 880	Transport sector	597 390	Thermal	2 656 884
Total PES	2 141 286	Other sectors	587 151	Hydro	278 511
Coal	425 057	Total FEC	1 431 166	Nuclear	801 129
Oil	771 265	Coal	20 118	Geothermal	210 463
Gas	595 704	Oil	746 074	Others	3 946 987
Other	349 260	Gas	296 580		
		Electricity and other	368 393		

Source: (EDMC, 2014).

The US held about 4.7% of the world's natural gas reserves in 2012 (BP, 2014). It 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 slightly since the mid-1970s, and the total end-of-year storage volume stood at approximately 59.0% of maximum working gas volume in 2014 (EIA, 2014e).

From 2006, the introduction of horizontal drilling in combination with hydraulic fracturing has enabled the economic extraction of unconventional gas, largely from shale formations. In particular, US shale gas production has increased rapidly from about 2.0% of production in 2006 to 39.0% of production in 2012 (EIA, 2013c). Further increases in shale gas production are anticipated, with total production expected to increase around threefold from 2010 to 2035 and to account for almost half of US gas production. The size of unconventional gas reserves, which include shale gas, tight gas and coalbed methane, is still uncertain; however, the Energy Information Administration (EIA) estimates that technically recoverable unconventional gas reserves may exceed 33 trillion cubic metres or over 50.0% of total reserves. Interest in liquefied natural gas (LNG) exports has grown with the abundant supplies, and relatively low price compared to other LNG supplies. Proposals to construct new LNG exporting facilities are facing environmental and regulatory review, although several proposals have now received approval.

The primary energy supply of coal in the US totalled 428 Mtoe in 2012 (EDMC, 2014). The 2012 primary coal production declined considerably by 11.2% over the previous year's level of 479 Mtoe. US coal reserves are concentrated east of the Mississippi River in Appalachia and in several key western states (EIA, 2012a, 2012c). The U.S. coal production in 2012 fell almost everywhere; specifically, Central Appalachia decreased significantly by 16.0%, followed by a 9.0% production decline in the Powder River Basins, the two key sources for thermal coal of the economy (EIA, 2013a).

In 2012, the US was the fourth largest coal exporter in the world, behind Indonesia, Australia and Russia (EIA, 2013b). In 2012 coal exports were 126.7 million short tonnes or an increase of over 17.0% from 2011. Coal imports have steadily declined from 38.8 million short tonnes in 2007 to 10.3 million short tonnes in 2012 (EIA, 2013b). Europe is the largest importer of US coal, accounting for around 50.0% of net exports (EIA, 2012c).

In 2013, the US produced 4.1 million gigawatt-hours of electricity; of that total, 67.5% came from fossil fuel plants, 19.4% from nuclear power, and the 13.1% shared by renewable energy and other sources (EIA, 2015).

The US generates more nuclear power than any other economy, currently four new nuclear reactors are being constructed, and construction of one has been reactivated(NRC, 2013). 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 2007, work began again on the partially built Watts Bar 2, where construction had ceased in 1985; commercial operation of this reactor is expected to begin between 2015 and 2016 (TVA, 2014). In 2013, the average utilisation rate of the 100 operable commercial nuclear units (down from a peak of 112 units in 1990) rose to over 90.0%, where it has largely remained since (EIA, 2014f). Many nuclear plants have applied to the Nuclear Regulatory Commission (NRC) for 20-year extensions of their operating licences, to 60 years. In late 2014, the NRC had approved licence extensions for 76 nuclear reactor units and had applications for another 19 extensions under review, while the remaining 5 units had informed the agency of their intention to seek extensions between 2015 and 2021 (NRC, 2014).

Recently, nuclear energy has suffered a major setback with the first closures of operating plants in 15 years. Four nuclear power plants were closed earlier than expected. Two of the reactors in Vermont and Wisconsin cited stiff economic conditions as the reason for their closing, and the other two plants in California and Florida closed due to structural damage and safety concerns. However, in late 2014, DOE issued the Advanced Nuclear Energy Projects loan guarantee solicitation, which provides USD 12.5 billion to support innovative nuclear energy projects as a part of the Administration's all-of-the-above energy strategy

Total renewable energy production in the US in 2013 was approximately 234 Mtoe, or 11.4% of total primary energy supply, according to the EIA. Production from non-hydro (or new and renewable) sources increased 8.7% from the previous year, an annual growth rate of 8.4% since 2005 (EIA, 2015a, 2015b).

By consumption of renewable energy type, biomass as a whole represented 49.6% of the total, hydroelectric power 27.5%, geothermal 2.4%, wind 17.2% and solar/photovoltaic 3.3%. There has been a particularly rapid expansion of wind power, which between 2000 and 2013 recorded a 29.2% average annual growth rate (EIA, 2015). Government incentives, including subsidies and renewable energy mandates as discussed below, in addition to cost reductions relative to fossil-fuelled alternatives, spurred the growth of renewable energy production.

FINAL ENERGY CONSUMPTION

In 2012, total final energy consumption in the US was 1 431 Mtoe, a decrease of 3.6% from the previous year. The transport and other sectors accounted more than 40.0% each of the total demand while the remaining share was consumed by the industry sector at 17.0%. In terms of fuel, petroleum accounted more than 50.0% of the final consumption while electricity and natural gas 26.0 % and 21.0%, respectively and a modest amount from coal (1.0 %) (EDMC, 2014).

ENERGY INTENSITY ANALYSIS

The energy intensity of the USA for 2012 has considerably improved across all sectors. Primary intensity in 2012 improved by 4.9% from the last year's primary intensity of 143.85 tonnes of oil equivalent per USD. Similarly, the final energy demand has decreased in the last year's energy demand level, which prompted the intensity to decline by 6.2%. Significant improvement in the final energy intensity was mainly due to the drop in the 'other' sector's intensity by 9.9% in 2012 (Table 3).

Table 3: Energy Intensity Analysis

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	143.9	136.8	-4.9
Final Energy Demand	97.5	91.4	-6.2
Industry	17.2	15.8	-8.2
Transportation	38.7	38.2	-1.4
Others	41.6	37.5	-9.9

Source: (EDMC 2014).

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 (DOE). 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, shift towards alternative energy sources, create a market for independent power producers and give the 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 of 2005 (EPAct 2005) was introduced as the successor to the Energy Policy Act of 1992. 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 (ARRA) is also noteworthy for having dramatically increased funding for 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 70.0% 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.

In order to improve energy security in the transportation sector EPA and DOT's National Highway Transportation Safety Administration (NHTSA) jointly developed vehicle greenhouse gas (GHG) emissions standards and fuel economy standards to 23.2 kilometres per litre (54.5 miles per gallon) for passenger cars, light-duty trucks and medium-duty passenger vehicles manufactured in 2025 (MY 2025) (EPA & NHTSA, 2012b)

The 2005 EPAct promoted enhanced domestic production of oil by removing some regulatory barriers and offering incentives for production from deep-water resources, low-production wells and unconventional sources. One regulatory change was to exclude the underground injection of hydraulic fracturing fluids from regulation under the Safe Drinking Water Act of 1974, 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 (DOE, 2005).

Biofuels represent another avenue for improving US energy security, which has received strong policy support. Development of vehicles powered by alternative fuels and biofuel production were promoted by the 2005 EPAct, but in 2007 EISA 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 42 billion litres (11.1 billion gallons) in 2009. This included the increase to 79 billion litres (21 billion gallons) in 2022 from 2.3 billion litres (0.6 billion gallons) in 2009 of advanced biofuels, i.e. renewable fuel, other than ethanol derived from corn starch, that has lifecycle greenhouse gas emissions that are at least 50.0% less than baseline lifecycle GHG emissions. EISA also stipulates that the production of advanced biofuels is to be encouraged by a grant programme. 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). Since this law was passed, US consumption of oil has, in fact, been reduced in recent years causing the biofuel blend ratio in gasoline to rise unexpectedly. The current blend ratio is fast approaching 10.0%. Many auto manufactures have said their warranties will not cover any damage from biofuel blending above this ratio. In response, refineries are purchasing renewable credits to waiver their obligations instead of complying with the mandated targets (CRS, 2013). As a result, biofuel production is already tracking below the current targets.

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. The total hybrid-electric vehicle (HEV) sales during 2014 were 452 172 (425 612

cars and 26 560 light trucks), down 8.7% from 2013 sales, but from 2000 electric vehicle sales have gone steadily up (DOE, 2015c).

Coal-fired power plants provide just under half of US electricity. 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 2010, US consumers spent an estimated USD 1.2 trillion on energy purchases (EIA, 2012a). The government plays many roles in this large market, including as an 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).

State and federal governments share regulation of upstream development. In some cases, the division between state and federal responsibility 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 of 1970 and the Clean Water Act of 1972. In such cases where state and federal regulatory responsibilities overlap, coordinating the activities of state and federal agencies is an important task (EPA, 2012a).

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 organisations 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 (69.0%), but public power systems (14.0%) and cooperatives (12.0%) 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, 2010a; DOJ et al., 2007).

Natural gas markets are similar to electricity markets, with competitive wholesale markets supplying federally regulated transmission pipelines and 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. DOT's Pipeline and Hazardous Materials Safety Administration regulates gas transmission pipelines to ensure they are operated safely. Pricing and the safety of natural gas distribution networks are 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).

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). Total government spending for energy-related research and development remained relatively stable at around USD 3 billion a year (in USD 2005 terms) from the 1990s until 2009 with the enactment of the Recovery Act (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 35.0%, while state rates range from 0.0% to 10.0%. 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 the 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 11.9 billion in royalty payments in 2012 (ONRR, 2012). 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 0.049 per litre (18.4 cents per gallon) and on diesel is USD 0.064 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, 2012). 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 programmes.

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.

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, 2012). 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 could claim a tax credit for up to 30.0% 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, 2012). Much of the Recovery Act allocation for energy efficiency was distributed through state energy programmes 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 with new generation in their planning, and many utilities administer demand-side management programmes that provide incentives and technical assistance to reduce demand for electricity and natural gas (DSIRE, 2012; US House, 1992).

RENEWABLE ENERGY

In 2013, US cumulative wind energy capacity reached 61 107 megawatts (MW) or approximately 5.3% of total US electricity generating capacity. The total 2013 wind energy installations were 1 087 MW, and from 2007 to 2011 wind installations accounted for roughly 35.0% of all new US electricity generating capacity (AWEA, 2012). Another significant change under the Recovery Act is that new NRE facilities may select either the PTC, a 30.0% 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. 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 30.0% 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 programmes also exist to encourage the development of renewable energy and other advanced energy facilities (DSIRE, 2012).

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. Thirty-nine states, District of Columbia, Guam, Puerto Rico, Virgin Islands and N. Mariana Islands had enacted RPS legislation, with varying degrees of stringency, by the end of 2014.

Other measures have also been introduced to support NRE development, such as generation disclosure rules, mandatory utility green power options, green power purchasing policies and the use of public benefit funds (DSIRE, 2014).

NUCLEAR

The US government has enhanced its support for the nuclear industry through various means, including legislative and financial ones. For example, the Energy Policy Act of 2005 included several provisions considered important to revitalising the American nuclear power industry. It extended the Price-Anderson Nuclear Industries Indemnity Act of 1957 (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 programme intended to improve access to financing for new nuclear plants and other energy projects that reduce air pollution emissions or introduce new technologies (DOE, 2005). Thus, as authorised by its Title XVII, the Advanced Nuclear Energy Projects Solicitation provides 'loan guarantees to support construction of innovative nuclear energy and front-end nuclear projects in the United States that reduce, avoid, or sequester greenhouse gas emissions' (DOE, 2014a). In February 2014, DOE issued USD 6.5 billion in loan guarantees to support the construction of two Westinghouse AP1000 Generation III+ reactors at the Alvin W. Vogtle Electric Generating Site, which currently has two older generation 4-loop pressurised water reactors in operation (DOE, 2014b).

Since the Energy Reorganisation Act of 1974, the DOE have held responsibility for the development and promotion of nuclear energy, and the Nuclear Regulatory Commission (NRC) has provided the regulatory oversight of the industry. 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, 2011b). The partially completed waste depository facility in Yucca Mountain, Nevada was recently abandoned and there remains no viable long term storage option for nuclear waste. The US government maintains the financial burden of storing spent fuel and currently compensate utilities for storing their nuclear waste on-site. However, the U.S. Court of Appeals for the District of Columbia Circuit's ruling in June 2012 banned the NRC from issuing new reactor licenses or renewals until it sufficiently assessed the risk of storing spent radioactive fuel at nuclear plant sites, and thus, the environmental consequences of not building a permanent waste repository. This ruling prompted the NRC to issue an order in August 2012 suspending actions related to issuing license renewals and new operating licenses (EIA, 2014a).

The United States has the world's largest nuclear energy sector consisting of 100 operating reactors generating 789 017 million kW of electricity in 2013 and 528 639 million kW of electricity between January

and August 2014 (EIA, 2014b), as well as five under-construction reactors. The NRC has the authority to issue initial operating licenses to newly-built reactors for a period of 40 years after which they need license renewals to extend their lifetime for an additional 20 years of operation. Given the majority of these reactors were built before the 1990s (mainly in the 1960s and 1970s), they have already undergone lifetime extension or need to go through this process in this decade or the next one. After about two years of deliberation as requested by the mentioned court ruling, on 18 September 2014, the NRC issued the revised and renamed Continued Storage of Spent Nuclear Fuel rule effective on 20 October 2014 in compliance with the mentioned court ruling. Consequently, it may now legally resume issuing license renewals and also new operating licenses. In fact, the NRC resumed its issuance activity in October 2014 when it renewed the operating licenses for Limerick Generating Station Units 1 and 2 located in northwest of Philadelphia. It extended their license expiration dates by 20 years, to 2044 and 2049, respectively. (EIA, 2014a). Over time, the NRC has granted 20-year license renewals to 74 of the 100 operating American reactors enabling them to operate for a total period of 60 years. Currently, the NRC is reviewing license renewal applications for "an additional 17 reactors while expecting to receive seven more applications in the next few years" (EIA, 2014c).

The American reactors could operate beyond 60 years for up to 20 additional years, if their operating companies apply for and receive a Subsequent License Renewal (SLR) from the NRC (EIA, 2014c). In August 2014, the NRC determined that the "existing license renewal regulations were sufficient to support the SLR process" backed by the May 2014 findings of the NRC's Advisory Committee on Reactor Safeguards (EIA, 2014c).

The March 2011 accident at Japan's Fukushima Daiichi Nuclear Power Plant prompted the strengthening of the American safety regulations and thus operating standards of the nuclear power plants to avoid similar accidents in the United States. Towards this end, the NRC and the US nuclear industry have been working together. Thus, in the aftermath of the accident, they initiated "an immediate coordinated response to the accident, as well as long-term actions" meant to ensure the safety of the existing and planned American nuclear reactors (EIA, 2014d). One of the subsequent major activities was the NRC's comprehensive review of its own processes and regulations leading to its Near-Term Task Force's release of a report, namely, *Recommendations for Enhancing Reactor Safety in the 21st Century*. They consisted of 12 recommendations covering short- and long-term actions followed by the NRC's issuing three orders with respect to the short-term recommendations in March 2012. The orders required the implementation of the following measures while requiring the affected nuclear power plants' operators to submit their initial status reports in 60 days and their integrated plans by February 2013 (EIA, 2014d):

- All boiling-water reactors (BWRs) with Mark I and II containment systems must have reliable hardened containment venting capability to reduce pressure and hydrogen build-up. This may require improving or replacing existing containment ventilation systems;
- Reactors must have enhanced instrumentation installed to monitor water levels in their spent fuel pools in the event of an emergency; and
- Nuclear power plants must be capable of responding to multiple simultaneous events and ensuring that reactors and spent fuel pools remain cooled. The order specifies a three-phase approach involving use of installed on-site resources, use of portable on-site equipment and indefinite use of off-site resources.

For its part, the American nuclear industry has taken certain measures. They include developing its FLEX strategy through the Nuclear Energy Institute (NEI). It is a 'comprehensive, flexible, and integrated plan to mitigate the effects of severe natural phenomena and to take steps to achieve safety benefits quickly.' Scheduled to become fully operational by 2014, the plan provides for two regional response centres to be located near Memphis, Tennessee, and Phoenix, Arizona, from where 'critical emergency equipment can be delivered to nuclear power plants within 24 hours' (EIA, 2014d).

CLIMATE CHANGE

The US pledged to reduce economy-wide GHG emissions in the range of 17.0% 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. There are several state and regional initiatives to incorporate a price for carbon emissions including plans implemented in California and the Northeast.

An important U.S.-China Joint Announcement on Climate Change made in late 2014 will target an economy-wide target of reducing US GHG emissions by 26.0-28.0% below its 2005 level in 2025 (Whitehouse, 2014).

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, which gave the EPA the authority to issue rules to limit GHG emissions. EPA has used this authority to move forward vehicle emission standards and to define GHG permitting requirements for large CO_2 emitters (EPA, 2012b). The EPA engenderment finding was challenged through the Court of Appeals but upheld in mid-2012. Further appeals are under consideration in the US Supreme Court. The outcome of this ruling and subsequent plans to limit GHG emissions will have major implications for US energy developments in future.

Principally, the EPA is proposing to limit CO_2 emissions in the power sector. The proposed standard restricts CO_2 emissions to a limit of 454 kilograms (1000 lb) for every megawatt-hour of electricity produced. These proposed restrictions apply to new generating units and currently exclude existing units in operation or under construction. However, the EPA is also investigating CO_2 emission limits for existing generating units, as of June 2014 a proposed rule was issued, the final rule is expected in summer 2015. The emission regulation is aimed at limiting climate change by enforcing the use of modern and more efficient fossil fuel generation technologies (EPA, 2012c). The carbon restriction will essentially require new coal plants to operate using the latest high efficiency technology, employ biomass co-firing fuels or utilise carbon sequestration.

In addition to GHG emissions limits, the EPA has enforced emission standards on mercury and toxic pollutants in 2012. The strict emission standards will be fully enforced by 2015. This will have a major impact on reducing toxic emissions from coal, primarily in the electricity sector (EPA, 2012b). The new standards will require expensive technological retrofits to existing facilities and will affect almost half the coal generating capacity. Most of the affected coal facilities are over 40 years old and the new standards are likely to result in extensive capacity retirements, which may exceed 50 GW.

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 it was noted that the state was particularly vulnerable to the impact 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 (ARB, 2014). 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 programme in the period 2012–2020 (ARB, 2008).

Nine 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 (CO2) emissions from the power sector by 45.0% from 2005 levels by 2020. 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 10.0% below 1990 levels by 2020 (NEG & 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 the US with 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 15.0% 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 DOE 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 was restructured to focus on a large-scale commercial demonstration. The preferred site is a recently retired coal plant in Illinois State owned by Ameren Energy Resources. In January 2014, DOE issued a Record of Decision (ROD) to provide financial assistance for the FutureGen 2.0 Project of approximately $1 billion of cost-shared funding, mainly appropriated under the ARRA. This decision is to implement the proposed action in the Final Environmental Impact Statement (EIS), evaluating the potential environmental impacts associated with construction and operation of the FutureGen 2.0 Project (DOE, 2014d).

VEHICLE EMISSION STANDARDS

In 2007, EISA mandated a 40.0% increase in combined car and light truck fleet fuel economy (CAFE) standards by 2020, to reach 14.9 kilometres per litre (35 miles per gallon), and required further study into commercial vehicle fuel economy (CRS, 2007b). In 2009, the administration proposed a plan to speed the introduction of the new CAFE standards. In July 2011, a new US CAFE standard was agreed to by 13 major automakers and in cooperation with the State of California, to harmonise economy-wide fuel standards to 23.2 kilometres per litre (54.5 miles per gallon) for cars and light-duty trucks by 2025. The supportive automakers together account for over 90.0% of all vehicles sold in the US (NHTSA, 2011). In addition, the EPA and NHTSA recently proposed the first fuel economy standard for heavy-duty vehicles (NHTSA, 2011). In the absence of standards, the average fuel economy of heavy-duty trucks has improved, in absolute terms, by 16.0% in the past four decades from 2.3 kilometres per litre (5.5 miles per gallon) in 1970 to 2.7 kilometres per litre (6.4 miles per gallon) in 2008 (EIA, 2012a). The newly proposed standards are expected to reduce the fuel consumption of heavy-duty vehicles by 10.0–20.0% between 2014 and 2018, depending on the heavy vehicle type. 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, 2011).

The new standards have several loopholes which may inhibit their effectiveness. The chief concern is the use of a size-weighted average fuel economy, where larger vehicles have lower fuel efficiency targets. This policy was included to eliminate penalties, which favour the sales of small vehicles over large vehicles. However, sales of larger vehicles may increase in market share and reduce real fuel efficiency improvements. A published study suggests average vehicle sizes, particularly for light trucks, may increase between 2.0% and 32.0% under the new standards. This would result in a net reduction in the average fuel economy of between 1 and 4 miles per gallon (between 0.4 and 1.7 kilometres per litre) (Whitefoot & Skerlos, 2011). Other uncertainties that may reduce the standards' effectiveness include low fees for non-compliance, overstated fuel economy ratings and low targets for heavy trucks. These negative effects are expected to be limited and real efficiency improvements are likely to accelerate under these rules, but perhaps at a rate lower than anticipated.

AMERICAN RECOVERY AND REINVESTMENT ACT OF 2009 PROGRAMMES

As of late 2014, USD 30.2 billion was authorised in funding for energy and environment under the ARRA. Major investment programmes include the Weatherisation Assistance Program, which invests in energy efficiency improvements for the homes of low-income families. Other notable projects include the development of electric vehicle, smart grid technology and greater support for renewable energy. ARRA also contains tax credits for the purchase of alternatively fuelled vehicles. The EIA estimated that ARRA funding would achieve 50.0% more generation of renewable electricity (excluding hydro) by 2012, as well as efficiency measures that will reduce residential and commercial energy expenditures by 2.6% in 2020.

ARRA is also expected to result in the development of about 1 gigawatt of coal fired generating capacity with carbon capture and sequestration by the end of 2018 (EIA, 2014g, 2014h).

NOTABLE ENERGY DEVELOPMENTS

CLIMATE ACTION PLAN

On 25 June 2013, President Obama announced the Climate Action Plan, a plan for tackling climate change. The President's Climate Action Plan consists of wide variety of executive actions and has three key pillars as follows:

- **Cut Carbon Pollution in America:** In 2012, even as the economy continued to grow, the U.S. carbon emissions fell to the lowest level in two decades. So, in order to build on this progress, the Obama Administration is putting in place tough new rules to cut carbon pollution.
- **Prepare the United States for the Impacts of Climate Change:** Hand in hand in taking new steps to reduce carbon pollution, the Plan also includes preparation for the impacts of the changing climate that are already being felt across the economy. Moving forward, the Obama Administration will help state and local governments strengthen the roads, bridges, and shorelines to better protect people's homes, businesses and way of life from severe weather.
- **Lead International Efforts to Combat Global Climate Change and Prepare for its Impacts:** It is understood that no country is immune from the impacts of climate change and no country can meet this challenge alone. Hence, it is imperative for the United States to couple action at home with leadership internationally. America must help forge a truly global solution to this global challenge by galvanising international action to significantly reduce emissions (particularly among the major emitting countries), prepare for climate impacts, and drive progress through the international negotiations (Whitehouse, 2013)

QUADRENNIAL ENERGY REVIEW

On 9 January 2014, President Obama issued a Presidential Memorandum directing his Administration to conduct a Quadrennial Energy Review (QER). The effort aims to establish a comprehensive and integrated energy strategy to ensure clean, affordable, and secure energy and services that are essential in improving the US economic productivity, protecting the environment and ensuring the Nation's Security. The first-ever comprehensive energy review will focus on energy infrastructure such as the transmission, storage and distribution infrastructure. It will also identify the threats, risks and opportunities for energy and climate security, which will enable the Federal government to develop concrete integrated actions to implement energy and environmental policy goals (DOE, 2014b).

BILATERAL COOPERATION WITH CHINA

The United States of America and the People's Republic of China have a critical role to play in combating global climate change, one of the greatest threats facing humanity. The seriousness of the challenge calls upon the two sides to work constructively together for the common good. Hence on 14 November 2014, the US and China reaffirmed the importance of strengthening bilateral cooperation on climate change and will work together, and with other countries, to adopt a protocol, another legal instrument or an agreed outcome with legal force under the Convention applicable to all Parties at the United Nations Climate Conference in Paris in 2015 (Whitehouse, 2014).

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Federal Energy Regulatory Commission—www.ferc.gov

Fuel economy—www.fueleconomy.gov

Nuclear Regulatory Commission—www.nrc.gov

VIET NAM

INTRODUCTION

Viet Nam is located in South-East Asia, shares borders with Cambodia and Laos to the west and China to the north. The economy has an area of 333 972 square kilometres and a marine exclusive economic zone stretching 200 nautical miles from its 3 260 kilometre coastline. In 2012, its population was 88.8 million people, of which 32.0% lived in cities and 68.0% in rural areas (GSO, 2014).

While maintaining the socio-politic stability, building an open socialist-oriented market economy and progressively industrialising the country, Viet Nam's economic growth was 7.1% for GDP and 5.6% for income per capita per annum on average over 1990-2011. However, since 2008, the pace of the economy's development has exhibited some slowdown compared to the previous period. This is a result of the global context, such as volatile energy prices, a prolonged financial crisis, recessions, and from intrinsic shortcomings in the economy structure. In 2012, Viet Nam recorded a GDP of USD 427.7 billion (a growth of 5.3% from 2011 level) and an income per capita of USD 4 818, both at the 2010 price based on PPP (EDMC, 2014). In September 2012, to achieve the goal of turning Viet Nam into a modern industrialised country by 2020 with further international integration, the government of Viet Nam has established and issued the National Strategy on Green Growth to 2020 with a vision to 2050 (PMVN, 2012a) and in February 2013 the Socio-Economic Development Master Plan up to 2020 (PMVN, 2013a). Accordingly, Viet Nam will accelerate the economy restructure in association with the growth model renovation towards guaranteeing growth quality and improving the economy's efficiency and competitiveness during the period of 2013-20.

Energy is a key driving sector for Viet Nam's economic development, contributing to the country's industrialisation through attracting foreign investment and export earnings. Endowed with diverse fossil energy resources such as oil, gas and coal, as well as renewable sources, Viet Nam has been a net energy exporter since 1990, exporting mainly of crude oil and coal, and being self-sufficient in natural gas. As of end 2012, Viet Nam's proved fossil energy reserves consisted of 4.4 billion barrels of oil, 600 billion cubic metres (bcm) of gas, 150 million tons (Mt) of coal (BP, 2014). Renewable energy resources suitable for the development include hydro, solar, biomass, wind and geothermal. The current economic and technical potential of hydro is estimated about 20 000 MW (excluding about 4 000 MW suitable for developing small hydropower with less than 30 MW capacity per site). Potential power capacity for deployment within the coming 15 years from wind, biomass and geothermal are about 2000 MW, 800 MW and 300–400 MW respectively (IE, 2011).

Table 1: Key data and economic profile, 2012

Key data		Energy reserves	
Area (sq. km)[a]	333 972	Oil (billion barrels)[d]	4.4
Population (million)[b]	88.8	Gas (billion cubic metres)[d]	600
GDP (USD (2010) billion at PPP)[c]	427.7	Coal (million tonnes)[d]	150
GDP (USD (2010) per capita at PPP)[c]	4 817	Uranium (kilotonnes U)[e]	1.0

Source: a. (GSO, 2014); b. (WB, 2014); c. (EDMC, 2014); d. Proven reserves (BP, 2014); e. proven reserves of uranium (WEC, 2010).

ENERGY DEMAND AND SUPPLY

PRIMARY ENERGY SUPPLY

Viet Nam's total primary energy supply (TPES) in 2012 was 44 347 kilotonnes of oil equivalent (ktoe), which is a slight increase of 1.9% from the 2011 level and double compared to the 2000 level (EDMC, 2014)[2]. By energy source, 35.6% of supply came from coal, 35.3% from oil, 18.6% from natural gas and 10.5% from other sources. During 2005-12, primary electricity (including hydropower as the major source next to electricity import in a tiny share of less than 5.0%) developed at the fastest rate, averaging 17.7% per annum, much higher than the average growth of 8.1% per annum of TPES. However, fossil fuels

[2] EDMC excludes non-commercial energy sources such as biomass, wood waste etc.

remained the major primary energy sources in absolute quantity and coal passed oil in 2012 for the first time to take the first position among the primary energy sources, reflecting the government policy since 2007 to increase coal power generation.

COAL

Viet Nam's coal production and export had an average annual growth rate of 20.9% and 39.4%, respectively, during 2000-07 and then slowed down at average -0.1% and -11.1% per year during 2008-12, reflecting changes in government policy prioritising coal conservation for domestic uses rather than boosting exports for generating foreign currencies. In 2012, Viet Nam produced about 23 734 ktoe of anthracite and semi-anthracite coals, which is 9.1% less than what it produced in 2011 but about the same level as that produced in 2007. With increasing domestic demand for coal, coal export has steadily declined to 8 521 ktoe in 2012, about 36.0% of the country's production and roughly half of its export in 2007.

Viet Nam has about 48.7 billion tons as of 2010 in estimated potential coal resources (PMVN, 2012b). The sub-bituminous-rich coal basin of Red River Delta (in the provinces of Thai Binh, Hung Yen and Nam Dinh) accounts for 81.0%. The anthracite-rich coal basin in the north-east (in the provinces of Quang Ninh, Bac Giang and Hai Duong) accounts for a share of 18.0%. And the share of other mines in the provinces of Hai Phong, Thai Nguyen, Lang Son, Nghe An, and Quang Nam account for about 7.0%. Peat coal in the Mekong delta is about 1.0%. Until now, Viet Nam's domestic coal has produced and supplied mainly from opencast and underground mines in the Quang Ninh province. Vinacomin is the dominant coal producer in Viet Nam with output accounting for about 95.0% of the Viet Nam total coal production. Exploration activities in the Red River Delta coal basin is still preliminary, and given its characteristics of complex geological conditions and as a sensitive environmental and economic area, the exploitation of coal resources in this basin is forecasted to take place only beyond 2020. From 2020, Viet Nam will need to rely on international cooperation and foreign investments in order to effectively and sustainably develop these resources.

OIL

Oil reserves are mainly offshore and in the southern part of Viet Nam. Active and successful offshore exploration since 2011 increased the number of oil reserves. Crude oil production grew 9.8% from 15 959 ktoe in 2011 to 17 518 ktoe in 2012 (16.3% down from a peak of 20 940 ktoe in 2004), of which 55.0% was exported. The Cuu Long basin in southern Viet Nam has been the primary area for oil production. As of the end of 2013, there were 23 producing oil fields in Viet Nam (PVN, 2014). According to PVN's forecast and planning, oil production will be about 16-18 Mt/year until 2022 and then will decline.

Viet Nam is a net crude oil exporter but net importer of petroleum products. Petroleum products imports have shown a downward trend since 2009 as the first refinery in Viet Nam, the 140 000 bbl per day Dung Quat refinery, came on operation over that period. However, to meet the increasing demand for petroleum products in the economy, imported petroleum products continue to account for the majority part (9 109 ktoe or 58.0%) of Viet Nam's total primary oil supply, which was 15,643 ktoe in 2012. According to the government's existing master plan for refinery development up to 2025, the government will build four new refinery construction projects, the Dung Quat expansion, Nghi Son, Vung Ro, and Long Son. As of end 2014, one new project, the Nhon Hoi refinery of PTT, is also under consideration. This expansion expects to increase the Viet Nam's refining capacity to 25 Mt by 2020 and 45-58 Mt by 2025.

NATURAL GAS

There are three offshore gas pipeline systems built to deliver gas from Viet Nam's oil and gas fields in the petroleum basins of Cuu Long, Nam Con Son, and Malay-Tho Chu to shore in south-east and south-west regions of Viet Nam. They are:

- Rang Dong-Bach Ho with 1.5 bcm per year capacity and in operation since 1995;
- Nam Con Son with 7 bcm per year capacity and operating since 2003; and
- PM3-Ca Mau with 2 bcm per year capacity and operating since 2007.

In 2012, 13 oil and gas fields produced an annual natural gas supply of 9.4 bcm, raising 9.2% compared to the 2011 level, and translating to an annual average growth of 8.6% during 2005-12 (PVN, 2014). Growth in the electricity, fertiliser and petrochemical industries have driven demand for natural gas.

Since 2007 foreign investment increased and has led to greater exploration for natural gas, significantly increasing Viet Nam's proved natural gas reserves. In 2012, natural gas reserves increased from 6.8 Tcf in 2011 to 24.7 Tcf in 2012, according to Oil and Gas Journal.

POWER GENERATION

In 2012, with a total installed power capacity of nearly 27.5 GW (VNEEP, 2013), Viet Nam produced 117 094 GWh (or 10 114 ktoe), growing at an annual rate of 13.2% from its 2011 level, and 4.4 fold the outputs in 2000. Of this total electricity output, 45.0% came from hydropower plants and 55.0% from thermal power plant (EDMC, 2014). During 2008-12, according to Viet Nam's energy statistics, the installed hydropower capacity doubled from 6.0 GW to 12.6 GW, reflecting an average growth of 18.0% per annum, higher than that for the overall thermal power plants, which was at 12.0% per annum. As a result, hydropower's share in Viet Nam's total installed capacity increased significantly from 38.0% in 2008 to 48.0% in 2012. Among thermal power sources, gas-fired power plants' contribution remained the biggest in terms of capacity in absolute value (7.7 GW in 2012); however, coal-fired power plants recorded the fastest pace of growth in development, averaging 19.0% per annum from 2008 through 2012. With a total capacity reached 4.9 GW, coal power's share increased by 4.0% to 19.0% in 2012. Growing deployment of hydropower and coal power led to relative reductions in gas and oil power plants' role in Viet Nam's electricity system. Gas power plants experienced a sharp decline in its share from the record level of 41.0% in 2008 to 29.0% in 2012, and from 6.0% to 5.0% for share of oil power plants over the same period.

In order to optimise the electricity supply and cost-effectiveness to all regions in the country, Viet Nam has also relied on power sources from biomass and electricity imports since 2004 from neighbouring economies and countries such as China and Laos. The participation of these sources were, however, still very marginal in the economy's power system over 2008-12.

Table 2: Energy supply and consumption, 2012

Primary energy supply (ktoe)		Final energy consumption (ktoe)		Power generation (GWh)	
Indigenous production	54 046	Industry sector	16 106	Total	117 094
Net imports and other	-8 059	Transport sector	10 701	Thermal	64 289
Total PES	44 347	Other sectors	8 271	Hydro	52 805
Coal	15 802	Total FEC	35 078	Nuclear	–
Oil	15 643	Coal	9 678	Geothermal	–
Gas	8 253	Oil	14 896	Others	507
Other	4 648	Gas	1 438		
		Electricity and other	9 065		

Source: (EDMC, 2014)

FINAL ENERGY CONSUMPTION

In 2012, Viet Nam's total commercial final energy consumption (TFEC) was 35 078 ktoe, up 2.2% from 2011. By fuel source, oil contributed the largest share (42.5%), followed by coal (27.6%), electricity and others (25.8%) and gas (4.1%). Between 2008 and 2012, consumption of coal and oil continued to be constrained to low growths of 4.0% per year and 1.9% per year in average; by contrast, gas and electricity grew rapidly, at an average annual growth rate of 27.0% and 11.6%, respectively.

Industry is an important driving sector in GDP growth and it had the biggest final energy demand at 46.0% of TFEC. This sector consumed mainly coal at 52.0%, then electricity 30.0%, petroleum products 10.0%, and natural gas 9.0%. The transport sector was the second largest energy-consuming sector accounting for 30.0% of TFEC and remained the main consumer of petroleum products at 72.0% of the economy's total requirement. The other sector's (residential, agricultural and commercial) consumption represented 24.0% of TFEC. In this sector, electricity accounted for 52.0%, oil 31.0%, and coal 17.0%. Demand on electricity grew fast in the residential sector, reflecting the improvement of household income, which brings about an increase in electric appliance use, and of power supply quality.

ENERGY INTENSITY ANALYSIS

In 2012, Viet Nam's energy intensity was 103.7 tonnes of oil equivalent per USD million GDP (PPP), which is a decrease of 3.2% from 107 tonnes of oil equivalent per USD million GDP in 2011, and almost at the same level as in 2008.

In 2012, encouraging improvements in energy efficiency continued to be observed in all sectors. The transport sector recorded the fastest decline in energy intensity, at 6.0% in 2012 from its level of 26.6 tonnes of oil equivalent per USD million GDP in 2011. The industry sector, although with the highest level of energy intensity of 37.7 tonnes of oil equivalent per USD million GDP in 2012, has attained a reduction of 1.8% compared to the previous year. Other sectors' energy intensity was the lowest, at 19.3 tonnes of oil equivalent per USD million GDP in 2012, which is a reduction of 1.5% from 2011 level.

Table 3: Energy Intensity Analysis, 2012

Energy	Energy Intensity (tonnes of oil equivalent per million USD)		Change (%)
	2011	2012	2011 vs 2012
Primary Energy	107.1	103.7	-3.2
Final Energy Demand	84.6	82.0	-3.1
Industry	38.4	37.7	-1.8
Transportation	26.6	25.0	-6.0
Others	19.6	19.3	-1.5

Source: (EDMC, 2014)

POLICY OVERVIEW

ENERGY POLICY FRAMEWORK

In 2007, Viet Nam issued the National Energy Development Strategy to 2020 with a Vision to 2050 (PMVN, 2007a), which addresses the Vietnamese Government's energy development key objectives, major policies, and measures to be realised up to 2020 in energy industries. Meanwhile, detailed development strategy and master plans by energy subsectors include:

- Viet Nam Oil and Gas Development Strategy to 2015 with orientation to 2025 (PMVN, 2006a);
- Viet Nam Gas Development Master Plan for the period to 2015 with orientation to 2025, also known as, GMP2011 in brief (PMVN, 2011b);
- Viet Nam Power Development Master Plan for the period 2010-2020 with perspective to 2030, also known as, PDP7 (PMVN, 2011c);
- Viet Nam Coal Development Master Plan to 2020 with perspective to 2030 (PMVN, 2012b).

Below is the summary of some main targets for the energy development in Viet Nam for the next 10-15 years:

- Ensuring a sufficient and high quality supply of energy to meet the demands of socio-economic development, in which primary energy is expected to reach 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 60 days in 2020 and 90 days in 2025;
- Achieving a share of renewable energy in the total commercial primary energy supply of 5.0% in 2025 and 11.0% in 2050;
- Completing the rural electrification program for rural and mountainous areas, and increasing the proportion of rural households with access to electricity to 100.0% 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; and by 2015 for coal and petroleum products markets; and
- Carefully reviewing safety issues and actively preparing the conditions for putting the first unit of a nuclear power plant into operation during the 2020-25 period, and then gradually expanding the role of nuclear power in the economy's energy structure.

The Ministry of Industry and Trade (MOIT) oversees all energy industries. Formed in 2007 out of the merger of the Ministry of Industry and the Ministry of Trade, it operates currently in accordance with functions, tasks and powers as defined in the Government's Decree 36/2012/ND-CP dated 18 April 2012 and the Government's Decree 95/2012/ND-CP dated 12 November 2012. It draft laws, policies, development strategies, master plans, economy-wide target programs, technical-economic program, and important projects for all energy sectors. It submits them to the Government, the Prime Minister for issue or approval. The Ministry administers the implementation of these laws, policies, and plans. It takes on responsibility for issuing technical regulations and standards, eco-technical norms, guidelines on the implementation of approved law and policies. The Ministry carries out the state management of public services, state-owned enterprises in energy sectors, and is in charge of communicating the Government's policies, as well as reporting on sector development results.

Within MOIT, the General Directorate of Energy (GDE) and the Energy Regulatory Authority of Vietnam (ERAV) are two key advisory and executive units, assisting MOIT's Minister with the management of the energy sectors.

On 25 October 2011 the PMVN's Decision 50/2011/QD-TTg established the GDE and it commenced operation (PMVN, 2011a). It focuses on formulating law, policy and planning, and generally managing all energy sectors. The PMVN's Decision 258/QD-TTg signed on 19 October 2005 (in accordance to Provision 66 of Electricity Law 2004) and the PMVN's Decision 153/2008/QD-TTg dated 28 November 2008 established the ERAV. It specialises in implementing regulatory activities in the electricity sector in order to ensure a safe and high-quality supply of electricity for the economy. It also fosters the economical and efficient consumption of electricity and upholds the equity and transparency in the sector in compliance with the law. ERAV's concrete tasks include:

- Implementing regulatory activities relating to electricity market and tariff (including approving the Termed Bilateral Purchase Power Agreements (PPA));
- Reviewing provincial/city power development master plans and power development projects;
- Monitoring and making the mid- and long-term forecasts for the electricity supply-demand balance;
- Granting permits for power businesses; and
- Doing inspections for electricity activities.

Viet Nam Oil and Gas Group (Petrovietnam, or PVN), Viet Nam National Petroleum Group (Petrolimex), Viet Nam Electricity (EVN), Viet Nam National Coal and Mineral Industries Holding Corporation Limited (Vinacomin) are the leading state-owned enterprises (SOEs) in energy industries in Viet Nam. They actively contribute to formulating and implementing development strategies, master plans and annual plans issued by the Government in energy sectors. The government restructured the SOEs gradually to operate on a commercial basis. PVN still participates in some regulatory activities relating to oil and gas exploration and exploitation, and gas distribution.

ENERGY SECURITY

The Government of Viet Nam's energy security priorities include:

- Synchronously developing various energy sources;
- Exploiting and using domestic energy sources in an economical and efficient manner;
- Reducing dependence on imported petroleum products,
- Exporting a rational quantity of coal (in the immediate future, reducing annual coal exports);
- Connecting to the regional energy systems;

- Expanding stockpiles of petroleum products; and
- Combining energy security with assurance of defence and security.

To lessen dependency on oil product imports and to ensure energy security, the government has implemented the following detailed policies and measures:

- Strengthen domestic energy supply capacity through legislative reforms (especially regarding price, fiscal systems, equity among enterprises forms, information transparency) and the expansion of the infrastructure;
- Apply preferential policies for financing and expanding 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;
- Improve energy efficiency, reduce energy losses and implement extensive measures for the conservation of energy;
- Encourage 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; and
- Develop clean energy, especially new and renewable energy.

ENERGY MARKET

POWER SECTOR RESTRUCTURE

The Government of Viet Nam established a competitive power market as part of the long-term development strategy of electricity sector. The Electricity Law of December 2004 (effective from 01 July 2005 and amended on 20 November 2012) outlines the major principles for establishing the power market in Viet Nam. The scheme and conditions for the power market are detailed in the PMVN's Decision 26/2006/QD-TTg dated 26 January 2006 (hereinafter Road Map) and revised by PMVN's Decision 63/2013/QD-TTg dated 08 November 2013. According to the Road Map, Viet Nam's competitive power market has three phases of development:

- Phase 1 (Up to 2014): Competitive Generation Power Market;
- Phase 2 (2015–21): Competitive Wholesale Power Market (the first two years are pilot); and
- Phase 3 (2021 forward): Competitive Retail Power Market (with a pilot period from 2021- 23).

Each phase contains two steps: pilot and full operation.

The application of the market is a means for creating a new dynamic in Viet Nam's power sector. It aims to reinforce the effectiveness of production and business activities within the electricity sector, facilitate the decrease of selling electricity prices, and enhance the transparency and efficiency in power generation and distribution activities to ensure the robust development of the electricity sector over time.

On 1 July 2011, Viet Nam's competitive generation power market launched its pilot operation and commenced full operation on 1 July 2012. Additional enacted regulations complement the road map. These cover licensing and technical concerns, market rules, tariffs and contract regulation. As a result, by the end of 2014, there were 55 power plants with a total capacity of 12.82 GW directly participating in selling electricity on the spot market. Those 55 power plants constitute 40.0% of total capacity of the power system and about 52 power plants are yet to participate. They include hydropower, 'build-operate-transfer' ('BOT'), 'build-operate-own' (BOO) and some gas-fired power plants in the south-west region with a total capacity of over 18 GW or 60.0% of the total capacity of the power system. The total installed capacity of the plants directly involved in competitive electricity market is likely to increase in the coming years.

MOIT's Circular 30/2014/TT-BCT dated 02 October 2014, requires power generating companies involved in the competitive market, certain payment settlements principle. Contract coverage of not higher than 95.0%, applies in the first year of the electricity market, which is gradually decreased in the following years to not lower than 60.0%. For example:

- From 01 July 2012 to 31 Dec 2012, contract coverage applied to both hydro power plant and thermal power plant was 95.0%;
- From 01 January 2013 to 31 March 2013, contract coverage applied to both hydro power plants and thermal power plants was 90.0%; and
- From 01 April 2013 to now, the contract coverage applied with reservoir more than two days is 80.0%, and for hydro power plants with reservoir less than two days as well as thermal power plants is 90.0%.

As part of the electricity sector reform, EVN has been corporatising member enterprises since the early 2000s. So far, the following generation and distribution companies have been restructured:

- In 2008, four power transmission companies were merged into one company, the National Power Transmission Corporation, which is a separate entity under the management of EVN (or an independent cost-accounting subsidiary of EVN);
- In 2010, five Power Corporation was established after merging eleven power companies who are eligible customers in Viet Nam Competitive Wholesale Power Market (VWEM); and
- In 2012, EVN established three Generation Companies (GENCOs) including GENCO 1, 2 and 3.

In addition, the Electricity Power Trading Company, which is the 'Single Buyer' in the current power market, and the National Load Dispatch Centre, which manages the spot market's transactions, still operate as branches of EVN. Strategic power plants, including large hydropower plants, namely Hoa Binh, Tri An, Yaly and Son La, and nuclear power plants (in the future), remain under the management of EVN. EVN has a strong position in the competitive generation market as the biggest player.

In 2013, Viet Nam restructured the power generating market as follows (NLDC, 2014):

- EVN's power plants accounted for 63.0% of the total installed capacity; EVN's ownership was 26.0% and EVN's joint stocks 37.0%;
- PVN's power plants accounted for 11.0%;
- Foreign investors' power plants accounted for 8.0%;
- Vinacomin's power plants accounted for 6.0%; and
- Various other local investors' power plants accounted for 12.0%.

According to the Roadmap, Viet Nam is preparing Competitive Wholesale Power Market. On 22 July 2014, Minister of MOIT issued the Decision 6463/2014/Q-BCT on approval of the Conceptual Design of the Vietnam Wholesale Electricity Market of Vietnam.

TARIFFS

Electricity prices are in accordance with the market mechanism and under the regulation of the Government (Provision 29 of Electricity Law 2004 and amendments in 2012). The baseline of the average retail electricity tariff in Viet Nam is calculated annually by MOIT and is based on:

- the audited costs;
- the generation, transmission, distribution sectors' investors' reasonable profits; and
- the costs of regulating, managing and supporting services in the electricity system.

The baseline is threshold for electricity retail tariff adjustments. Adjustments occur following changes in fundamental costs such as fuel cost, exchange rates, and generated capacity. Any changes occur within the tariff scope approved by the Prime Minister.

For the period between 2013-15, following the PMVN's decision No 2165/QD-TTg dated 11 November 2013, the average retail tariffs are allowed to fluctuate in the range from VND 1,437/kWh (USD 6.8 cents) to VND 1 835/kWh (USD 8.7 cents). According to the PMVN's decision No. 69/2013/QD-TTg dated 19 November 2013 (effective from 1 January 2014), EVN is allowed to increase retail tariffs only when:

- the fundamental costs change from 7.0% to under 10.0%;

- the Electricity Price Stabilisation Fund has been used; and
- MOIT, through consultation with the Ministry of Finance (MOF), provides an endorsement.

Any tariff increase outside of the approved tariff scope and in cases of cost fluctuation of 10.0% or more require a decision by the Prime Minister. The government's policy aims for tariff adjustments that are transparent and publically announced. The minimum timeframe between two consecutive electricity tariff adjustments is six months. The government can deploy the Electricity Price Stabilisation Fund and other measures stipulated in legislations where it is necessary to stabilise the electricity tariff in order to minimise negative impacts on the stability of the macro-economy and the welfare of the population.

CRUDE OIL MARKET

Players in the upstream oil sector in Viet Nam include PVN, various international oil companies and other foreign enterprises. According to the Petroleum Law 1993 and amendments in 2000 and 2008, the government reserves the right to be a priority buyer of oil production from contractors and in such case, foreign contractors have the right to sell their profit oil at international prices.

There is only one refinery in Dung Quat, Quang Ngai province, with a capacity of 6.5 Mt per year. In operation from 2009 by the Binh Son Refinery Company (BSR), it is a PVN's 100.0%-owned subsidiary. BSR has bought crude oil mainly via the Petrovietnam Oil Corporation (PVOil), a subsidiary of PVN.

PETROLEUM ENGINE FUEL MARKET

Petroleum engine fuels (PEF) include gasoline, diesel, jet A1, fuel oil, kerosene, biofuels and other engine fuels, excluding LPG and CNG (GOV, 2014).

The government, represented by the Ministry of Industry and Trade, the Ministry of Planning and Investment (MPI) and the Ministry of Finance (MOF), controls the PEF market. MOIT administers all enterprises participating in the market, especially refineries, importer-wholesale enterprises, and the development of petroleum trading infrastructures (import terminal, strategic stockpiles, commercial stockpiles, and oil products pipelines) in order to ensure the supply of PEF for the economy. Annually, MOIT selects qualified enterprises to implement PEF imports, allocates the import quota[3] to these enterprises based on the MPI's forecast of total PEF demand for the economy, and approves their importing and production plans. MOIT manages the development of refineries, oil trading infrastructure according to the Master Plans approved by the Prime Minister. MOF manages all fiscal and economic issues, including tax rates, retail prices and the Petroleum Price Stabilisation Fund.

As of June 2013, there are 17 wholesale enterprises in the domestic PEF market, of which Petrolimex is the leading state owned enterprise with a market share of 48.0%, PV Oil has 17.0% (PV Oil also distributes BSR's output products), and the remaining 35.0% is from 15 other companies. Fourteen of the 17 wholesale enterprises were authorised to import by MOIT in 2013. The list of importers can change every year depending on each enterprise's business performance, and whether they achieved the import quota of the previous year. In general, three state-owned enterprises namely Petrolimex, PV Oil and Saigon Petro, hold the biggest quotas, and together they can make up to nearly 80.0% of total annual imports. Key enterprises, including refineries and importer-wholesale enterprises, are responsible for ensuring the petroleum engine fuel supply for the whole economy, both in term of quantity and range of products. Foreign investors are yet to participate in PEF trading in domestic market.

In term of the retail market, Viet Nam has more than 12 000 petrol stations as of 2013. State-owned enterprises financed 30.0% of these stations and private investors financed 70.0%. The government is planning to increase the number of fuelling stations to 18 000 by 2020.

In September 2014, the government issued a new decree on PEF business, which came into effect on 1 November 2014 (GOV, 2014). It detailed the business operating conditions required for importer-wholesale enterprises, and other enterprises that participate in the PEF trade and distribution in Viet Nam's domestic market, and their rights and duties. A notable requirement for importer-wholesale enterprises and refineries is that they must ensure a 30-day minimum stockpile equivalent available according to their level of supply and product structure. The average daily sales in the domestic market during the previous year determines the stockpile level. This includes stockpiles for both the economy's energy security and commercial needs.

[3] The PEF import quota is the minimum annual amount of petroleum products that an authorised enterprise can import.

From 2009, the government regulates retail PEF prices based on the approval of a baseline for the importer-wholesale enterprises' selling price. The base price is composed of a number of price elements including: CIF importing price of importers; government taxes and levies (import tax, excise tax, VAT, environment tax); business expenses norm; deductions for the Petroleum Price Stabilisation Fund; and profit norm.

MOF regulates the calculation of each price element in the base price. Importing and wholesale enterprises can define their wholesale prices and adjust their retail prices based on the fluctuations of their actual costs compared to their approved base price. In the case of raising prices, importer-wholesale enterprises are allowed to decide the adjustments equivalent to changes of their costs up to 7.0%, after having informed (in case of a change less than 3.0%) or received guidelines from MOIT and MOF (in case of a change above 3.0% to 7.0%). The Prime Minister decides on the adjustments when they increase more than 7.0%. Intervals between the two consecutive price adjustments are set at a minimum of 15 days in the case of increasing prices, and a maximum 15 days in the case of decreasing prices.

NATURAL GAS MARKET

The government reserves the right to be the first priority buyer of all natural gas exploited and produced in Viet Nam. PVN and PVGas are the authorised buyers of natural gas from oil and gas contractors and the sellers to consumers in the Vietnamese gas market. According to the Price Law, gas prices are not subject to government regulation. All upstream sellers and downstream buyers are free to negotiate the price and other terms in the Gas Purchase and Supply Agreement (GPSA) with PVN and PVGas. The gas price formulas and levels are set with consideration to their competitiveness against alternative fuels. This ensures a reasonable profit margin for investors in related upstream and midstream gas projects. PVN submits GSPA, including price formula and level, to authorised organisations and the Prime Minister for approval before these GSPA come into effect. PVGas is responsible for planning, developing and operating gas infrastructure projects to ensure a safe and reliable natural gas supply and support gas exploration and production in Viet Nam.

COAL MARKET

Vinacomin's production and sales account for 95.0% of the total market in Viet Nam. Recently, the North-East Coal Corporation separated from Vinacomin to become an independent company and operate under the management of the Ministry of Defence. In addition, PVN established the PV Power Coal, which is in charge of coal imports, trading, and ensuring coal supply to their five new coal power plants, namely Vung Ang 1, Thai Binh 2, Long Phu 1, Song Hau 1 and Quang Trach 1. The forecast for total coal demand for these power plants of PVN is about 16 Mt in 2020 and 20 Mt in 2030. Compared to the total coal demand for power generation, PVN will take a share of about 24.0% by 2019-20, and 10.0% by 2030.

Since July 2009, Vinacomin set the price for local customers, except power generators, at the market price. In addition, the government has been preparing a strategy to deregulate the price of coal used for power generation. As a first step, in 2012, the government allowed the coal price for power production to raise according to the latest electricity price adjustment. Any adjustments are no less than the coal production cost, in order to ensure funding for the renovation, expansion and improvement of the capacity of the existing mines and building of new mines to meet coal demand and contribute to improvements in energy efficiency.

ENERGY EFFICIENCY

In April 2006, the Prime Minister approved the Viet Nam National Energy Efficiency Program (VNEEP) for 2006–2015 (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 society as a whole.

The aim of the program was to save 3.0%–5.0% of the total energy consumption over the 2006–10 period and 5.0%–8.0% 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.

Phase one of the VNEEP for the period 2006–11 was successfully implemented, saving about 4 900 ktoe in total energy consumption for the period 2006–10, equivalent to 3.4% of the total energy consumption in the respective period. Key legal documents on EE&C have been built and issued, including the Law No 50/2010/QH12 dated 17 July 2010 on Energy Savings and Efficiency (effective from 1 January 2011) and its implementing regulations and guidelines by sectors. Phase two for the 2012–15 period is now underway (PMVN 2012c).

MOIT is the focal coordinator of the EE&C and is authorised to administer the implementation of the VNEEP. As part of this mechanism, the government established Energy Efficiency and Conservation Office within MOIT 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 the local government. According to the MOIT's report at the 7th National Conference on Energy Saving held in Tien Giang Province on 17th October 2014, a network of 14 energy conservation centres and more than 40 industrial promotion centres, counselling centres, technology transfer centres have been established across the country.

MOIT established a National Steering Committee chaired by MOIT 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 the Ministry of 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 recently finished a project to raise the effectiveness of energy use in small and medium enterprises (SMEs). The Global Environmental Fund through the UNDP funded the project. Over five years from 2006-10, the project provided USD 29 million to implement 500 SMEs operating in the areas of clean production, ceramics, weaving, paper and pulp manufacture, and food processing. The project included 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 0.96 million tonnes annually during 2006–10.

The Promotion of Energy Efficiency and Conservation project, funded by Japan, began in 2000 and finished successfully in 2010. The Association of South East Asian Nations (ASEAN) Centre for Energy jointly implemented this project, along with the ASEAN economies and the Energy Conservation Centre, Japan. The project focused on the building, industry, energy management and transport sectors.

In order to realise targets in energy efficiency programs, the Government encourages major energy-using establishments to improve their energy planning, management and auditing. Major energy-using establishments are those with the consumption of energy as follows:

- Establishments of industrial, agricultural production, and transportation units with a total yearly energy consumption of at least 1000 toe.
- Buildings used as headquarters, offices, accommodations, institutions of education, health care, recreation, fitness and sports, hotels, supermarkets, restaurants, stores with a total yearly energy consumption of at least 500 toe.

MOIT, in coordination with other Ministries, related sectors and localities, shall organise and manage the operation of these establishments. In addition, it will coordinate with the related Ministries, Departments and People's Committees of Central Provinces and Cities to set up a list of these establishments, and annually update and submit that list to the Prime Minister for approval.

According to the List issued by the Prime Minister in 2013, there were 1 720 major energy-using establishments in the whole country. Cities and provinces with large number of such establishments are Ho Chi Minh City (241); Binh Duong (178); Hanoi (176); Dong Nai (106); Quang Ninh (98); Ba Ria - Vung Tau (89) and An Giang (6). The four provinces without any major energy-using establishments are Bac Kan, Ninh Thuan, Dak Nong and Bac Lieu.

RENEWABLE ENERGY

The National Strategy on Climate Change (the PMVN's Decision 2139/QD-TTg dated 6 December 2011) stipulated the missions and targets for development of new and renewable energies for the period to 2020 and with a vision to 2050. It aims to:

- Review, plan and develop hydroelectric projects properly for various purposes, so that the total output capacity of hydroelectric plants can reach 20 000-22 000 MW by 2020;
- Boost research and development of new and renewable producing technologies, including wind energy, solar energy, tidal energy, geothermal energy, biofuel, and universal energy; to design and implement policies on engaging socio-economic sectors in applying and popularising renewable energies; and
- Guarantee energy security through synchronously developing different sources of energy; to raise the percentage of new and renewable energies to 5.0% of the total primary commercial energy supply by 2020 and 11.0% by 2050.

Since 2008, the government of Viet Nam developed policies to support the use of renewable energy, as follows:

SMALL HYDRO POWER

The MOIT's circular No. 32/2014/TT-BCT dated 09 October 2014 on Regulation on avoided cost based on electricity tariff and power purchase agreement for small hydropower plants (MOIT, 2014) replaces the previous MOIT's Decision No. 18/2008/QD-BCT dated 18 July 2008 on 'Regulation on avoided cost based on electricity tariff schedule and standard power purchase agreement'.

WIND POWER

Enacted regulations include the PMVN's Decision No. 37/2011/QD-TTg dated 29 June 2011 on 'Mechanism for supporting wind power development' (PMVN, 2011d) and the MOF's circular No. 96/2012/TT-BTC dated 8 June 2012 on 'Financial mechanisms for grid-connecting wind power projects'.

The key elements of the decision on wind power development are incentives for capital investment, and the provisions about related land use, transmission fees and electricity tariffs called the Fit-In Tariff (FIT). The FIT is equal to 0.078 USD/kWh and Electricity of Viet Nam (EVN) is responsible for purchasing electricity from all wind power plants. The government provides a subsidy of 0.01 USD/kWh of the power price for EVN through the Viet Nam Environment Protection Fund.

BIOMASS AND WASTE POWER

Decision No. 24/2014/QD-TTg dated 24 March 2014 on 'Mechanism for supporting biomass power development and Decision No. 31/2014/QD-TTg dated 5 May 2014 on 'Mechanism for supporting solid waste power development' support the biomass and waste power development.

BIOFUELS

Biofuels are encouraged in Viet Nam as an alternative to partially replace conventional fossil fuels, contributing to assuring energy security and environmental protection. In 2007, the government of Viet Nam announced a biofuel development scheme for the period to 2015 with a vision to 2025, stipulating the target to build and develop biofuel production and use nationwide (PMVN, 2007b). By 2015, the output of ethanol and vegetable oil will reach 250 000 tons (enough for blending 5 million tons of E5 and B5), satisfying 1.0% of the whole country's gasoline and oil demand. Towards 2025, Viet Nam aims to build an advanced biofuel industry and the biofuel production technology applied in Vietnam will eventually reach the world's advanced level. The ethanol and vegetable oil output will increase to 1.8 million tons, satisfying some 5.0% of the whole country's gasoline and oil demand.

MOIT, in coordination with concerned ministries, branches, organisations and individuals, assumes the prime responsibility for organising the efficient and timely implementation of the biofuels scheme. It annually reports to the Prime Minister. Enterprises that want to invest in biofuels producing projects are

required submit their plan for development to MOIT. Biofuels traded and used in Viet Nam are required to follow the technical regulation and standards for biofuels.

In November 2012, the government announced the applicable ratio for mixing biofuels with conventional fuels for road-motorised vehicles using gasoline and diesel in Viet Nam and the road map for the implementation (PMVN, 2012d). Since 15 January 2013, Viet Nam has produced, traded and distributed biofuels for motorised road vehicles. The fuels include E5, E10, B5, and B10. From 1 December 2014, the distribution and use of E5 for all motorised road vehicles is mandatory in seven cities and provinces, including Ha Noi, Ho Chi Minh City, Hai Phong, Da Nang, Can Tho, Quang Ngai, and Ba Ria-Vung Tau. It will be mandatory for the whole economy from 1 December 2015. E10 will be mandatory in the abovementioned seven cities and provinces from 1 December 2016, and then will expand to the whole country from 1 December 2017.

From the 2007-15, the government classifies investment in biofuel production as an area eligible for special investment incentives. Biofuel production enterprises are entitled to an income tax exemption or reduction for biofuel products according to the Government's Decree No. 24/2007/ND-CP of 14 February 2007, detailing the implementation of the Law on Enterprise Income Tax. They are entitled to the highest land rent and land use incentives for 20 years. Raw materials, components, machinery and equipment for scientific research and technological development for biofuel production are exempt from import tax. Raw materials, components, machinery and equipment used for biofuel production are eligible for the lowest import tax rate.

Since the 2007 deployment of government Decision No. 177/QD-TTg dated 20 November 2007 (PMVN, 2007b), investments in biofuel research and production have increased. Biofuel research focuses on biofuel technologies, application in electricity generation and transportation use. The government has invested in domestic research capacity to advance the biofuel sector in accordance with the framework of Project 177, as well as in other economy-wide and provincial funding programs available for the scientific and technological development of Vietnam. In 2009 many ethanol plants were built in Quang Nam, Phu Tho, Quang Ngai (Dung Quat), Binh Phuoc and Dong Nai. Investments have increased from domestic enterprises including Petrovietnam. In 2014, there were five ethanol producers with a total installed capacity of 365 000 tons per year, enough for mixing 7.3 million tons of E5.

NUCLEAR

In June 2010, the Prime Minister approved a plan to build and develop nuclear technology industry and to contribute to socioeconomic development and the strengthening of the economy's nuclear scientific and technological capacity (PMVN 2010).

MOIT submitted a 2005 pre-feasibility study on the building of a 2 000 MW nuclear power plant in Ninh Phuoc or Ninh Hai (two districts of Ninh Thuan Province in central Viet Nam) for approval. 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 July 2010, the Prime Minister also approved the 'Planning Orientation on Nuclear Power Development in Vietnam up to 2030' project. This proposes that one unit with a capacity of 1 000 MW will operate by 2020.

The construction of both plants will begin in 2014–15, and will be followed by the further development of the economy's nuclear energy capacity so that it reaches 8 000–10 000 MW by 2030 (IE, 2011). However, after the March 2011 Fukushima nuclear power plant accident in Japan, safety issues in the development and operation of nuclear power plants became a top priority for Viet Nam, and the program's timeframe and the generation capacity over the long term are under careful review.

CLIMATE CHANGE

In Viet Nam, the government exercises unified management over natural resources and environmental protection throughout the country. The institutional framework for environmental governance consists of the administrative hierarchy, with economy-wide representation through the National Assembly, and provincial-, district-, and commune-level representation through People's Councils and Committees. More than ten line ministries and central agencies deal with natural resources, and other ministries deal with general planning responsibilities. The Ministry of Natural Resources and Environment (MONRE) played a central coordinating role in environmental management.

Since 1990s, the government of Viet Nam motivated by the serious impacts of climate change on the country's sustainable development. Viet Nam is one of the economies most affected by climate change. It

signed the United Nations Framework Convention on Climate Change (UNFCCC) on 16 November 1994, signed the Kyoto Protocol (KP) in 1997 and ratified it on 20 August 2002. Viet Nam has fulfilled all requirements to be an Annex II economy for the developing clean development mechanisms (CDMs) under the Protocol.

Government agencies are progressively revising and completing the institutional framework and the system of legal documents to prevent and mitigate natural disasters due to climate change. In April 2003, the government established the CDM National Executive and Consultative Board, comprising officials from MONRE and other ministries. 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.

Every five years the Vietnamese government issues its 'National Target Program to Respond to Climate Change' (NTP-RCC) to assess climate change's impact on sectors and regions over specific periods, and to develop feasible action plans that can effectively respond to climate change in the short and long term in order to ensure the sustainable development of Viet Nam. In December 2008, the Prime Minister approved the National Target Program to Respond to Climate Change. It has a budget of about VND 1 965 billion.

On 5 December 2011, Prime Minister Nguyen Tan Dung issued the National Strategy on Climate Change (the Decision 2139/QD-TTg). This strategy has a century-long vision and it is the foundation for all other ministerial, sectoral and local strategies, plans and programs.

Viet Nam has set a target to reduce 8.0-10.0% of its CO_s emissions compared to its 2010 level and to reduce annual energy intensity at a rate of 1.0-1.5%.

Many international financial institutions and developed economies in the APEC region, including the World Bank, the Asian Development Bank, and the governments of Australia, Canada, Japan, the US and others are helping Viet Nam to build specific projects aimed at reducing the impact of climate change. These include risk management for 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 the Cuu Long River Delta to cope with climate change.

NOTABLE ENERGY DEVELOPMENTS

TOWARD A LOW-CARBON ECONOMY

In 2013-14, Viet Nam continues to revise its legal framework to facilitate and enhance the effectiveness of developing new and renewable energy projects, especially small hydro, wind power, biomass and waste power, and biofuels (for more information see the Renewable section).

In addition, MOIT issued Circular No. 02/2014 dated 16 January 2014, stipulating the concrete measures for enhancing energy savings and efficiency in the industrial sector. In previous years, MOIT issued similar regulations for the transport (2011) and agricultural (2013) sectors.

Viet Nam is currently revising the Power Development Master Plan to 2020 with perspective to 2035 (PDP7 revised). Renewable energy is expected to have a bigger share in 2035 compared to the previous PDP7.

ENHANCING TRANSPARENCY IN ELECTRICITY AND PETROLEUM PRODUCTS MARKETS

Enhancing the transparency of the government's electricity and petroleum engine fuels markets regulation as well as the regulations monitoring the business performance information of SOEs in these key and sensitive sectors is a focus of the government. Two regulations relating to these issues include:

- MOIT's Directive No. 11/CT-BCT dated 22 April 2014 on enhancing the public communication and information transparency in electricity and petroleum products trading activities; and
- Government's Decree No. 61/2013/ND-CP dated 25 June 2013 on regulations monitoring finance and business performance, and financial information transparency of enterprises owned by the State and having State financial participation.

- In order to accelerate administration reforms and enhance the quality of state management in conditions of commercial and economic international integration of the economy, the Prime Minister revised the functions, powers and tasks of many governmental organisations, including MOIT's, emphasising MOIT's task of managing SOEs.

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Ministry of Industry and Trade—www.moit.gov.vn

National energy efficiency programme (VNEEP)—www.vneec.gov.vn

Electricity Regulatory Authority of Vietnam (ERAV)—www.erav.vn

National Load Dispatch Centre (NLDC) – www.nldc.evn.vn/

Vietnam Electricity—www.evn.com.vn

Energy savings (EVN)—tietkiemnangluong.vn

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