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Study on Electricity Supply Mix and Role of Policy in ASEAN

Edited by

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The findings, interpretations, conclusions, and views expressed herein do not necessarily reflect the views and policies of the Economic Research Institute for ASEAN and East Asia, its Governing Board, Academic Advisory Council, or the institutions and governments they represent.

Preface and Acknowledgements

In member states of the Association of Southeast Asian Nations (ASEAN) where electricity demand is rapidly increasing, there is a necessity to build up more generating capacity to meet the growing demand. At the same time, cheaper electricity will be required when considering the impact on the general public and economy, and the need for cleaner electricity will become stronger when considering the impact on pollution and the climate issue.

Towards this goal, each country has its policy or target for its future power supply mix. However, it is obvious that without appropriate implementation tools, a policy or plan will end up being merely a decorative notion. Moreover, the electricity market's structure will affect the capability or applicable option of government in policy implementation. For instance, in a liberalised market, in general, government has no direct means to control the market which makes it difficult to guide the market towards its goal in the future.

This kind of issue is not a matter only for ASEAN. Many developed countries have also experienced past and even ongoing challenges under the new circumstances. Therefore, ASEAN could learn much from these experiences.

Against this backdrop, the Economic Research Institute for ASEAN and East Asia (ERIA) organised a working group to carry out a study which aims to analyse the pros and cons of different market structures in terms of policy implementation. Experts from ASEAN member states were gathered to discuss their existing power development plans and the possibility for regional optimisation.

It is our hope that the outcomes from this study will serve as a valuable reference for policymakers in ASEAN member states and contribute to the improvement of energy security in the region as a whole.

This analysis has been implemented by a working group under the Economic Research Institute for ASEAN and East Asia (ERIA). It was a joint effort of the Working Group members from the ASEAN member states and the Institute of Energy Economics, Japan (IEEJ) as the secretariat of the Working Group. We would like to acknowledge the support provided by everyone involved. We would especially like to express our gratitude to the members of the Working Group, ERIA, and IEEJ's study project team.

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Leader of the Working Group

June 2016

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List of Abbreviations

ASEAN	Association of Southeast Asian Nations
ERIA	Economic Research Institute for ASEAN and East Asia
HAPUA	Heads of ASEAN Power Utilities/Authorities
IEEJ	The Institute for Energy Economics, Japan
IPP	independent power producer
OECD	Organisation for Economic Co-operation and Development
PDP	Power Development Plan
WG	Working Group

Executive Summary

It is assumed that the demand for electricity of member states of the Association of Southeast Asian Nations (ASEAN) will be increasing in the future. ASEAN member states have to achieve an appropriate power supply mix while at the same time achieving energy supply security, economic efficiency, and environmental protection (3Es). This study aims at suggesting possible policy tools to realise such an appropriate power supply mix:

- The applicable policy tool for achieving the electricity mix target differs by a country's developing stage and market model.
- Therefore, a simple copy and paste of policies will not work effectively; thus, each country/region needs to understand its own situation first.
- It is suggested that each government and/or region formulate a vision for its future electricity supply mix in order to indicate a preferable direction of investment.
- For the industry side, life cycle cost evaluation in power station investment is recommended to compare the true value of different investment options.

We first analyse ASEAN member states' existing market structures and relevant policy implementation mechanisms to control their power supply mix. We then analyse the required policy measures and market/industry structure to realise a balanced electricity supply mix based on European Union countries' experience.

While most ASEAN member states have adopted a single buyer system in which the government could easily control its market, countries such as Singapore have introduced competition even into the retail market. Although a liberalised market is enabled to enhance economic efficiency, it is unsuitable for promoting infrastructure development and to build a balanced electricity supply mix.

Given the diverse situations in ASEAN member states' market models, it could be considered desirable to first adopt a model such as the National Monopoly Model to prioritise the creation of infrastructure and a balanced electricity mix, and then later move forward incrementally with the creation of systems that emphasise economic efficiency.

Chapter 1

Introduction

In the Association of Southeast Asian Nations (ASEAN), increasing demand for electricity and relatively lower income levels are urging member states to develop large-scale power generating capacity in an economically efficient way. Needless to say, it is also becoming ever more important to mitigate the environmental burden in developing this capacity. That is, the simultaneous achievement of three elements in power development – the so-called 3Es of energy supply security, economic efficiency, and environmental protection – is becoming an indispensable part of energy policy in ASEAN member states.

Towards this goal, each country has its policy or target for its future power supply mix. The question to ask is how to turn such a policy into actual practice. It is obvious that without appropriate implementation tools, a policy or plan will end up being merely a fanciful notion.

In addition, from a pan-regional viewpoint, a past study conducted by the Economic Research Institute for ASEAN and East Asia (ERIA) has indicated the importance of having a pan-regional planning coordination function to maximise the regional benefit in power development. The power development plan in each country basically does not consider the regional benefit or effect for neighbouring countries. The pan-regional planning coordination function acts as a possible measure to implement the regional power supply mix policy in a market.

Objective

This study will examine the experiences of many developed countries because this kind of issue is not a matter only for ASEAN. Many developed countries have also experienced past and even ongoing challenges under different circumstances. Therefore, ASEAN could learn much from these experiences.

In this light, the study also aims at suggesting possible policy tools and market designs to achieve an appropriate power supply mix for ASEAN member states.

Work Stream

The study consists of four work streams for fiscal year 2015.

(A) Analysis of need for achieving a balanced electricity supply mix

First, the study will identify the necessity and importance of achieving a well-balanced electricity supply mix (i.e. fuel mix) in each country and/or region.

(B) Analysis of policy measures for achieving a balanced electricity supply mix

Second, the study will analyse required policy measures and the market/industry structure to realise a balanced electricity supply mix.

Possible issues to be discussed:

- Role of government intervention
- Process of market liberalisation
- Assessment method of power plant investment
- Role of electricity import/trade

(C) Case study

The study will select and visit European countries (Sweden, Germany, Switzerland, France, and the United Kingdom) to analyse their existing market structure and relevant policy implementation mechanisms to control their power supply mix.

(D) Policy recommendation

The study will derive policy recommendations for how to implement the national/regional policy for achieving a better electricity supply mix.

Working Group Activity in 2015

The Working Group met in November 2015 in Bangkok, Thailand. At the meeting, the Working Group shared information and held discussions regarding each country's energy policy and power source development plan.

Chapter 2

Electric Power Policy and Market Structure in ASEAN Member States

This chapter will provide an outline of the energy policies of the 10 ASEAN member states (Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic (Lao PDR), Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam) and will look at the structure of their electricity markets, the circumstances relating to the liberalisation of their electricity markets, and the policy measures they use to achieve their electricity mix targets.

The roles of state-run electricity companies and independent power producers (IPPs) in the electricity sectors of the 10 ASEAN member states are listed in Table 2-1.

The information that has been gathered clearly shows that the electricity generation sector in many of the nations in the ASEAN region has been liberalised and that IPPs have entered these markets. Note, however, that many of these countries use a single buyer system in which state-run companies purchase all of the electricity generated by IPPs etc. and sell it on a monopolistic basis to electricity distribution companies. The single buyers (state-run companies) in such systems are able to select electricity sources. Conversely, in Singapore and the Philippines, where progress has been made with overall electricity market liberalisation, the involvement of the state has become limited.

Table 2-1: Electricity Market Structures in ASEAN Member States

Country	Market Structure
Brunei Darussalam	- The electricity market has not been liberalised. The Department of Electrical Services (DES) and the state-run Berakas Power Company (BPC) carry out electricity source development.
Cambodia	- The state-run public corporation Electricité du Cambodge (EDC) accounts for 6.4% of total electricity generation capacity. It supplies electricity it has itself generated to major cities and also supplies electricity from independent power producers (IPPs) and electricity imported from neighbouring countries. - On the other hand, IPPs supply electricity to regions other than the major urban centres and play a major role in electricity generation.
Indonesia	- The state-run Perusahaan Listrik Negara (PLN) created a system of financial independence-oriented internal business units. - IPPs are developing electricity sources in anticipation of the need to satisfy rapid increases in demand for electricity.
Lao People's Democratic Republic (Lao PDR)	- Electricite du Laos (EDL) generates electricity for the main grid in the Lao PDR and exports excess electricity to Thailand, while also importing electricity from Thailand and Viet Nam into some areas which are not connected to the interconnected transmission system. They also invest in existing IPPs by holding a portion of their shares etc. - IPPs can, upon receiving permission from the government, participate in electricity development using the BOT and BOOT approaches,[1] and their electrical facilities are then transferred to the government 20–30 years later. - As of 2015, the proportion of electricity generated by IPPs was overwhelmingly large, accounting for 87% of electricity generation capacity.
Malaysia	- In Peninsular Malaysia and the states of Sabah and Sarawak, the companies Tenaga Nasional Berhad (TNB), Sabah Electricity Sdn. Bhd. (SESB), and Syarikat SESCO Berhad (SESCO) operate as a vertically integrated business with regional monopolies. - In addition to this, there are a large number of IPPs licensed by the Energy Commission (EC).

Country	Market Structure
Myanmar	- The jurisdiction of the Ministry of Electric Power No. 1 covers everything from the drafting of hydroelectricity-related development plans to the operation of electric power plants. The jurisdiction of the Ministry of Electric Power No. 2 covers the construction and operation of thermal power plants, as well as electricity transmission, distribution, and retail. - IPPs participate in the power generation sector through joint ventures and BOT frameworks after receiving permission from the Myanmar Investment Commission. - Myanma Electric Power Enterprise (MEPE) is a single buyer that purchases electricity from all power generation companies. - There are two distributors: Yangon Electricity Supply Board (YESB) and Electricity Supply Board (ESB).
Philippines	- Liberalisation is being carried out in the electricity sector and the electricity generation sector is operated by the state-run National Power Corporation (NPC) and IPPs. - It is the policy of the NPC not to develop any new sources of electricity other than small-scale sources for the purpose of electrification of rural areas. - IPPs are the primary developers of electricity sources.
Singapore	- Singapore's electricity generation sector has been liberalised and the country has no state-run electricity companies. - IPPs receive business licences from government organisations to develop electricity sources.
Thailand	- The state-run Electricity Generating Authority of Thailand (EGAT) purchases electricity from IPPs, small power producers (SPPs), and neighbouring countries (Lao PDR and Malaysia), supplies this on a wholesale basis to distribution companies (Provincial Electricity Authority (PEA) and Metropolitan Electricity Authority (MEA)), and provides electricity directly to major electricity consumers. - IPPs and SPPs engage in the development of electricity sources in order to satisfy the rapidly increasing demand for electricity.

Country	Market Structure
Viet Nam	- The state-run electricity group Vietnam Electricity (EVN) purchases electricity from IPPs etc. and sells this domestically on a monopolistic basis. - Any company operating an electricity generator with an output of 30 megawatts or more is able to enter the market, and participation can be direct or through an EVN representative using a BOT-type framework.

Note: *BOT stands for 'build-operate-transfer' and is a framework in which private sector companies are contracted to build and operate facilities and then, after a certain period, the property rights are transferred to a public department. BOOT stands for 'build-own-operate-transfer'.

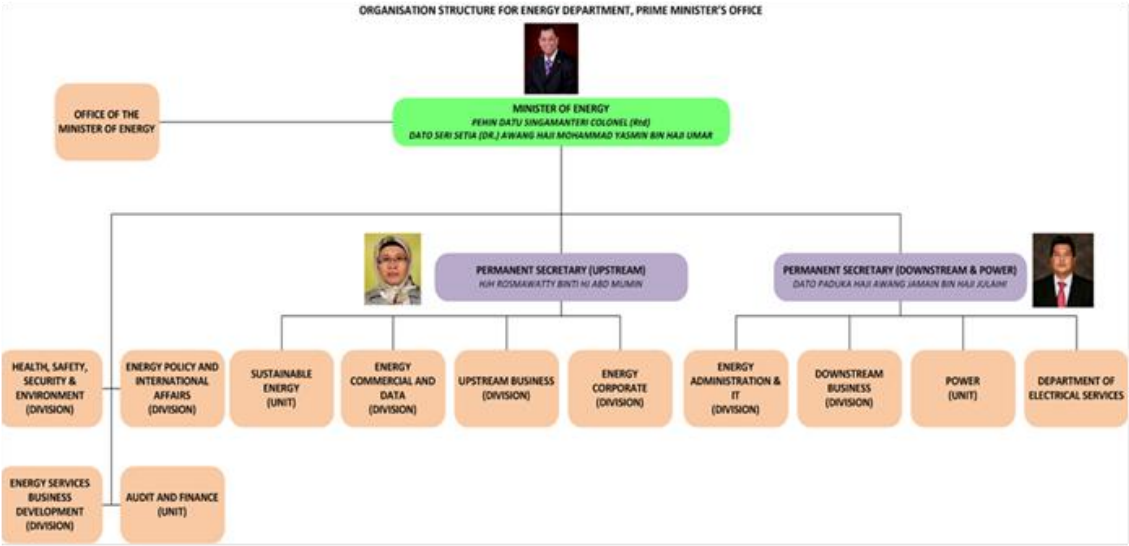
Source: Study team.

1. Brunei Darussalam

1.1 Electric Power Policy

The Ministry of Energy (MOE), which resides within the Prime Minister's Office, is in charge of all energy policies in Brunei Darussalam.

Figure 2-1: Regulatory Framework of the Energy Sector in Brunei Darussalam



Source: Government of Brunei Darussalam homepage.

In 2004, the Government of Brunei Darussalam formulated a 30-year long-term development plan and a national vision task force. In January 2008, the 30-year vision called Wawasan Brunei 2035 was launched, and a 10-year development strategy and policy framework called Outline of Strategies and Policies for Development 2007–2017 went into effect.

According to the MOE's Energy White Paper 2014, the government defined the following strategic goals and outlined a plan to expand the 2010 oil and gas upstream and downstream activities to energy services companies, electric power, renewable energy, and other energy-related businesses by 2035, and to boost profits in the process:

- Strengthen and grow oil and gas upstream and downstream activities.
- Ensure safe, secure, reliable and efficient supply and use of energy.
- Maximise economic spin-off from the energy industry.

It also defines a 6-percent annual target growth for the energy sector between the 2010 and 2035 rates (Brunei Ministry of Energy, 2014).

1.2 Electric Power Market Structure

a. Market structure

Electric power businesses are handled by the Department of Electrical Services (DES), an electric utility company situated under the MOE, and Berakas Power Company (BPC), the electric utility company in charge of providing power to the Sultan's palace, other royal facilities, and the military. In addition, three oil and gas companies, Brunei Shell Petroleum (BSP), Brunei Liquefied Natural Gas (BLNG), and Brunei Methanol Co. (BMC), possess their own power generation facilities and sell any excess electricity generated to DES.

b. Deregulation

Although the aforementioned three companies are involved in the power generation sector, the remaining sectors have not been deregulated. We have yet to obtain any detailed information pertaining to the deregulation of the electricity market.

c. Mechanism of policy implementation

The electricity market has not been deregulated, and the two state-run companies, DES and BPC, are developing electric power sources in accordance with MOE's energy policies. For this reason, investments in power plants are the direct reflection of the electric power mix that the government aims to achieve.

2. Cambodia

2.1. Electric Power Policy

In Cambodia, the Ministry of Mines and Energy (MME) formulates energy policies and electric power development plans. Cambodia's Energy Sector Development Policy released in October 1994 set the following four goals:

- Provide an adequate supply of energy throughout Cambodia at a reasonable and affordable price.
- Ensure a reliable and secured electricity supply at a reasonable price to facilitate investment in Cambodia and the development of the national economy.
- Encourage exploration and environmentally and socially acceptable development of energy resources needed for supply to all sectors of the Cambodian economy.
- Encourage the efficient use of energy and minimise the detrimental environmental effects resulting from the supply and consumption of energy.

The Government of Cambodia's National Strategic Development Plan 2014–2018 aims to generate 10,823 gigawatt-hours (GWh) of power and to increase per capita annual power consumption to 544 kilowatt-hours (kWh) by 2018 (Royal Government of Cambodia, 2014). With regard to developing power sources, the development plan emphasises boosting power supply capacity by stepping up competitiveness, promoting economic growth, strengthening energy security, and raising the standard of living. It lists the following as priority targets:

- Further expanding the capacity of low-cost and high-tech electricity production and ensuring distribution to respond to development needs.
- Further encouraging the private sector to invest in electricity generation, and transmission and distribution infrastructure.
- Stepping up the implementation of the electrification strategy to realise the goal that 'by 2020, all villages in the Kingdom of Cambodia will have access to electricity'.
- Further supporting the rural electrification fund aimed at achieving equitable electricity access for the population.
- Pursuing rationalisation measures for electricity consumption by reducing power tariffs during off-peak hours.
- Stepping up the exploration and commercialisation of the oil and gas sector which has enormous potential for ensuring energy security and economic development.
- Further strengthening institutional capacity [and] human resources.
- Continuing active involvement in energy cooperation under the regional framework.

With the action plan for the 5-year Power Development Plan (2012–2016), Cambodia aims to reduce the cost of power generation and increase the electrification rate using the following methods:[1]

- Import cheaper electricity from neighbouring countries.
- Build and bring online large-scale hydroelectric, coal-fired, and biomass power generation facilities.
- Improve the transmission network and inter-regional links.
- Expand the power distribution network nationwide.

[1] Based on documents provided by the Ministry of Mines and Energy (November 2014).

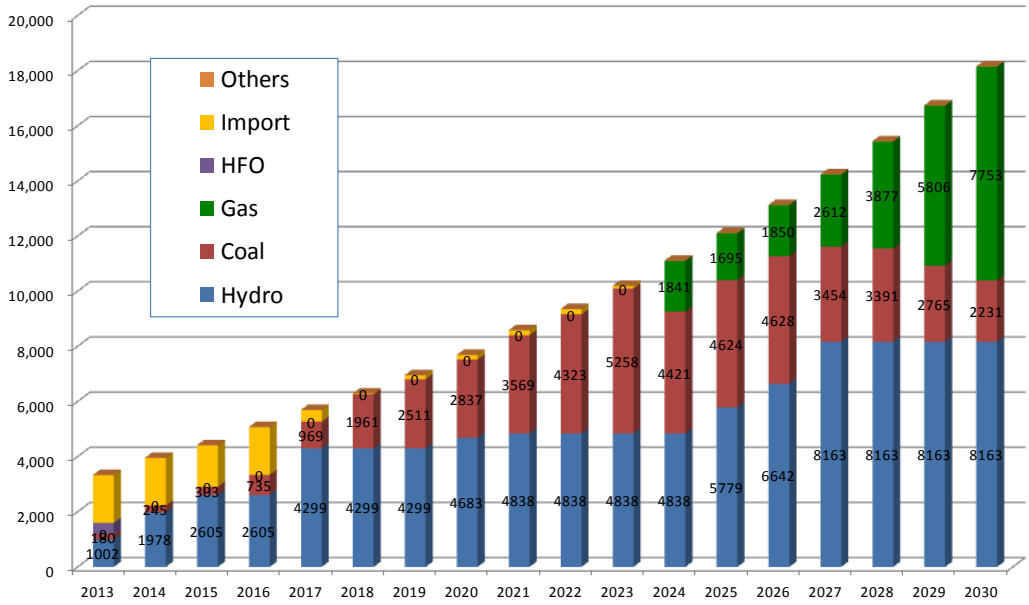
Cambodia's Power Development Plan is currently being implemented in accordance with the Master Plan on Power Sector Development of the Kingdom of Cambodia, which was formulated in 2008 by the state-run Electricité du Cambodge (EDC). The master plan lists the following objectives:

- Increase hydroelectric and coal-fired power generation, in addition to diesel power generation.
- Establish a power grid with links throughout Cambodia.
- Electrify outlying regions.
- Discuss an electricity trading scheme with Viet Nam, Thailand, the Lao PDR, and other ASEAN member states.
- Promote commercialisation and injection of private capital.
- Formulate policies for competition and regulatory measures in the electricity market.

Having reached 691.72 megawatts (MW) in 2013 and 805.84 MW in 2014, the maximum power demand in Cambodia continues to increase year after year. Meanwhile, although the supply capacity accounts for 1,986 MW in 2015, half of that came from hydroelectric power, and facility usage rates remained under 50 percent. According to the Master Plan on Power Sector Development of the Kingdom of Cambodia, the Cambodian government plans to diversify and expand the power mix, after which time it will improve transmission infrastructure. By doing this, it aims to move away from its current over-reliance on imports, so that by 2030 gas will account for half of the electricity supply, hydroelectric power and coal will account for the rest, and the electrification rate will reach 70 percent.

Figure 2-2: Prospective Energy Supply Mix in Cambodia

(Unit:MW)



HFO = heavy fuel oil.

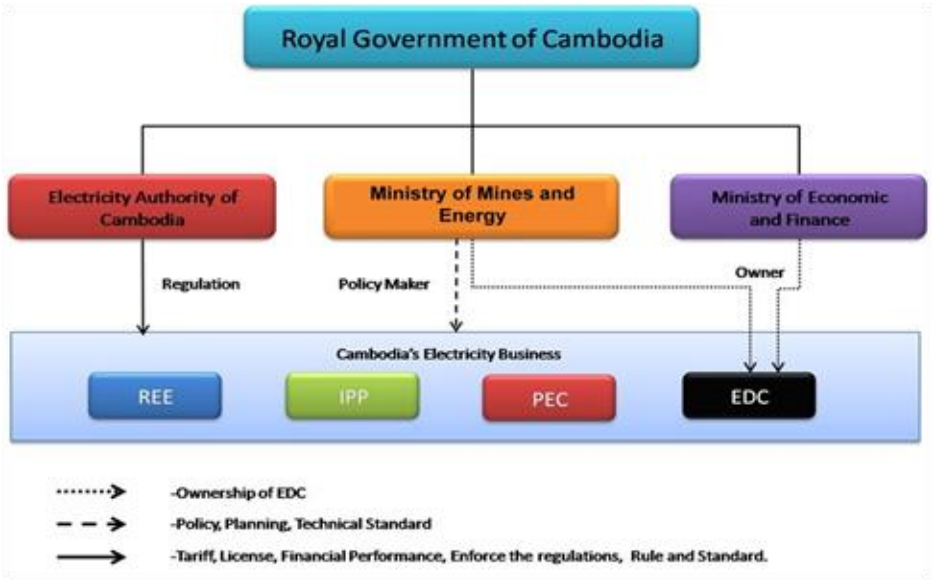
Source: Ministry of Mines and Energy, Cambodia.

2.2 Electric Power Market Structure

a. Market structure

Jurisdiction over Cambodia's electricity sector belongs to the MME and the Electricity Authority of Cambodia (EAC). Electric utilities include EDC, public power companies, IPPs, and private sector/regional utilities.

Figure 2-3: Electric Power Market Structure in Cambodia



EDC = Electricité du Cambodge, IPP = independent power producer, PEC = Provincial Electricity Company, REE = rural electricity enterprise.

Source: Ministry of Mines and Energy, Cambodia.

The electrification rate in Cambodia is currently around 55.37 percent, which covers 1.76 million of the total of 3.18 million households, with supplies concentrated primarily in the national and provincial capitals. In addition to electricity provided by EDC and IPPs, electricity for major cities is imported from neighbouring countries. Private sector utilities and the Department of Mines and Energy (DME) supply electricity in regions outside of EDC's supply area.

Meanwhile, the role of IPPs in power generation is significant. EDC accounts for 6.4 percent of the country's total power facility capacity in 2013, while IPPs account for 88.5 percent (EAC, 2014). In Phnom Penh and other major cities, EDC supplies power in the form of electricity it generates itself or imports from IPPs and neighbouring countries, but off-grid distribution outside of the major cities is handled by rural electricity enterprises (REEs).

b. Deregulation

Cambodia is currently working on infrastructure improvements to encourage more private and foreign investment with the aim of expanding the electricity supply. The government has enacted a raft of laws, including the Law on Investment of 1994, to provide incentives for investment. It has stated that competitive bidding should be adopted in the electricity sector (with particular emphasis on unelectrified areas) (The Electric Power Industry in Japan, 2014).

Although there are no restrictions on the introduction of foreign capital, all enterprises, be they foreign or domestic, must obtain a licence from EAC to enter the electricity utility business. There are eight types of licences depending on the type of business: generation, transmission, distribution, consolidated (generation + distribution), dispatch, bulk, retail, and subcontract (Japan External Trade Organization, 2015a).

c. Mechanism of policy implementation

Power development by EDC, the state-run utility, directly reflects the government's electric power mix targets.

Meanwhile, power development by IPPs complies with the government's electric power mix targets since licensing serves as a form of indirect management. In other words, since IPPs need licences from the government, the government checks that their business plans are in compliance with the electric power mix targets during the licence screening process. If an IPP's business plan does not comply with the targets, the government may decide not to issue a licence.

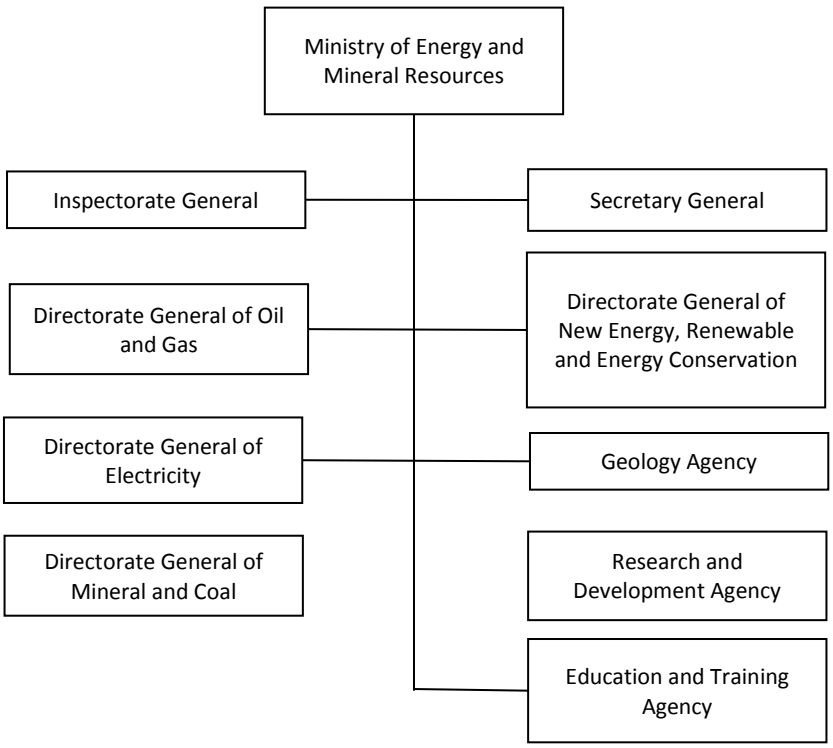
3. Indonesia

3.1 Electric Power Policy

Indonesia formulates basic energy policies and plans in accordance with its Energy Law, which went into effect in August 2007. The Energy Law mandated the establishment of the National Energy Council (Dewan Energi Nasional (DEN)), encouraged the development of resources, and emphasised the procurement of energy from domestic sources, among other things. In accordance with the Energy Law, DEN is in charge of formulating the National Energy Policy

(Kebijakan Energi Nasional (KEN)), while the Ministry of Energy and Mineral Resources (MEMR or ESDM) is responsible for formulating and implementing individual energy and mineral resource policies.

Figure 2-4: Structure of the Ministry of Energy and Mineral Resources in Indonesia



Source: Ministry of Energy and Mineral Resources, Indonesia.

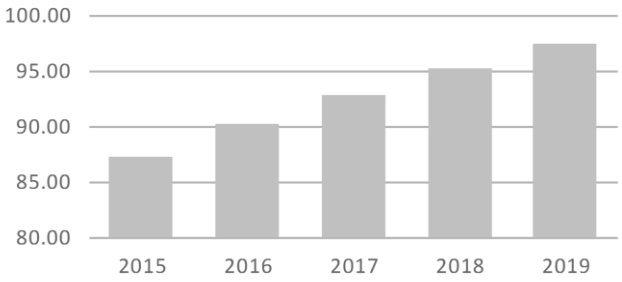
With regard to power development planning, MEMR has formulated the General National Power Plan (Rencana Umum Ketenagalistrikan Nasional (RUKN)), a comprehensive 20-year plan based on its energy and environmental policies, and Perusahaan Listrik Negara (PLN), a wholly-owned subsidiary of the government, has formulated a more detailed 10-year Electrical Power Supply Plan (Rencana Umum Penyediaan Tenaga Listrik (RUPTL)) (Japan Electric Power Information Center, 2011a).

RUPTL 2011–2020, the power development plan for 2011–2020, forecasts that electricity demand will increase at an annual average of 8.5 percent during that timeframe. The plan anticipates that not only will electricity demand continue to increase on the Java and Bali grids,

but it will also grow at an average annual rate of 10.8 percent in the poorly electrified regions of eastern and western Indonesia. To satisfy this demand, it will be absolutely essential for Indonesia to expand and reinforce equipment for power generation, transmission, and distribution. For this reason, the Government of Indonesia has released a plan to add 35 gigawatts (GW) of power over the 5-year span of 2015–2019.

Figure 2-5: Electrification Rate Plan in Indonesia

(Unit:%)



Source: Ministry of Energy and Mineral Resources, Indonesia.

Table 2-2: 35 GW Electricity Programme in Indonesia

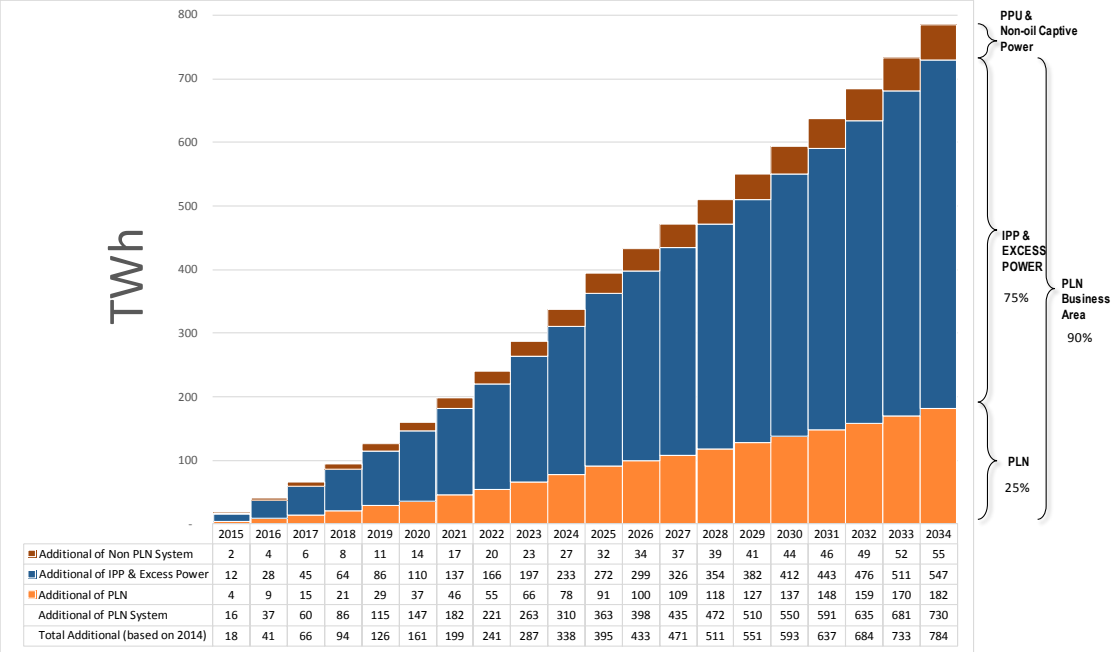
(GW)

source	2016	2017	2018	2019	Total	Percentage
Coal	–	–	3.8	16.2	20.0	56%
Geothermal	–	0.1	0.3	0.4	0.8	2%
Hydro	–	–	0.1	1.4	1.5	4%
Gas	2.2	5.3	4.5	0.8	12.8	36%
Others	–	0.4	0.2	0.2	0.8	2%
Total	2.3	5.8	8.8	19.0	35.9	100%

GW = gigawatt.
Source: Agency of Natural Resources and Energy, Indonesia.

Furthermore, in the draft version of RUPTL 2015–2034, the power development plan for 2015–2034, the government aims to add approximately 780 terrawatt-hours (TWh) of power supply capacity by 2034, of which 75 percent will be covered by IPPs.

Figure 2-6: Electricity Supply Prospects in RUPTL 2015–2034 in Indonesia



	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Additional of Non PLN System	2	4	6	8	11	14	17	20	23	27	32	34	37	39	41	44	46	49	52	55
Additional of IPP & Excess Power	12	28	45	64	86	110	137	166	197	233	272	299	326	354	382	412	443	476	511	547
Additional of PLN	4	9	15	21	29	37	46	55	66	78	91	100	109	118	127	137	148	159	170	182
Additional of PLN System	16	37	60	86	115	147	182	221	263	310	363	398	435	472	510	550	591	635	681	730
Total Additional (based on 2014)	18	41	66	94	126	161	199	241	287	338	395	433	471	511	551	593	637	684	733	784

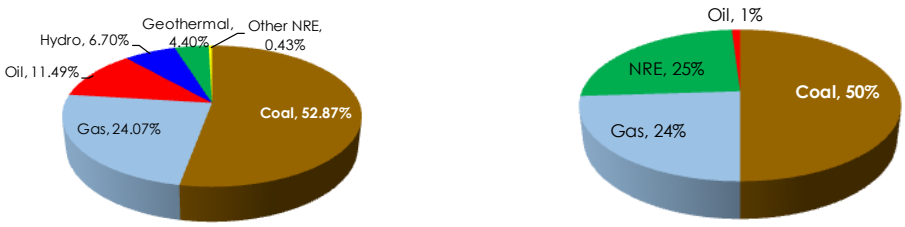
IPP = independent power producer, PLN = Perusahaan Listrik Negara, PPU = private power utility, RUPTL = Electrical Power Supply Plan (Rencana Umum Penyediaan Tenaga Listrik), TWh = terawatt-hour.

Source: Ministry of Energy and Mineral Resources, Indonesia.

Looking at the power development plans for 2025 for each type of generation, coal will account for 352 TWh, or 50 percent of the total power supply capacity of 703 TWh, with renewable energy accounting for 176 TWh (25 percent), gas for 169 TWh (24 percent), and oil for 7 TWh (1 percent).

Figure 2-7: Prospective Power Generation Mix in 2025 in Indonesia

(kWh basis, left: actual in 2014, right: target in 2025)



kWh = kilowatt-hour, NRE = non-renewable energy.
Source: Ministry of Energy and Mineral Resources, Indonesia (2015).

With regard to renewable energy, hydroelectric power has great potential, but development issues abound. For instance, while the demand is greatest on Java, all of the optimal areas for hydroelectric power stations are located on Papua and other outlying islands, which would make the cost of transmitting electricity to the areas with the highest demand more expensive.

3.2. Electric Power Market Structure

a. Market structure

At present, the structure of the electric utility industry is such that PLN, a wholly-owned subsidiary of the government, and its subsidiary companies handle generation along with some IPPs, but PLN has a monopoly over power transmission and distribution. PLN is working to split into separate companies and separate the duties of the supply and distribution divisions. It has established a power generation subsidiary and a subsidiary in charge of power transmission and distribution for designated development zones. By organising its internal workings into a system of business units, PLN has successfully become able to run operations with a focus on the profitability of each unit. In Java and Bali, where operations are the most extensive, power generation is handled by two subsidiaries.

b. Deregulation

To meet the demand for electricity that has been skyrocketing since the late 1980s, Indonesia began allowing IPPs into the electricity sector in 1992.

In August 1998, in an effort to open up the electricity market to competition, make the industry more transparent, and facilitate the entry of private enterprises, the Indonesian government announced a plan for structural reforms that would divide PLN into regional and functional units. In the draft version of the new Electricity Law, which aimed to deregulate the electric power sector and introduce competition into power generation, central and regional governments were granted authority to issue permits for electricity businesses under the supervision of the central government. The proposed law was ratified by the legislature in September 2009, thereby opening up PLN's monopoly on the electrical utility business to new players.

According to the Business Plan for Electricity Provision published in 2015, Indonesia aims for IPPs to account for 75 percent of all power providers by 2034. Furthermore, MEMR Regulation 01/2015 made the opening of the transmission network mandatory.

c. Mechanism of policy implementation

Power development by PLN, the state-run utility, directly reflects the government's electric power mix targets.

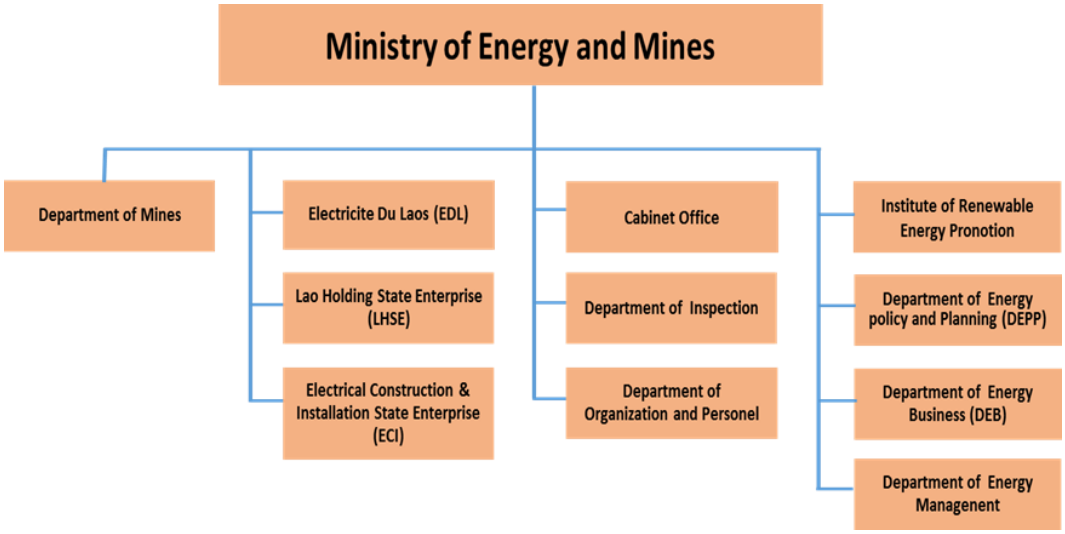
PLN also solicits applications from new IPPs, but IPP categories are not proposed by the enterprises themselves; rather, they are set by PLN according to the government's electric power mix targets. (This is called direct appointment and direct selection.) In other words, all power development complies with the government's electric power mix targets.

4. Lao PDR

4.1. Electric Power Policy

The Ministry of Energy and Mines (MEM) has jurisdiction over energy policy, strategy, and the management of the energy and mining sectors in the Lao PDR.

Figure 2-8: Structure of the Ministry of Energy and Mines in the Lao PDR



Lao PDR = Lao People's Democratic Republic.

Source: Electricite du Laos.

The Lao PDR defines the electric power sector as an important element of the economy and has presented the following energy policy (Sithideth, 2011):

- Maintain and expand power supply with economic efficiency, reliability, and sustainability in order to promote economic and social development.
- Promote electric power development and expand electricity export in order to secure finances that are targeted by the government.
- Develop and strengthen laws and regulations in order to make the development of electricity sector effective through the government, the private sector, or partnership between the public and the private sector.
- Increase the nation's capabilities while developing international standard techniques, know-how, and experiences.
- Achieve sustainable development by identifying impacts and responsibilities against society and environment.

The following concrete policy direction for the electric power sector is listed in the 2030 vision:

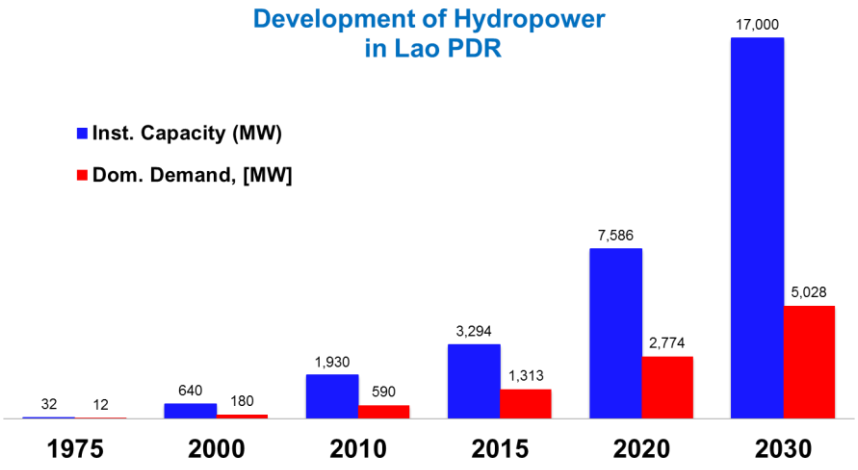
- Increase the electrification rate to 98 percent of all households by maintaining affordable cost.
- Develop all possible latent resources through competition, sustainability, and efficiency.
- Strengthen the domestic transmission network to improve inter-regional links.
- Ensure a reliable supply of electricity to all sectors in accordance with industrialisation and modernisation policies.

Furthermore, the government has indicated the following strategic power development initiatives for 2025:

- Develop all renewable energy and all hydroelectric power as soon as possible; promote the development of renewable energy projects. (By 2020, account for at least 25 percent of domestic power consumption with small-scale (under 15 MW) hydroelectric, biogas, biomass, and wind power generation facilities.)
- Develop over 12,000 MW of energy primarily from hydroelectric power.
- Supply sufficient amounts of electricity domestically at reasonable rates.
- Ensure a steady and reliable supply of electricity.
- Build 500-kilovolt (kV) back-born transmission lines connecting the north and the south; build control centres in the northern and southern regions.
- Promote cross-border power grid integration in the Greater Mekong Subregion (GMS) and ASEAN Power Grid (APG) with ASEAN member states.
- Implement a multifaceted electricity trade scheme with Thailand, Malaysia, and Singapore.

Meanwhile, in addition to hydroelectric power, the country's mainstay, plans are in the works to bring online 600 MW of wind power and 500 MW of solar power.

Figure 2-9: Development of Hydroelectric Power in the Lao PDR

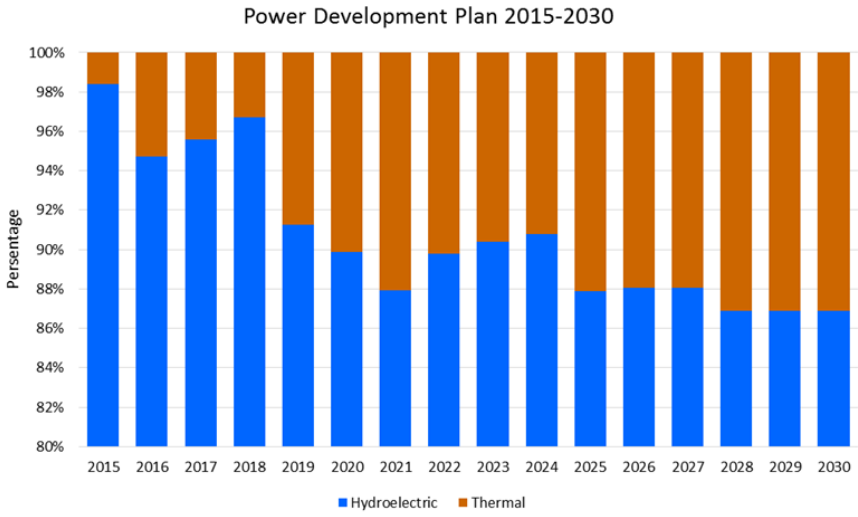


Lao PDR = Lao People's Democratic Republic, MW = megawatt. Installed Capacity (MW)

Domestic Demand (MW)

Source: Electricite du Laos.

Figure 2-10: Prospective Power Generation Mix in 2015–2030 in the Lao PDR



Lao PDR = Lao People's Democratic Republic.

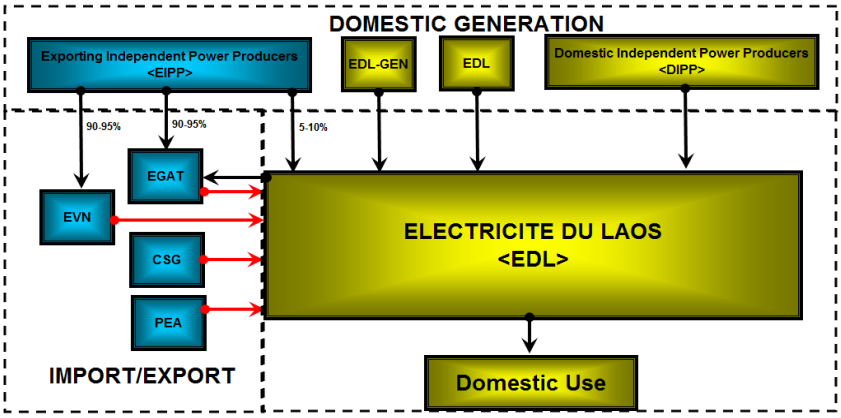
Source: Electricite du Laos.

4.2 Electric Power Market Structure

a. Market structure

The state-run Electricite du Laos (EDL) is a wholly-owned government subsidiary under the jurisdiction of MEM that handles all domestic power generation, transmission, and distribution on the primary grids in the country. While EDL exports some of its excess capacity to Thailand, it also imports electricity from Thailand, China, and Viet Nam for some of those areas that are not connected to the transmission grid. In addition to owning the hydroelectric power stations in the Lao PDR, EDL also holds shares in existing IPPs, among other investments.

Figure 2-11: Present Structure of the Energy Supply Industry in the Lao PDR



CSG = China Southern Power Grid, EGAT = Electricity Generating Authority of Thailand, EVN = Vietnam Electricity, Lao PDR = Lao People's Democratic Republic, PEA = Provincial Electricity Authority (Thailand).

Source: Electricite du Laos.

b. Deregulation

The Government of the Lao PDR permits the investment of private capital in electricity generation (i.e., hydroelectric generation by IPPs) by way of BOT and BOOT projects.[2] In many cases where IPPs develop power, electricity equipment is transferred to the government after

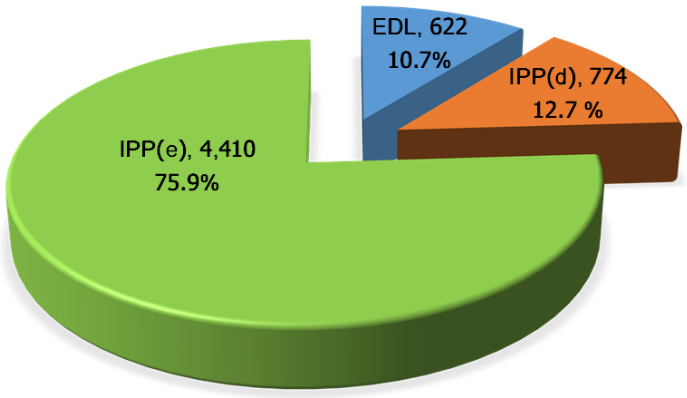
[2] BOT stands for 'build-operate-transfer' and refers to a financing scheme in which a private enterprise is contracted to build and operate a facility before transferring it back to the public sector after a certain period of time. Meanwhile, BOOT stands for 'build-own-operate-transfer'.

a span of 20–30 years. However, EDL holds a monopoly over power transmission and distribution.

Although there are almost no obstacles barring foreign investment, the Electricity Law that was revised in 2011 includes language barring foreign capital injections into small-scale (under 15 MW) hydroelectric power projects (Japan External Trade Organization, 2015b).

Looking at power generation capacity ratios in 2015, the IPP(e) share (IPP for export) was at 75.9 percent and IPP(d) (IPP for domestic) at 12.7 percent, followed by EDL-GEN, which is a functional subsidiary of EDL, at 10.7 percent and small-scale power generators at 0.1 percent (*Electricite du Laos,* 2015).

Figure 2-12: Structure of Power Generation in the Lao PDR



EDL = Electricite du Laos, IPP(e) = independent power producer for export, IPP(d) = independent power producer for domestic, Lao PDR = Lao People's Democratic Republic.
Source: Electricite du Laos.

c. Mechanism of policy implementation

Power development by EDL, the state-run utility, directly reflects the government's electric power mix targets.

Since IPPs need licences from the government, the government checks that their business plans are in compliance with the electric power mix targets during the licence screening process. If an IPP's business plan does not comply with the targets, the government will not issue a licence.

5. Malaysia

5.1 Electric Power Policy

Malaysia's energy policy is overseen by the Energy Section of the Economic Planning Unit (EPU), one of the organisations under the direct jurisdiction of the Office of the Prime Minister, the highest decision making body in the country. The primary roles of the section are as follows:[3]

- Formulate policies and strategies for the sustainable development of the energy sector.
- Promote the development of oil and gas industries.
- Ensure an adequate, secure, quality, and cost-effective supply of energy.
- Promote the increased utilisation of renewable energy and energy efficiency in the energy sector.
- Provide allocation for energy-related development programmes and evaluate their achievements.

Malaysia's energy policy is stipulated in the National Energy Policy and it calls for the steady supply of energy resources at reasonable rates to the domestic market for the sake of ensuring sustainable growth. To do this, the Government of Malaysia has formulated the following three basic plans to serve as guidelines for its energy policy:[4]

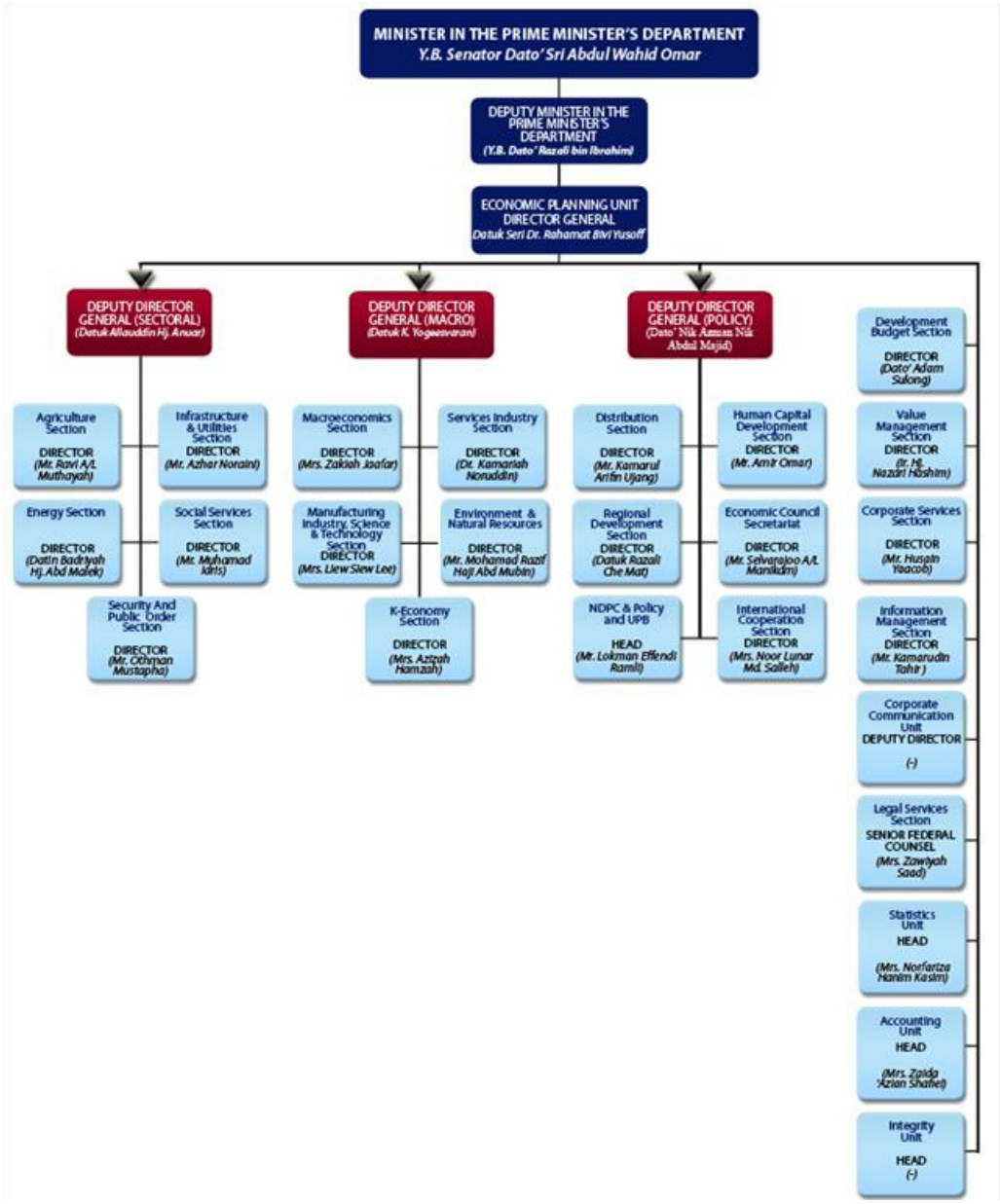
1. The Supply Objective: To ensure adequate, secure, and cost-effective energy supply by developing alternative sources of energy (both non-renewable and renewable) and diversifying the energy supply within and outside the country.
2. The Utilisation Objective: To promote the efficient utilisation of energy and discourage wasteful and non-productive patterns of energy consumption.

[3] Taken from the Economic Planning Unit homepage (http://www.epu.gov.my/).

[4] Taken from the Ministry of Energy, Green Technology and Water (MEGTW) homepage (http://www.kettha.gov.my/portal/index.php)

3. The Environmental Objective: To minimise the negative environmental impacts on the energy supply chain, i.e. energy production, transportation, conversion, and consumption.

Figure 2-13: Structure of the Economic Planning Unit in Malaysia



Source: Economic Planning Unit homepage as of 1 September 2015.

In the 11th Malaysia Plan 2016–2020 released in May 2015, the Government of Malaysia defines the following six key strategic thrusts with the aim of transitioning to an advanced economy by 2020 (EPU, 2015):

1. Enhancing inclusiveness towards an equitable society
2. Improving well-being for all
3. Accelerating human capital development for an advanced nation
4. Pursuing green technology growth for sustainability and resilience
5. Strengthening infrastructure to support economic expansion
6. Re-engineering economic growth for greater prosperity

With regard to pursuing green technology growth, Malaysia has set a goal to reduce CO_2 emissions per unit of GDP to 40 percent of 2005 levels by 2020 and has laid out the following four policy measures (IEEJ, 2015):

1. Formulate a demand side management master plan and expand demand side management in buildings and the industrial and residential sectors.
2. Set the green procurement rate for government agencies at 20 percent
3. Boost power generation capacity via renewable energy from 243 MW in 2014 to 2,080 MW in 2020.
4. Set the household recycling rate at 22 percent.

In addition to these measures, the following initiatives have also been planned:

- Encourage the acquisition of eco-friendly building certification and strengthen the assessment system thereof.
- Expand the MyHIJAU labelling programme (for products manufactured in an eco-friendly manner).

- Use a carbon tax, green bonds, REDD+, and other tools to build a green financing scheme.
- Promote low-carbon mobility, in particular the use of highly efficient automobiles, compressed natural gas (CNG), and biofuel.
- Raise the biodiesel blend mandate from 7 percent to 15 percent.
- Adopt the Euro5 standards for emissions.

5.2. Electric Power Market Structure

a. Market structure

In Peninsular Malaysia and the states of Sabah and Sarawak, three vertically integrated companies – Tenaga National Berhad (TNB), Sabah Electricity Sdn. Bhd. (SESB), and Syarikat SESCO Berhad (SESCO) – respectively operate as regional monopolies. In addition, there exist several IPPs licensed by the Energy Commission (EC).

b. Deregulation

In the power generation sector, private investment was deemed essential to respond to rapidly increasing electricity demand, so an IPP scheme was adopted; the first electricity purchase agreement with an IPP was signed in 1993.

In 2001, the government decided to cease efforts to unbundle vertically integrated enterprises and fully liberalise the electricity market due in part to the effect of the energy crisis that occurred in California (USA) in 2000 (Japan Electric Power Information Center, 2011b).

c. Mechanism of policy implementation

Power development by TNB, a state-run utility, directly reflects the government's electric power mix targets.

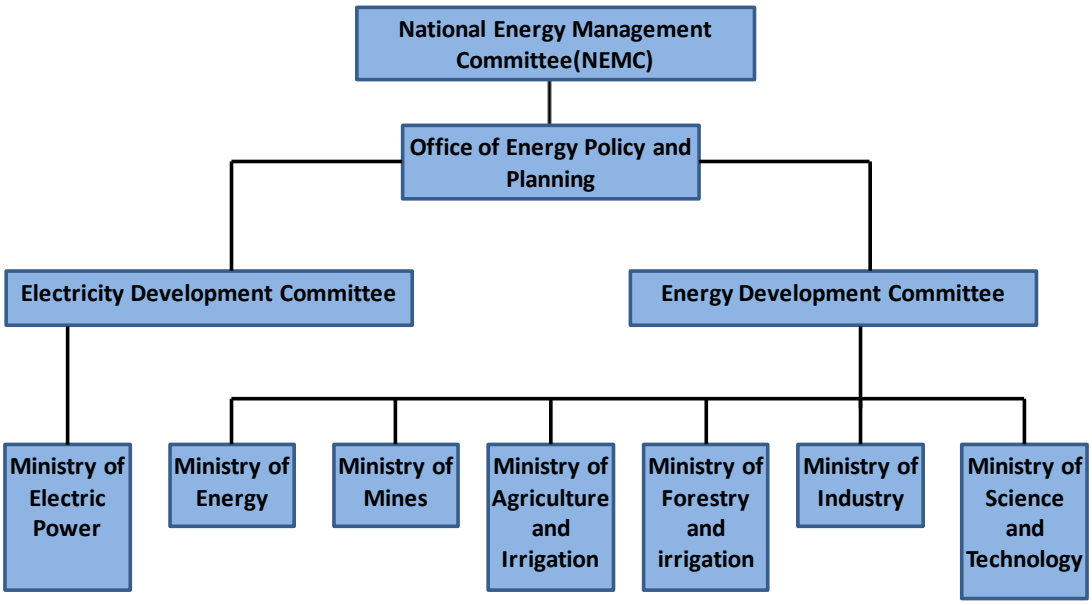
The power generation sector has been liberalised to allow the entry of IPPs, but they must obtain licences from the government to operate. This process allows the government to manage the selection of power sources to ensure compliance with its electric power mix targets. If an IPP's business plan does not comply with the targets, the government will not issue a licence.

6. Myanmar

6.1. Electric Power Policy

The National Energy Management Committee, which was newly established in January 2013, oversees the entire energy sector in Myanmar. The Energy Planning Department in the Ministry of Energy (MOE) formulates energy policies as well as oil and gas development policies and plans, while MOE has jurisdiction over Myanmar's oil and gas industry. The Ministry of Electric Power (MOEP) has jurisdiction over electricity businesses.

Figure 2-14: Regulatory Framework of the Energy Sector in Myanmar



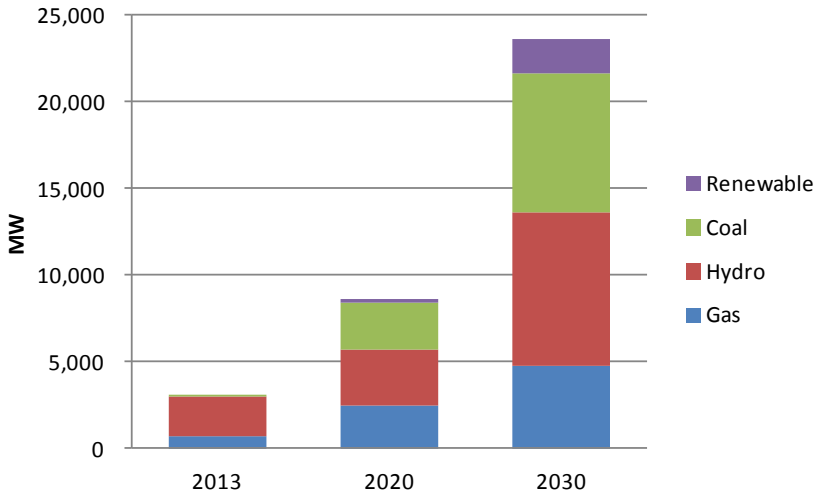
Source: Wint Thiri Swe (2013), country report presentation for JICA Energy Policy Training Course, 24 June–12 July.

Myanmar's energy policy covers the following seven points:

1. Engage in sustainable energy development.
2. Promote the wide-ranging usage of renewable energy.
3. Encourage energy efficiency.
4. Promote the usage of alternative fuels in the residential sector.
5. Prioritise the response to domestic energy demand.
6. Effectively utilise oil and natural gas in such a way that benefits all citizens.
7. Encourage the participation of private companies.

The power supply mix in 2013 saw gas-fired power accounting for 715 MW (or 23percent of all generation capacity), hydroelectric for 2,259MW (73 percent), and coal for 120 MW (4 percent). However, Myanmar aims to adjust this composition to 29 percent gas-fired (2,484 MW), 32 percent hydroelectric (3,164 MW), 37 percent coal (2,760 MW), and 2 percent renewable energy (200 MW) by 2020, and further still to 20 percent gas-fired (4,758 MW), 33 percent coal (7,940 MW), 6 percent large-scale hydroelectric (1,412 MW), 32 percent small-scale hydroelectric (7,484 MW), and 9 percent renewable energy (2,000 MW) by 2030.

Figure 2-15: Electricity Supply Prospects in Myanmar



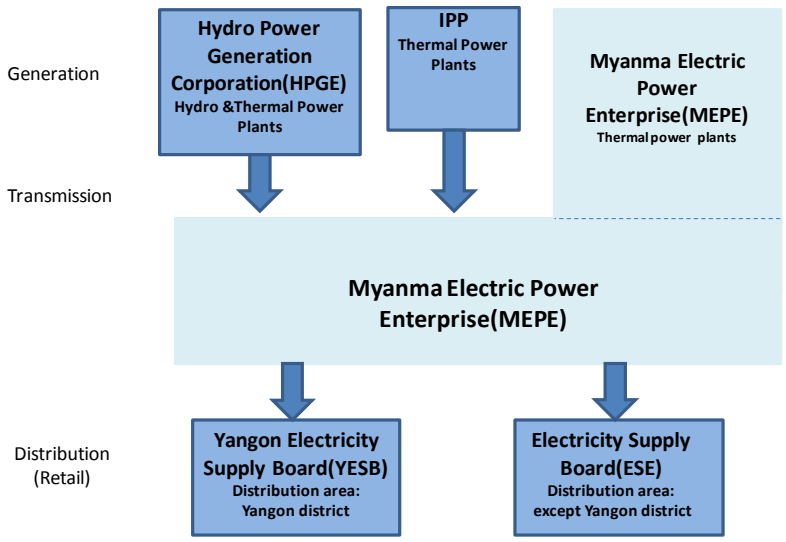
Source: Long-term Energy Master Plan.

6.2. Electric Power Market Structure

a. Market structure

Myanmar's electric utility industry is divided into three businesses: generation, transmission, and distribution. The Ministry of Electric Power No. 1 has jurisdiction over hydroelectric power, from development planning through to generation and operations, while the Ministry of Electric Power No. 2 oversees the construction and operation of thermal power plants as well as the transmission, distribution, and retail sale of electricity.

Figure 2-16: Electric Power Market Structure in Myanmar



Source: Japan Electric Power Information Center.

b. Deregulation

Since revising its Foreign Investment Law in 1994, Myanmar has permitted the injection of private capital into the electric power sector. In the power generation sector, participation in the form of joint ventures and BOT projects is allowed, provided operators obtain a licence from the Myanmar Investment Commission (Murakami, 2012). With low rates and other factors, the initial conditions for investment were not in place, and no companies attempted to forge into the electric power sector. More recently, however, a plan has been conceived for a joint IPP project with Thai and Chinese partners in which hydroelectric power will be

exported (ADB, 2012).[5] Developments are also afoot that could see Japanese companies participating in an IPP project.

c. Mechanism of policy implementation

Given that the Ministry of Electric Power No. 1 and No. 2 oversee all aspects of the electric utility industry in Myanmar, only investment that complies with the government's power development plans is carried out.

IPPs participate in power generation, but they can only do so as joint ventures or BOT projects after having obtained licences from the Myanmar Investment Commission. During the licence screening process, the government checks that IPP business plans are in compliance with its electric power mix targets. If an IPP's business plan does not comply with the targets, the government will not issue a licence.

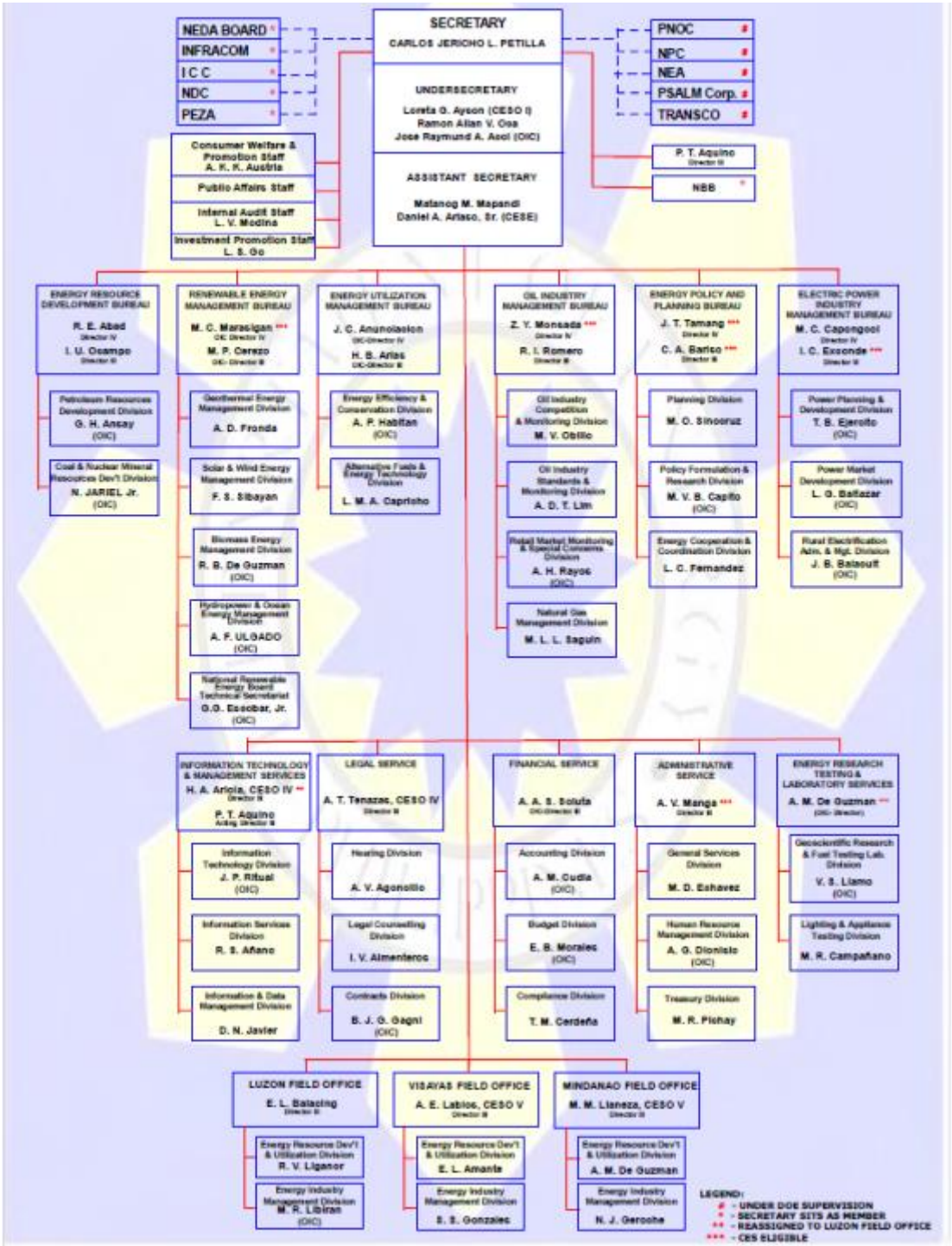
7. The Philippines

7.1. Electric Power Policy

The Department of Energy (DOE) holds jurisdiction over all aspects of energy policy in the Philippines. Its primary activities include the establishment, implementation, and management of DOE plans; the expansion, development, and application of energy sources; and the promotion of energy efficiency. The DOE directs the National Electrification Administration (NEA), which promotes regional electrification programmes, financing related to regional electrification, and the construction of power generation facilities.

[5] Shweli-1 (600 MW, opened in 2009) and Dapein-1 (240 MW, opened in 2011) are already in operation. More recently, however, there have been two successive cases where plans to build large-scale power plants with foreign capital were cancelled. In October 2011, in response to strong opposition from local residents, the government ordered construction to halt on the 4,100 MW Myitsone hydroelectric power plant in Kachin that China Power Investment was working on with its partners in Myanmar, Asia World Corp and Myanmar Electric Power Enterprise. In January 2012, construction was also halted on a Thai-backed 4,000 MW power plant in the Dawei Special Economic Zone.

Figure 2-17: Structure of the Department of Energy in the Philippines



Source: Department of Energy homepage.

In the most recent Philippine Energy Plan (PEP) 2012–2030, issued by the DOE in December 2012, the following seven key policy targets were raised:

1. Ensure energy security.
2. Expand energy access.
3. Promote a low-carbon future:
   - Make energy efficiency a way of life for Filipinos.
   - Promote use of clean alternative fuels and technologies.
4. Climate proof the energy sector.
5. Develop regional energy plans.
6. Promote investment in the energy sector.
7. Identify and implement energy sector reforms.

7.2. Electric Power Market Structure

a. Market structure

Since the Electric Power Industry Reform Act (EPIRA) went into effect in 2001, as regards the business structure in the generation/transmission sector, generation is managed by the state-run National Power Corporation (NPC) and IPPs, while the transmission sector is managed by the National Grid Corporation of Philippines (NGCP). In addition to standard IPPs, there are NPC-IPPs, which sell power through power purchase agreements (PPAs) using existing facilities.

With regard to distribution, there are about 15 private companies headed by the country's largest power company Manila Electric Company (MERALCO), eight regional governments, and approximately 120 small-scale electrification cooperatives (ECs), which are collectively referred to as distribution utilities (DUs). These negotiate transactions with power generation companies and do business with wholesale electricity spot markets (WESMs) to procure power and sell it to customers in their supply areas.

b. Deregulation

Since EPIRA went into effect, power sector reforms have been implemented in the Philippines (o break up and privatise the NPC and improve infrastructure for competition in the power market. As part of these reforms, WESMs were established in both the Luzon and Visayas regions and the Philippines Electricity Market Corporation (PEMC) was established by the DOE to manage them.

c. Mechanism of policy implementation

The state-run NPC has a policy to not conduct new power development except for small-scale power sources for the purpose of regional electrification. This has made private capital investors (i.e. IPPs) the principal power developers.

Meanwhile, power development by IPPs complies with the government's electric power source mix targets since licensing serves as a form of indirect management. In other words, since IPPs need licences from the government, the government checks that their business plans are in compliance with the electric power source mix targets during the licence screening process. If an IPP's business plan does not comply with the targets, the government will decide to not issue a licence.

The government is now in a position where it cannot directly implement power development due to its policies, which aim to increase the efficiency of management of electricity businesses through the introduction of private capital. Therefore, while there are some projects being planned without defined development goals, the necessary facility capacity cannot be secured because the implementation of these projects has been postponed. This has created a need for the government to actively introduce policies to improve the investment environment and promote power development.

8. Singapore

8.1. Electric Power Policy

In Singapore, the Ministry of Trade and Industry (MTI) establishes and implements the country's energy policy. The MTI also supervises 10 governmental institutions (referred to as statutory boards), including the Singapore Department of Statistics and the Energy Market

Authority (EMA), which promotes the deregulation of electric power and gas markets and is the regulatory authority for energy markets.[6]

In November 2007, the national energy strategy, called Energy for Growth, was announced through the cooperation of agencies including the MTI, the EMA, the Economic Development Board, and the Ministry of the Environment and Water Resources. The framework of the strategy covers the following six points:

1. Promote competitive markets.
2. Diversify energy supplies.
3. Improve energy efficiency.
4. Build the energy industry and invest in energy research and development (R&D).
5. Step up international cooperation.
6. Develop a whole-of-government approach.

The strategy calls for the strengthening of Singapore's position as Asia's primary petroleum hub, the expansion of the scope of its energy trade to include liquefied natural gas (LNG), biofuels, and CO_2 emission credits as well as improvements in the field of clean and renewable energies including solar, biofuels, and fuel cells (MTI, 2007).

In April 2009, the Ministry of the Environment and Water Resources and the Ministry of National Development published the Sustainable Development Blueprint, which set goals to reduce energy consumption per GDP by 20 percent from 2005 levels by 2020 and by 35 percent by 2030. In addition, the plan incorporated an improvement of the waste recycling rate to 70 percent by 2030, as well as reductions in water consumption.[7] In support of this plan, the Energy Conservation Act was implemented in June 2012.

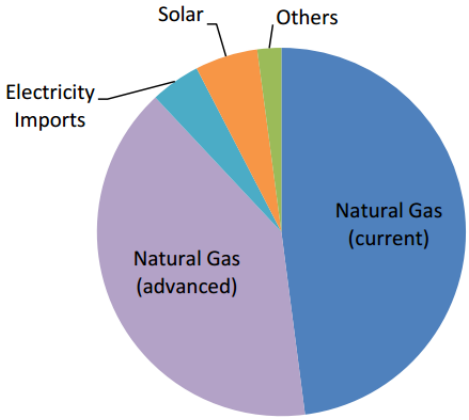
Moreover, the government has pledged that Singapore's GHG emissions will peak around 2030 at the equivalent of about 65 million tonnes of CO_2, even if the economy continues to grow after that year. The country will also become more efficient in its economic activity and reduce the amount of GHGs emitted to achieve each dollar of GDP.

[6] See MTI web page: http://www.mti.gov.sg/AboutMTI/Pages/Statutory-Boards.aspx
[7] See MEWR web page: https://www.nccs.gov.sg/sites/nccs/files/Sustainable_Spore_Blueprint.pdf

Furthermore, the *Sustainable Singapore Blueprint 2015* was published in November 2014. This revises the *Sustainable Development Blueprint* published in 2009 and adds analysis of progress in regards to the plan as of 2013, while setting new goals for initiatives that had already met existing targets[8].

According to energy source mix predictions for 2021 recently published by the government, Singapore plans to have almost half of its energy supplied by conventional, current thermal sources; another almost half by innovative, advanced gas thermal sources; and the remainder by solar power and electricity imports.

Figure 2-18: Electricity Supply Mix Prospects in Singapore



Source: Energy Market Authority 2015.

8.2. Electric Power Market Structure

a. Market structure

In Singapore, the control of the competitive fields of generation and retail are kept separate from the non-competitive fields of transmission and distribution. The companies SP Power Grid and SP Power Assets have exclusive permission for their business activities in the areas of transmission and distribution, and they manage and maintain the distribution network. Retailers procure electricity from the competitive wholesale power market and then supply it to contestable customers under contractual terms. Another company, SP Services, has a

[8] See MEWR web page: http://www.mewr.gov.sg/ssb/

monopoly to supply power to non-contestable customers, and it also acts as a market support services provider, performing changes of providers for customers as well as meter reading.

Table 2-3: Supply Side Players in Singapore

Market Participant	Registered Capacity (MW)	Market Share (%)
Senoko Energy	3,300	27.4%
YTL Power Seraya	3,100	25.8%
Tuas Power Generation	2,040	17.0%
Keppel Merlimau Cogen	1,310	10.9%
Sembcorp Cogen	785	6.5%
Exxonmobile Asia Pacific	220	1.8%
National Environment Agenc	180	1.5%
Others	1,096	9.1%
Total	12,031	100%

Source: Energy Market Company, 2015.

Government institutions regulate the energy market and private enterprises participate in power generation and retail in line with applicable regulations. Private enterprises also set their prices and formulate infrastructure investment strategies according to policies announced by the government. Prices are set with an emphasis on multifaceted analyses that take into account supply and demand, market conditions, and regulations, which creates a need for appropriate price controls from the market operator. This is achieved by introducing price caps and by investigating price spikes happening in the market.

In recent years, futures trading markets have been established, bringing with them trends of loosening restrictions on power supply contracts and increasing the number of choices available to customers.

b. Deregulation

As of 2016, Singapore's electricity market is in an advanced liberalisation stage. Deregulation began in October 1995, when the government privatised the power company sector to promote market competition in the areas of power generation, transmission, and distribution. Three power generating companies (Tuas Power, Senoko Energy, and Power Seraya), a

transmission and distribution company (PowerGrid, which later became SP PowerGrid and SP Power Assets), and a retail company (PowerSupply, which later became SP Services) were established. At the same time, Singapore Power[9] was established as a holding company for the four companies excluding Tuas Power.

In March 2000, as part of a policy push to further relax regulations for power companies, deregulation of the power retail market was enacted. In the first phase, deregulation for 5,000 large-scale (average monthly usage of 20,000 kWh or more) industrial and commercial users was completed by March 2009. In the second phase, deregulation began for 5,000 consumers with an average monthly usage of 10,000 kWh or more in December 2009. Combining the first and second phases represents the deregulation of 75 percent of the total electricity demand. Deregulation for the remaining 25 percent of consumers (approximately 1.3 million) has proceeded for users of over 8,000 kWh from April 2014, and for users of over 4,000 kWh from October 2014. With complete deregulation in mind, users of over 2,000 kWh were included in July 2015 (EMA, 2014b). Full retail contestability could be achieved in 2018. Transmission and distribution networks are exclusively maintained by SP Power Assets as a non-competitive sector.

Since January 2003, all power transactions have been carried out through the Energy Market Company (EMC).[10] In October 2014, EMC became a wholly-owned subsidiary of the Singapore Exchange (SGX). The SGX uses EMC's trading platform to provide market participants with improved services with the goal of being the price-determining centre for power and gas in the Asian market (EMA, 2014a).

Some challenges currently facing the domestic power market are that supplied power exceeds demand by approximately 50 percent, that stagnant gas prices are destabilising electricity prices, which in turn is delaying investment recovery, that power companies do not desire any additional competition, that the solar power generation sector is growing rapidly and increases competition for gas-fired generators, and that customers are beginning to participate in the market by going off-grid, making further market controls more difficult to implement.

[9] Singapore Power is itself a holding company of Power Gas, which is under the control of the state-run Temasek Holdings.

[10] A joint venture company between EMA and M-co of New Zealand. (*Energy Asia*, 2003)

c. Mechanism of policy implementation

Singapore's power generation sector has been deregulated, with a market monitoring authority managing fair competition and the supply of power, but a government body continues to manage regulation such as the granting of business licences. Since power companies need licences from the government, the government checks that their business plans are in compliance with the electric power mix targets during the licence screening process. If their business plan does not comply with the targets, the government may decide to not issue a licence.

The following issues would remain even in the completely deregulated market:

- An excess of supplied power by gas-fired generators.
- Unstable wholesale power prices raise risks for new investors in the power generation sector.
- Many businesses in the generation sector do not want any additional competition
- The anticipated growth of solar power generation beyond 350 MW in 2020 can make controlling the market more difficult, because solar power is variable in output.
- The policy mechanism on integrating solar capacity beyond 600 MW has not yet been made public.

9. Thailand

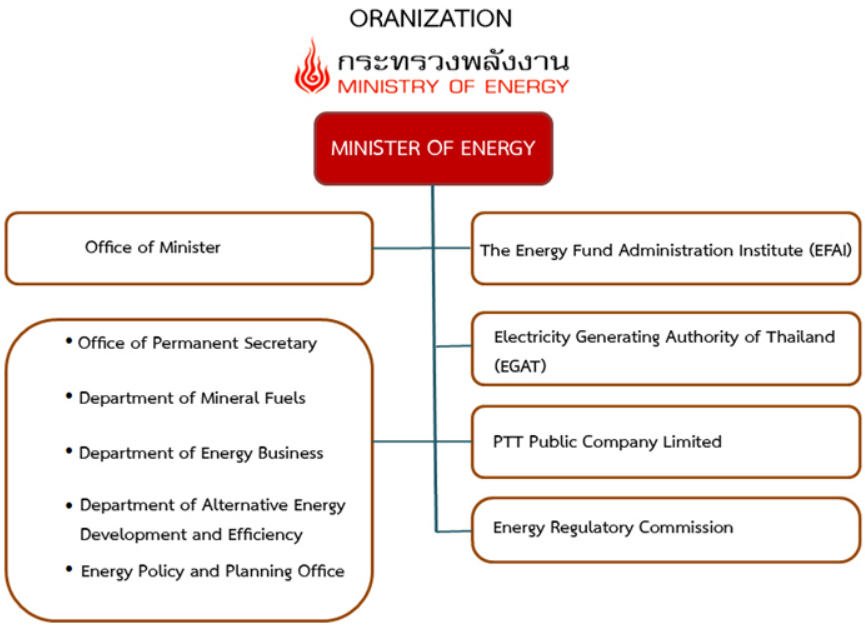
9.1. Electric Power Policy

The Ministry of Energy (MOE) manages the national energy policy. There are four divisions within MOE:

- Energy Policy and Planning Office (EPPO): Monitors energy supply and demand, establishes, implements, and evaluates energy policies, and coordinates policy making with related institutions. Also manages an 'Oil Fund' intended to stabilise prices and prevent domestic energy shortages.

- Department of Mineral Fuels: Holds jurisdiction over domestic petroleum and gas upstream sectors, and performs contract work for mining and development.
- Department of Energy Business: Has jurisdiction over energy businesses, and supervises related transactional, quality, safety, and environmental matters.
- Department of Alternative Energy Development and Efficiency: Has jurisdiction over regulations for energy efficiency and conservation as well as R&D of alternative energy sources.

Figure 2-19: Structure of the Ministry of Energy in Thailand



Source: Ministry of Energy.

The Government of Thailand aims to manage sustainable energy in order to secure the energy needs of the country. Specifically, they are striving to improve the country's self-sufficiency through the development of energy resources; the encouragement of the production and application of alternative energies; the monitoring and management of appropriate, stable energy prices and the efficient use of energy; and the development and application of environmentally friendly energy sources.

The Electricity Generating Authority of Thailand (EGAT) carries out power development planning, and their new power development plan, the Thailand Power Development Plan (PDP2015), was approved by the National Energy Policy Council in May 2015.

The three major criteria of the plan are as follows:

1. Security: Improve the security of power sources in the generation, transmission, and distribution sectors; diversify fuel sources to lower dependence on natural gas.
2. Economy: Supply power to all consumers at reasonable prices, most notably to support long-term growth.
3. Ecology: Alleviate environmental and social impacts in order to realise sustainable development.

PDP2015 includes the goal of expanding domestic power generation capacity, including power imports, from 37,612 MW in 2014 to 70,335 MW by 2036. The plan includes goals for the composition of primary sources of power generation in 2036 set to 30-40 percent natural gas (64 percent in 2014), 20–25 percent coal (20 percent in 2014), 15–20 percent hydroelectric power (7 percent in 2014), and 15–20 percent renewable energy (8 percent in 2014). The increase in the proportion of hydro and renewable energy is intended to reduce dependence on natural gas.

Table. 2-4: Prospective Power Generation Mix in the 2015 Power Development Plan in Thailand

Fuel types	As of Sep 2014 (%)	2026 (%)	2036 (%)
Imported Hydro Power	7	10–15	15–20
Coal & Lignite	20	20–25	20–25
Renewable	8	10–20	15–20
Natural gas	64	45–50	30–40
Nuclear	–	–	0–5
Diesel/Heavy oil	1	–	–

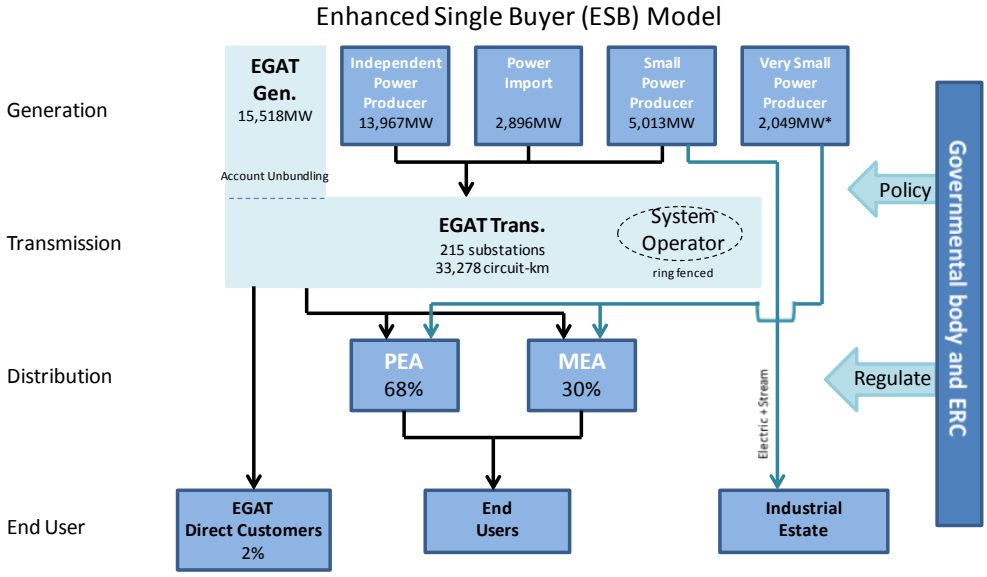
Source: Electricity Generating Authority of Thailand.

9.2. Electric Power Market Structure

a. Market structure

EGAT purchases power from IPPs and small power producers (SPPs) and from neighbouring countries (Lao PDR and Malaysia) and supplies it wholesale to the Metropolitan Electricity Authorities (MEAs) and Provincial Electricity Authorities (PEAs) which then distribute the power. Power is also provided directly to major customers. They also hold power transmission and supply facilities as an operator of the power grid.

Figure 2-20: Electric Power Market Structure in Thailand



Source: Electricity Generating Authority of Thailand.

b. Deregulation

Since 1992, the Thai government has encouraged the participation of private interests such as IPPs and SPPs in the power generation sector in order to promote competition. Until then, the state-run power company EGAT had exclusive rights for generation and transmission in Thailand, while MEAs and PEAs had sole control over distribution. However, it was difficult to keep up the pace of construction of power generation facilities to match the sudden rise in demand for power, creating a large investment burden for EGAT, which led to plans to introduce private investment.

c. Mechanism of policy implementation

Power development by EGAT, the state-run utility, directly reflects the government's electric power mix targets. MOE, together with EGAT, is developing and reviewing the long-term power development plan (PDP) periodically. The plan includes future possible and desirable IPPs which are consistent with the national long-term policy goal. If a new application for a power station appears as consistent with the PDP, the IPP business can smoothly obtain authorisation. In contrast, when a new application appears as controversial to the PDP, the IPP business may face tougher negotiations. This system enables the government to control the electricity supply mix of the nation.

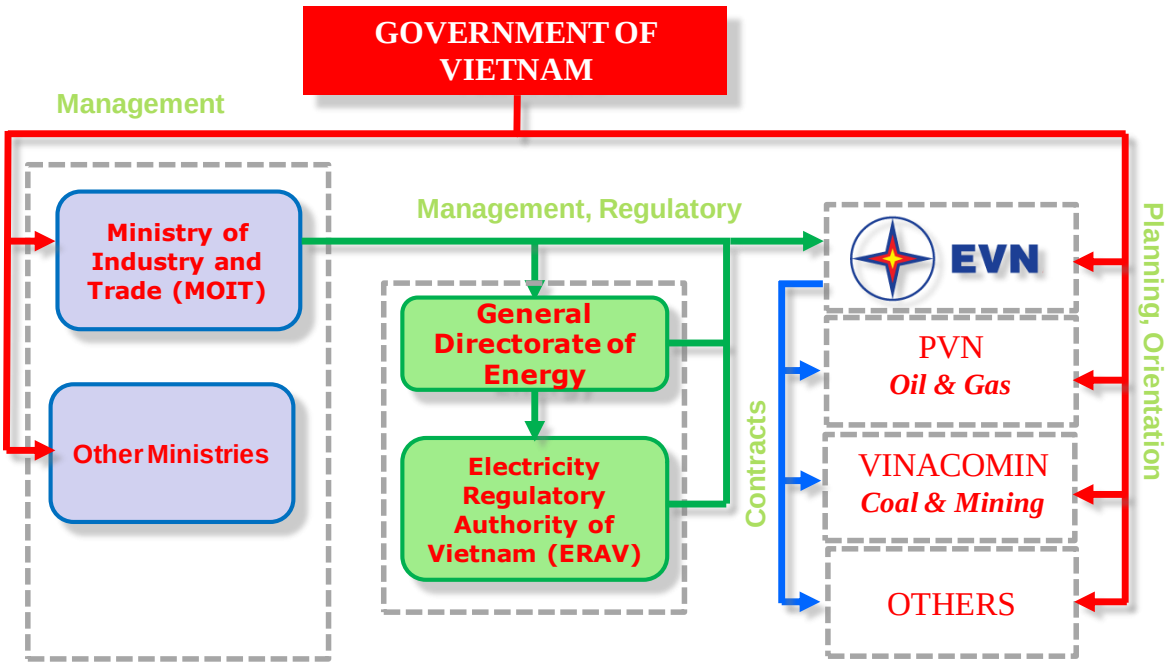
10. Viet Nam

10.1. Electric Power Policy

The Ministry of Industry and Trade (MOIT) oversees all aspects of the energy industry, including electricity, new energy, renewable energy, coal, petroleum, and gas. MOIT develops laws, policies, development strategies, master plans, and annual plans related to the energy industry, and submits these to the Prime Minister for issuance and approval. It also supervises and manages the energy sector. Under MOIT, the Electricity Regulatory Authority of Vietnam holds jurisdiction over the development and regulation of the electric power market, and the Institute of Energy proposes energy policies and establishes power development plans. The state-run utility Vietnam Electricity (EVN) follows these power development plans in its activities.

In July 2011, the 7th National Master Plan for Power Development was created, and power development planning has proceeded based on this document. The newest power development plan was established based on three cases (low scenario, base scenario, and high scenario) that predict power demand, with plans to increase power supplies by 10.5 percent per year from 2016 to 2020 to reach a total power supply of 265.4 TWh in 2020.

Figure 2-21: Regulatory Framework of the Energy Sector in Viet Nam



Source: Ministry of Industry and Trade.

Table. 2-5: Seventh Master Plan for Power Development in Viet Nam

Item	Unit	2014	2015	2020	2025	2030
Total power generation	GWh	145 540	161 250	265 406	400 327	571 752
Total commercial electricity	GWh	128 434	141 800	234 558	352 288	506 001
Pmax	MW	22 210	25 295	42 080	63 471	90 651

Source: Ministry of Industry and Trade.

By 2030, coal-based thermal power will become the primary power source, with plans to add a portfolio of new power sources including nuclear power.

Table. 2-6: Power Generation Structure in Viet Nam

Item	Unit	2015	2020	2025	2030
Sale Electricity	GWh	143.300	234.558	352.288	506.001
Power Generation	GWh	164.300	265.406	400.327	571.752
Pmax	MW	25.254	42.080	63.471	90.651

Source: Ministry of Industry and Trade.

In 2020, installed capacity is predicted to be about 60,500 MW, of which thermal power is 25,700 MW (representing 30.1 percent), small hydro and renewable energy (RE) about 6.000 MW (10 percent), hydro 18,100 MW (30 percent), oil and gas thermal power 9,000 MW (14 percent), and imports about 1,400 MW (2 percent).

In 2025, installed capacity is predicted to be about 95,400 MW, of which thermal power is 47,600 MW (representing 50 percent), small hydro and RE about 12,000 MW (16 percent), hydro 19,200 MW (20 percent), oil and gas thermal power 15,000 MW (16 percent), and imports about 1,400 MW (1.5 percent).

In 2030, installed capacity is predicted to be about 129,500 MW, of which thermal power is 55,300 MW (representing 43 percent), small hydro and RE about 27,200 MW (21 percent), hydro 21,900 MW (17 percent), oil and gas thermal power 19,000 MW (15 percent), nuclear power 4,600 MW (4 percent), and imports about 1,500 MW (1.0 percent).

10.2. Electric Power Market Structure

a. Market structure

In July 2006, EVN was established as a limited company with the government as the sole owner. EVN possesses and manages power dispatching offices, major power plants, transmission companies, distribution companies, and power facility research and design

companies. Some of these companies are wholly-owned subsidiaries of EVN, while others are joint venture-style financially independent entities.

b. Deregulation

On 10 August 2015, MOIT opened up the wholesale electric power market, allowing all companies that manage plants with output of 30 MW or more to participate in the market (No. 8266/QD-BC). Even power plants with output less than 30 MW can participate in the market if their facilities meet certain criteria. For BOT-format proposals, either direct market participation or participation through a representative division of EVN is possible. Companies providing power imports, wind power, solar power, geothermal power, and hydroelectric generation below 30 MW are still not permitted to participate in the market. The five power companies in the northern, central, and southern regions, and in Ha Noi and Ho Chi Minh, are the sales destinations for this power (NNA-Vietnam, 2015).

As for sectors other than power generation, a deregulation framework for the retail sector has started from 2015. Following trial market operations starting in 2016, the goal is to achieve complete deregulation by 2019.

c. Mechanism of policy implementation

Since IPPs need licences from the government, the government checks that their business plans are in compliance with the electric power mix targets during the licence screening process. If an IPP's business plan does not comply with the targets, the government will decide to not issue a licence.

The government will revise the plan including speeding up the progress of some projects to ensure energy security.

Chapter 3

Energy Mix and Market Structure in Europe

The market structure of ASEAN member states varies by country. While there are ASEAN member states such as the Philippines and Singapore that have managed to achieve electricity generation sector liberalisation, there are also countries such as Cambodia and the Lao PDR with state-run companies that operate as monopolies.

In order to respond to projected future increases in electricity demand, there are moves in many ASEAN member states to utilise IPPs and other private sector companies to relieve electricity supply shortages.

Conventionally in ASEAN member states, state-run companies have been central to electricity source development. However, there are now moves to entrust markets to free competition due to the inadequate know-how, human resources, and capital at state-run companies and also as a result of policies aimed at overcoming the inefficiency of state-run companies.

Moves such as these are rational in that they make it possible to streamline project implementation and take advantage of the dynamism of the private sector. At the same time, however, leaving the development and selection of electricity generation plants up to private companies within a competitive environment weakens the influence of governments on markets and leads to concerns about excessive electricity generation capacity surpluses and shortages as well as imbalance in the types of electricity generated.

Therefore, in this chapter, we will analyse the cases of electricity liberalisation carried out in European countries in the 1990s in order to look at the potential effects of electricity market liberalisation on the implementation of electricity mix-related policies. Specifically, we will provide an overview of changes in electricity mixes and electricity industry structures based on the results of surveys conducted in several European countries.

Table 3-1: Market Structure in ASEAN Member States

Country	Market Structure		Current situation of energy use
	Power generation	retail	
Cambodia	Monopolistic regulated market	Regulated market	・Hydro, oil, natural gas, lignite exist, but not developed. ・More than 90% of electricity generation from diesel generator.
Lao PDR			・Hydro power for export , coal-fired power for domestic use.
Myanmar	Liberalised market + Single buyer		・Focus on hydro power development.
Viet Nam			・energy exporting country now, but capable of turning to energy importing country. Considering oil stock.
Indonesia			・Less than 20% of oil-fire, more than 30% of natural gas-fire, 33% of coal-fired, 5% of RE by2025.
Thailand			・No natural resources. Difficulty in developing coal-fire.
Malaysia			・energy exporting country now, but capable of turning to energy importing country.
Brunei			・Plenty of oil, natural gas, but take resources preservation policy.
Philippines	Liberalised market		・Hydro is the key source. ・There 's spare development capacity.
Singapore		Liberalised market	・Almost 100% of primary energy depends on import. ・Difficulty in developing coal-fired.

Source: Study team.

1. Case of the UK

1.1. Transition of Energy Mix in the UK

The United Kingdom (UK) has abundant fossil fuel resources. In addition to coal, which became the primary fuel from the 1970s, gas and oil field development in the North Sea gained momentum in the 1960s and 1970s, and the UK was energy self-sufficient for approximately 20 years from the 1980s onward. However, North Sea gas and oil output began to drop off from the start of the 21st century and from 2004 onward the UK became a net energy importer.

Looking at each fuel separately, before 1970, resources were abundant with national coal production reaching 100 million tonnes of oil equivalent. However, with gas and oil field development in the North Sea, from the 1970s onward pipeline infrastructure was constructed throughout the UK in order to facilitate the expanded use of natural gas. The creation of an environment allowing large-scale utilisation of natural gas led to the 'Dash for Gas', a major shift towards greater natural gas usage. In the electricity generation sector, a series of gas-fired power plants (CCGT) were constructed in the UK in the 1990s and with this move coal-fired power plants were closed down. In the late 1990s, the UK even became a net

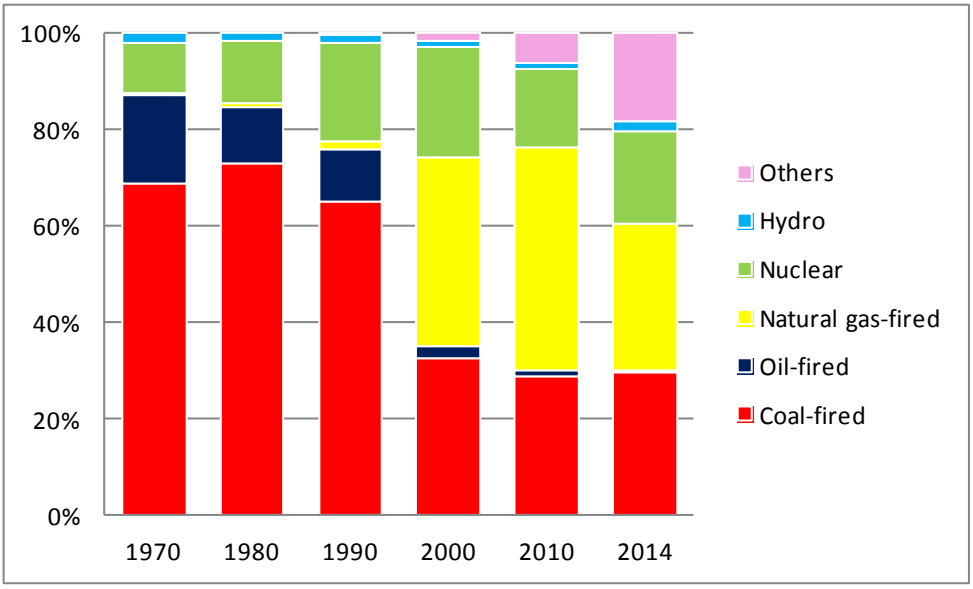
exporter of natural gas but it started to become increasingly clear that the North Sea gas fields were becoming depleted and national production levels have been dropping since peaking in 2000.

Enacted in 2008, the 2008 Climate Change Act stipulates that by 2050 GHGs should be reduced to 20 percent of the level in 1990. In addition, in 2009 the European Union issued the Renewable Energy Directive which requires the UK to see that 15 percent of its final energy consumption is based on energy from renewable sources by 2020 (equivalent to 240 GWh of electricity per year). Approximately half of this 15 percent is to be achieved through the electricity sector, and, in order to achieve this, at least 40 GWh worth of renewable electricity sources will need to be brought online.

In response to the issuance of the 2008 Climate Change Act and the European Union's Renewable Energy Directive of 2009, renewable energy has been increasingly used with a focus on wind power and biomass.

With regard to nuclear power, following electricity liberalisation and privatisation in 1990, the construction of new nuclear power plants has slowed, but the issue of increasingly pronounced depletion of the gas and oil fields from 2000 led the government to issue the 2008 White Paper on Nuclear Power and a decision was made to pursue the construction of additional new nuclear power plants. Renewable energy and nuclear power were also further promoted with the passing of the Energy Act 2013, which included electricity market reforms aimed at promoting investment in low-carbon electricity sources including nuclear power.

Figure 3-1: Trend of Energy Mix in the UK



Source: International Energy Agency, Energy Balance of OECD Countries 2015.

1.2. Electricity Market Reform and Energy Policy in the UK

With its abundant domestic coal resources, development of coal-fired electricity plants in the UK played a central role early on. On the other hand, following the discovery of the major North Sea gas fields in the mid-1960s the UK government made a transition from coal to low-cost natural gas in order to increase energy security. To promote the use of natural gas, the British Gas Corporation was established in 1973 to take sole responsibility for gas purchasing, conveyance, and distribution. By the latter half of the 1970s, the British Gas Corporation had completed the installation of gas trunk pipelines and infrastructure. This meant that it had a monopoly over the gas industry and it was through the British Gas Corporation that the government carried out its energy policy shift.

In addition, at the time that the UK's electricity market was under the monopoly of the Central Electricity Generation Board. Its monopoly over the market and that it therefore faced no risk from competition or loss of customers provided an additional boost to the energy policy shift from coal to gas.

With the advent of the first Thatcher administration, the introduction of the competition principle and the selling off of state-run companies to reduce budget deficits became core policies. At the time, the UK was experiencing a period of stagnation that was mockingly referred to as the 'British Disease' and one of its causes was understood to be the inefficiency of state-run company monopolies. For this reason, the electricity sector was also targeted and in 1990 moves were made to simultaneously liberalise the electricity market and break up and privatise state-owned electricity companies. The Central Electricity Generation Board, which had a monopoly over electricity generation and transmission, was split and privatised into three electricity generation companies and one transmission company.

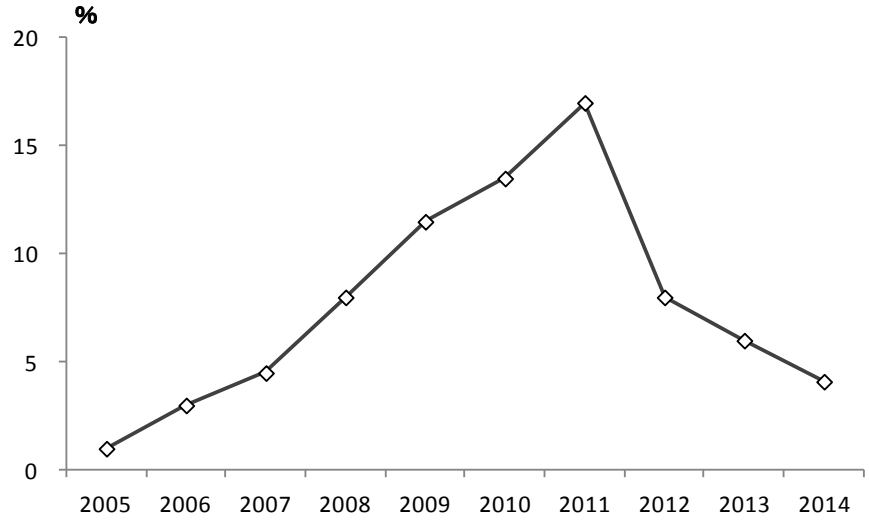
Liberalisation led to a series of new companies entering the market and increased competition, and vigorous merger and acquisition (M&A) activities led to large electricity companies being bought by major German, French, and Spanish energy companies. As a result, the British electricity market has been consolidated under six large groups including British Gas, RWE (Germany), E.ON (Germany), EDF (France), SSE (UK), and Iberdrola (Spain).

In recent years, energy policies in the UK have been promoting a shift to low-carbon electricity sources such as renewable energy, nuclear power, and carbon capture and storage (CCS) thermal power stations. However, the competitive electricity market, the creation of which began in the 1990s, functions in such a way as to exclude high-cost electricity generation plants. This environment means that high-cost electricity generation plants such as those using renewable energy, nuclear power, and CCS thermal power will not be developed without special policies aimed at encouraging this.

And since competitive markets have elements of uncertainty, there is a tendency to hold off from investing. Since particularly in the UK the electricity industry is funded by overseas capital, circumstances in the countries from which the capital originates have a direct impact on development planning in the UK. Recently, E.ON and RWE of Germany have backed out of nuclear power development plans in the UK as a result of expectedly reduced cash flow due to the decommissioning of nuclear power plants in Germany, and there is concern that there may be considerable supply shortages in the medium to long term.

There were also plans for the construction of coal-fired power plants in the past, but there are currently no such plans. The European Union also placed a limit on the total number of hours a coal-fired power plant can operate in accordance with the plant's pollutant emission levels, and a number of older coal-fired power plants in the UK reached this limit in close succession, leading to the decommissioning of 15 coal-fired power plants in the country since 2012. As a result, the UK's electricity reserve margin has continued to decrease and by 2014 had gone below 5 percent. In 2015, UK's electricity reserve margin had kept below 5 percent.

Figure 3-2: Trend of Generation Reserve Margin in the UK



Source: Winter Outlook, National Grid.

In order to respond to this issue, the UK government made major changes in 2010 to its electricity policy direction to increase the role of market mechanisms with the decision to implement the Electricity Market Reform policies. The objective of these policies is to inexpensively achieve targets relating to low-carbon energy, stable electricity supply, and renewable energy usage, and involves the following four policies:

1. Renewable energy/nuclear power/CCS-oriented Feed-in-Tariff (FIT) (Contract for Difference [CfD])
2. Introduction of the Capacity Market system

3. The Carbon Price Floor (CPF) system
4. Direct CO_2 emission regulations (Emission Performance Standard [EPS])

The Feed-in-Tariff system involves long-term fixed price purchasing of electricity generated using low-carbon methods. One of the characteristics of the system is that the difference in price between the fixed price and the electricity market price is settled between electricity generators and electricity purchasers. This system means that if the electricity market price goes below the exercise price, electricity generators receive the difference from electricity purchasers and if the electricity market price goes above the exercise price, electricity generators pay the difference to electricity purchasers. Another characteristic is that, in addition to renewable energy, the system also applies to CCS and nuclear power.

Since the exercise price is determined through bidding, the system promises to, within a liberalised market, encourage competition between electricity generators, make it possible to avoid excessively large subsidies, and maintain the income of electricity generators at a certain level.

The Capacity Market system was designed with the aim of attracting investment in electricity generation plants. In response to the increasing use of renewable electricity generation, the output of which is unstable, the UK will need thermal power plants in order to balance out supply. However, the existing thermal power plants, which are primarily coal-fired, are being phased out due to age-related deterioration, and the reserve margin is predicted to decrease further. In addition, since the utilisation rates of thermal power plants to be used as a backup for renewable electricity sources would be extremely low, they would generally have low economic potential, meaning private sector companies would not consider them a target for proactive investment.

The system involves electricity generators promising to provide, at times of electricity shortages, electricity generating capacity for a certain period of time at a price determined in contracts with electricity system operators. The introduction of this system promises to enable electricity generators, within a liberalised market, to move ahead with the construction of new electricity generation plants and the upgrading of existing ones. It also makes it possible to earn profits by providing electricity capacity not only during normal times

but also during emergencies, and it shows promise as a method of stimulating investment aimed at increasing supply capacity and bridging gaps between supply and demand

The Carbon Floor Price system involves setting a minimum limit for carbon prices based on the European Union Emissions Trading System (EU-ETS). Reflecting the excess of supply over demand, EU-ETS carbon prices have been low, and they remain at a level that is insufficient to encourage low-carbon energy investment. By maintaining carbon prices at or above an adequate level, it is expected to work in such a way as to encourage more low-carbon electricity generation.

Direct regulation of CO_2 emissions involves placing an upper limit on per kilowatt-hour CO_2 emissions of newly constructed electricity generation plants (450 g of CO_2 per kWh per year). The 450g/kWh target is not possible to achieve with ordinary coal-fired power plants, meaning in effect that it limits thermal power generation options to biomass, gas, coal-biomass co-combustion, and CCS coal-fired power plants. This system is also expected to work in such a way as to encourage more low-carbon electricity generation.

As explained above, these policies are being used to make up for issues arising from electricity market liberalisation. After liberalising the electricity market and then pushing forward with climate change countermeasures, by moving to strengthen regulations, the UK government is currently attempting to respond simultaneously to issues of supply stability, price adjustment, and the need for global warming countermeasures.

2. Case of Germany

2.1. Trend of Energy Mix in Germany

Germany yields large amounts of lignite and coal and the country's industry historically developed based on its coal resources. Since the 1973 oil crisis, the government has protected the domestic coal industry. In 1996, the obligation to take in domestic coal was abolished but protective measures still continued in the form of subsidies.

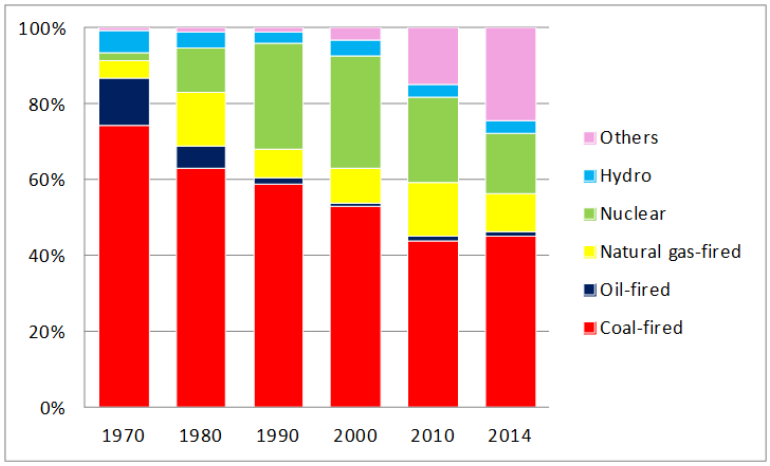
Another form of energy that garnered attention following the oil crisis was nuclear power. With the commissioning of Germany's first nuclear power plant in 1975, the government adopted a policy of promoting nuclear energy and moved forward with the development of

17 nuclear power plants. As a result, the proportion of electricity generated by nuclear power plants increased from 5 percent in the 1970 to approximately 27 percent in 1985, giving it the second largest share after coal. On the other hand, anti-nuclear activities grew more pronounced following the Chernobyl disaster in 1986, and the coalition administration formed in 1998 by the Social Democratic Party (SPD) and the Green Party amended nuclear power legislation in 2002 to decommission nuclear power plants in sequential order after they reach their 32nd year in operation.

On the other hand, the Merkel administration, which took office in 2009, carried out a partial review of nuclear power legislation and extended the allowed operational lifetime of nuclear power plants by 12 years. Following the Fukushima disaster, however, there was a shift in direction towards breaking with nuclear power and a decision was made to incrementally decommission all nuclear power plants by 2022.

The government has pushed forward with development of renewable energy and co-generation as a replacement for nuclear energy, and a Feed-in-Tariff (FIT) system was introduced based on the 1991 Electricity Feed-In Act and the 2000 Renewable Energy Act (EEG) that obligated electricity companies to purchase electricity generated using these power sources at high prices. As a result, renewable energy development made progress centred on solar and offshore wind power, and there is a plan to increase the share of electricity generated using renewable energy to at least 35 percent by 2020.

Figure 3-3: Trend of Energy Mix in Germany



Source: International Energy Agency, Energy Balance of OECD Countries 2015.

2.2. Electricity Market Reform and Energy Policy in Germany

Germany's new Energy Industry Act came into effect in 1998, leading to comprehensive liberalisation, and more than 100 new businesses (primarily retail) were formed. Existing electricity companies resisted this by conversely charging high consignment fees, while also decreasing capital investment and reducing costs in order to lower retail prices. As a result, new companies successively went out of business and the oligopoly of the major electricity companies became increasingly pronounced. The major companies have also merged and generation, transmission, and distribution is now largely concentrated under four major companies (E.ON, RWE, EnBW, and Vattenfall), which have about a 70 percent share of the retail market.

In order to remedy the high consignment fees, the government introduced an electricity transmission/distribution fee approval system in 2005 and reforms were implemented in 2009 to legally separate electricity transmission companies, among others. However, from the perspective of encouraging the participation of new companies and restraining prices, there have been no significant results.

In addition, subsidisation policies aimed at increasing the amount of electricity generated from renewable energy, such as the FIT system, have led to the need for additional subsidies. Specifically, renewable energy flowing into the market without regard to demand conditions has led to a slumping of wholesale electricity prices, while existing thermal electricity generation plants are suffering from low utilisation rates and margins. Thus, there are increasing moves to decommission existing thermal electricity generation plants. At first glance, this may appear to be a good example of success in expanding the use of renewable energy. However, thermal power plants are in fact essential as backup for the more unstable supply of electricity generated from renewable energy and the decommissioning of existing thermal power plants is in fact an unfortunate development. The German government is therefore facing the need to provide subsidies to enable electricity generators to maintain their thermal power plants even when market prices and the utilisation rates of thermal power facilities are low.

In this way, Germany's example shows that when subsidies are provided to a certain electricity source, market distortions are created that lead to a situation in which additional subsidies have to be created to other electricity sources in order to keep the system viable. The German government has moved forward with electricity market reform including the separation of businesses into generation, transmission, and distribution. However, given the subsequent move to break away from nuclear power and the concomitant increase in the amount of electricity generated from renewable sources, there is currently a shift towards strengthening regulation. This is an attempt to respond simultaneously to issues such as supply stability, price adjustment, and the need for global warming countermeasures.

3. Interview Survey of European Experience

This research involved visiting government organisations, electricity companies, investment banks, etc. in European countries that have already achieved electricity liberalisation to conduct interviews with a focus on the following questions:

1. What are the conditions required prior to carrying out electricity liberalisation?

a. Sufficient electricity supply capacity

b. An electricity transmission network

c. Market participants

2. Taking into consideration the maturity of a market, what kind of market structure do you recommend?

3. From the perspective of infrastructure development and energy policy implementation, what led to problems post-liberalisation?

4. What kinds of policy implementation tools can be used to achieve the desired share of certain electricity sources in line with liberalised markets?

3.1. Summary of Interview Survey in the UK

- From the perspective of facilitating liberalisation, unbundling is thought to be effective, but a monopolised market makes it easier for long-term investment to be carried out.
- In order to achieve the aims of energy policies in a liberalised market, the government needs to evaluate submitted applications for new electricity sources in accordance with energy policies. However, changes of government can result in changes to energy policies, and this can be a factor that hinders long-term investment.
- As a result of subsidising CO_2 emission reduction technologies to eliminate investment recovery risk, the gap between FIT-CfD and market prices grew larger.
- Although the use of solar and wind power as low-carbon electricity generation methods is increasing, the output of these electricity sources varies considerably and this is difficult to control. Therefore, countermeasures such as the Capacity Market system have been implemented.

3.2. Summary of Interview Survey in Germany

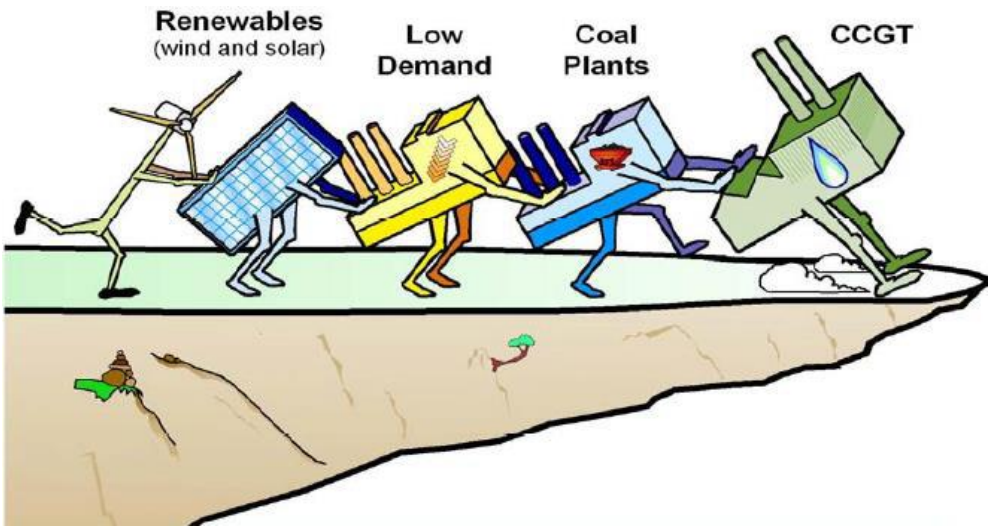
- The introduction of regulations such as FIT has resulted in electricity market distortions such as difficulty in maintaining the kinds of electricity sources that are necessary for maintaining energy security.
- While the government has set a target of achieving an 80 percent renewable energy share by 2050, achieving this target will require intervening with how people utilise electricity by, for example, drastically raising peak time electricity prices.
- There are concerns that moves such as these will interfere with electricity liberalisation and cause a return to increased regulation.

3.3. Summary of Interview Survey in Switzerland

- Merit order means that high-cost generation methods such as CCGT are under threat.
- As a result, the use of CCGT has been decreasing in recent years.

- That is, subsidising one energy source results in the paradoxical situation of causing other energy sources to erode to crisis levels, thereby constituting a threat to energy security.

Figure 3-4: Merit Order Pushed High-Cost Electricity Sources to the Brink of Crisis



Source: Mirco Borgdorf, Alpiq, October 2015.

3.4. Summary of Interview Survey in France

- Renewable energy has to be a source of economic growth for one country. The ideal approach therefore is to utilise renewable energy that is plentiful in the country and incrementally reduce subsidisation of that renewable energy once its use is well-established.
- In addition, replacing the capacity lost through the decommissioning of nuclear power plants with renewable energy will not result in an increase in the share of low-carbon energy, as nuclear itself is already low-carbon energy. If the total combined share of nuclear power and renewable energy is not increased, CO_2 emissions will not be reduced.
- Although electricity demand in advanced nations tends to be flat or decreasing, electricity demand in emerging markets including those in Asia is predicted to increase. With such an increase, usage of coal is also expected to increase. Since coal will continue to be a necessary energy source for many countries in Asia, it is recommended that instead of

reducing the number of coal-fired power plants, inefficient coal-fired power plants be replaced with efficient ones.

- On the other hand, energy saving measures ought to be implemented prior to replacing coal-fired power plants; if energy conservation can be achieved, most issues can be solved because reduction of electricity demand will result in a decrease of usage of coal power generation.

3.5. Summary of Interview Survey in Sweden

- Since energy prices can fluctuate at any time, it is necessary when pursuing liberalisation to create a system that enables long-term predictions to be made in 10-year units. Debates regarding energy policies ought to be based on this rather than a short- to medium-term perspective.
- When carrying out electricity liberalisation in countries that, unlike advanced nations, will experience a growing electricity demand, investment in CCGT plants, from which costs can be recovered quickly, will increase rapidly. Under such conditions, governments will stop supporting other electricity sources such as nuclear power and this may hinder the successful creation of energy mixes.
- The beginning of electricity liberalisation did not cause the government to change its energy policies. Changes in energy policies were the result of changes of government.
- Prior to liberalisation, countries in northern Europe only gave consideration to their own domestic energy mix, but this changed after liberalisation and they began to consider the energy mix of northern Europe as a whole. Sweden and Norway were the first to reach a cooperative agreement in 1994.
- The fact that nuclear power plants remained in Sweden even after the electricity liberalisation in northern Europe in the 1990s is largely down to economic reasons. Since the price of electricity in Sweden is high compared with other European Union countries and with global levels, electricity generation using low-cost nuclear power enjoys support from the general populace. Although increased anti-nuclear sentiment following the Three Mile Island and Chernobyl accidents led to a decision to phase out nuclear power,

this decision was later rescinded in response to issues such as climate change with the understanding of the populace. In the 2000s, the (EU-ETS) system which differentiated power generation plants by amounts of CO_2 emission provided additional impetus.

- Following a Court of Justice of the European Union decision that Sweden's charging of low tax rates on nuclear power was in contravention of European Union law, the Swedish government decided to charge nuclear power operators a capacity tax. As a result, the tax rate has been gradually increasing in recent years.
- In Sweden, compared with nuclear power, hydro power and electricity transactions with neighbouring countries such as Norway are relatively economically advantageous. Importation of electricity is increasing in Sweden.

3.6. Implications

The following implications were derived from the interviews relating to the experiences and issues of European countries that have already carried out electricity liberalisation:

1. What are the conditions required prior to carrying out electricity liberalisation?

   It goes without saying that before liberalisation is carried out, the necessary infrastructure such as an electricity distribution network to enable free transactions needs to be in place. If such infrastructure is inadequate, even if the system were liberalised, it would not be possible for competition to arise.

   If there is a state-run company monopolising the market or a vertically integrated system of several companies operating regional monopolies, it is difficult for new IPPs to enter the market and for liberalisation to progress. Therefore, state-run companies need to be privatised and vertically integrated companies need to be separated before moving to liberalisation to create an environment that makes it easier for new IPPs to participate.

   Furthermore, it is necessary to recognise that there are considerable hurdles for those who wish to participate in the electricity industry. For example, engaging in electricity generation requires land, personnel, know-how, and capital, so the kind of company that is able to participate is naturally limited.

In addition, the UK and Germany cases show that, in theory, the result of appropriate competition is that markets head towards oligopolies. Once an oligopoly is established, it is not easy to revitalise competition in a market.

2. Taking into consideration the maturity of a market, what kind of market structure do you recommend?

Monopolised markets are stable and easy to manage over the long term. Since the investment environment is stable, it becomes easy to attract investment. Therefore, for countries that are yet to construct infrastructure, maintaining the market monopolies of state-run companies makes it possible for governments to proceed with development that is in line with their energy policies.

Although the experiences of European countries are often referred to when proceeding with liberalisation, it is important not to forget that many European countries transitioned to liberalisation only after state-run monopoly companies had created adequate electricity generation plants and transmission/distribution networks. In other words, electricity infrastructure has up to now been created in monopolised markets and there are no examples of major infrastructure being created in free competition environments.

On the other hand, it is possible to facilitate free competition by splitting up vertically integrated companies in stages as electricity infrastructure and market participants mature.

3. From the perspective of infrastructure development and energy policy implementation, what led to problems post-liberalisation?

Once markets were liberalised and competition began, investment in profitable electricity sources increased and the country's electricity portfolio became imbalanced. In the case of Europe, low-cost coal-fired power generation increased and the more environment-friendly gas-fired power generation decreased considerably. In the case of Germany, even cutting-edge gas-fired power plants with a generation efficiency of 60 percent were unprofitable and are scheduled to be decommissioned before they reach the end of their

lifetime. These changes are based on market principles and are desirable from the point of view of competition policies, but clearly not from the point of view of climate.

In addition, even if the government provides incentives for the construction of new electricity generation plants to correct the overall electricity source mix, it is difficult to develop a long-term outlook, and the resulting difficulty in finding willing investors is an issue. Electricity generation plants have an operational lifetime of approximately 30 years, and with liberalised markets it is extremely difficult to predict market conditions 30 years in advance.

4. What kinds of policy implementation tools can be used to achieve the desired share of certain electricity sources in line with liberalised markets?

The methods that governments can use to control disproportionate participation and investment of private sector companies in liberalised markets are limited. The selection of the types of new electricity plants to be constructed is left up to private sector companies. The methods governments can use are inevitably indirect, for example electricity generation efficiency regulations and CO_2 emission regulations.

European countries are using FIT to increase the utilisation of renewable energy, but, as explained above, this method creates market distortions. European countries are also attempting to use the Capacity Market system to maintain thermal power stations as backup for renewable energy-based electricity generation, but it will take more time before the success or failure of this endeavour can be determined. In any event, the cases in European countries indicate that in order to be able to carry out electricity source development in accordance with policies, there is perhaps no option but to use a somewhat regulatory approach.

Chapter 4

Key Findings and Policy Recommendation

1. Possible Future Electricity Supply Mix in the ASEAN Region

It is not possible to satisfy all electricity demand with a single energy source. Each energy source has its own advantages and disadvantages (Table 4-1) and effort is required to make full use of the advantages and minimise the disadvantages. Therefore, creating a system featuring a mixture of electricity sources is crucial for ensuring stable supply.

Table 4-1: Comparison of Fuel Types

	Resource Availability	**Stability Electricity Output**	**Generating Cost**	**Environmental Friendliness**	**Necessary Action**
Coal	good	good	good	bad	Improve efficiency
Natural gas	good	good	medium	medium	Reduce price
Hydro	medium	good	good	good	Develop potential capacity
Biomass Geothermal	medium	good	medium	good	Financial support
Wind Solar	good	bad	bad	good	R&D for smart grid Financial support

* Score may differ depending on unique condition in each country.

Source: Study team.

While increasing demand for electricity is a widespread trend in the ASEAN region, the availability of fuel resources for use in electricity generation such as coal, natural gas, and hydropower differs in each country. While some countries have resources that are more than adequate to meet their own needs, others have insufficient resources and therefore have no choice but to rely on importation. If a country has an adversarial relationship with its

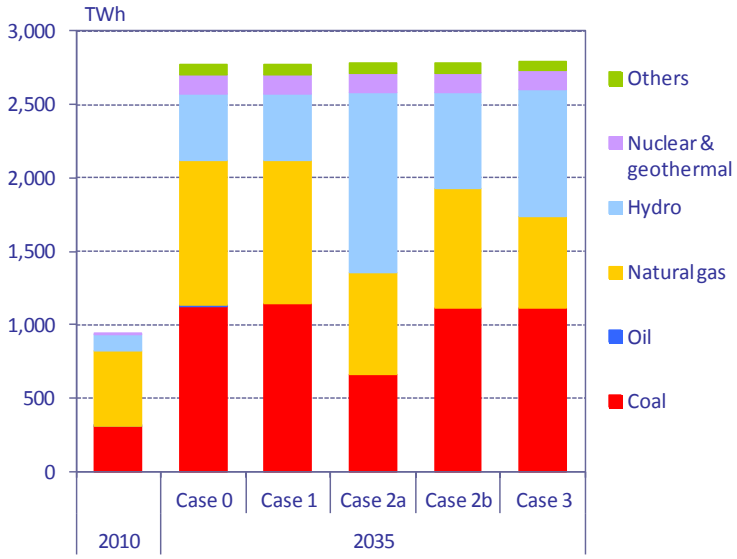
neighbours, it will have to deal with electricity supply and demand within its own borders. However, as there are moves towards increasing regional economic integration, balancing supply and demand across the entire region rather than within each individual country is more economically rational.

More specifically, in the ASEAN region, the Lao PDR, Cambodia, and Myanmar in particular and, outside the region, China's Yunnan Province have considerable hydropower generation potential. Although hydropower generation costs vary significantly according to location, in many cases it is competitive against natural gas- and coal-fired electricity generation. In response to climate change, there is a need to use low-carbon energy as much as possible. In this sense as well, the use of hydropower is an appropriate choice. In order to make full use of the potential of such resources, it is necessary to have power transmission lines to supply electricity from resource-rich areas to areas that require it. This is achieved using international grid interconnections.

Sharing electricity using international interconnected electricity transmission lines changes the electricity mix of each country and of the entire region. It makes it possible to make full use of the low-cost electricity sources available within the region. That is to say, increasing the electricity sharing capacity of international interconnected electricity transmission lines makes it possible to reduce overall electricity generating costs. Maximising the use of hydropower and other renewable energy also makes it possible to curb the emission of air pollutants including CO_2.

Through analysis based on this perspective, possible electricity mixes are projected for the ASEAN region in 2035 in the following figures.

Figure 4-1: Power Supply Mix by Case in 2035 (total of the region)



Case 0: Reference case (no grid connection)

Case 1: Grid connection, no additional hydro-potential

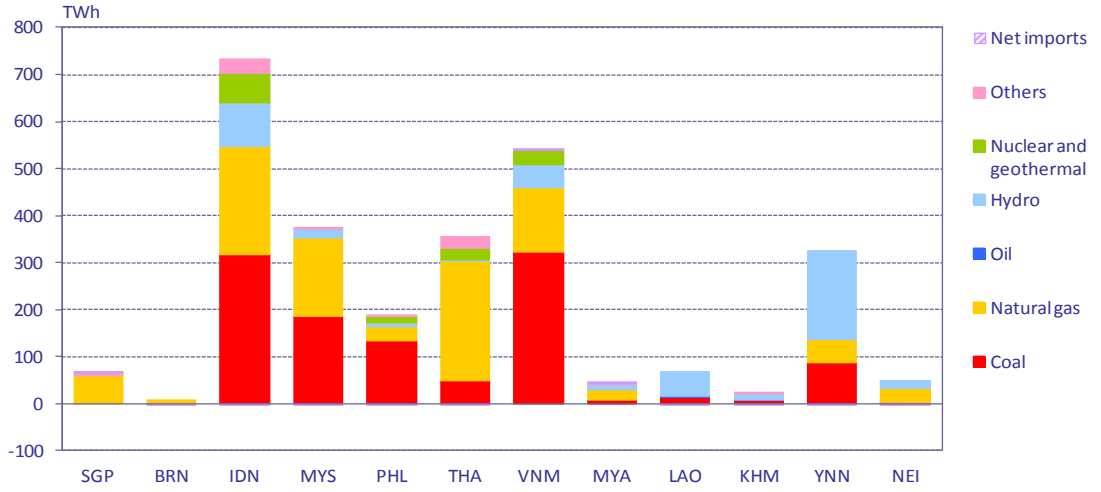
Case 2a: Grid connection, additional hydro-potential

Case 2b: Grid connection, additional hydro-potential (only utilised for export)

Case 3: Same as Case 2b, with no upper limit for the grid connection capacity

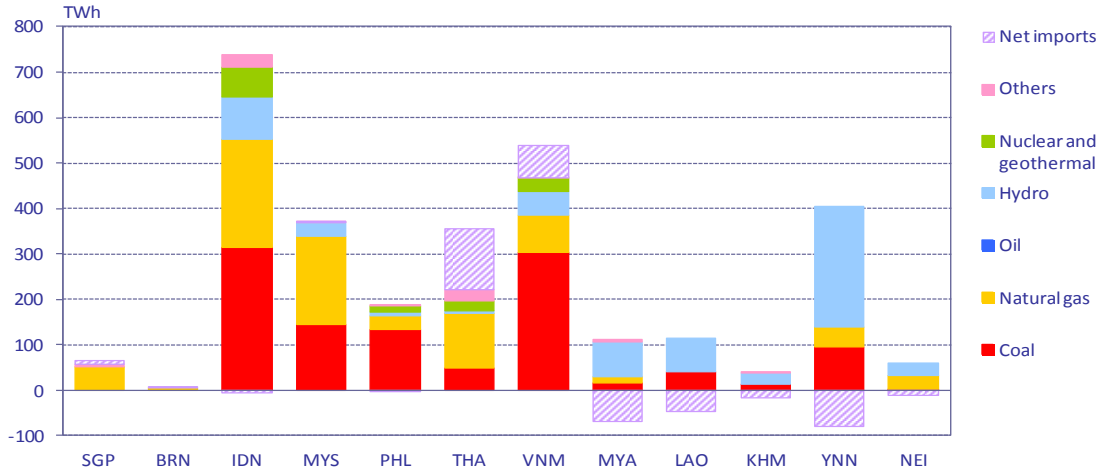
Source: Economic Research Institute for ASEAN and East Asia (2014).

Figure 4-2: Power Supply Mix in 2035 (Case 0)



IDN = Indonesia, KHM = Cambodia, LAO = Lao People's Democratic Republic, NEI = Northeast India, MYA = Myanmar, MYS = Malaysia, SGP = Singapore, THA = Thailand, VNM = Viet Nam, YNN = Yunnan Province (China).
Source: Economic Research Institute for ASEAN and East Asia (2014).

Figure 4-3: Power Supply Mix in 2035 (Case 2b)



IDN = Indonesia, KHM = Cambodia, LAO = Lao People's Democratic Republic, NEI = Northeast India, MYA = Myanmar, MYS = Malaysia, SGP = Singapore, THA = Thailand, VNM = Viet Nam, YNN = Yunnan Province (China).
Source: Economic Research Institute for ASEAN and East Asia (2014).

Then, what needs to be done to attain these electricity mixes?

Electricity markets have up to now been regulated, meaning that governments have been able to directly reflect their policies on markets through legislation and a variety of review procedures. Now, however, although conditions differ in each country, some ASEAN member states are moving to liberalise their electricity markets. Market liberalisation means that the strength of government involvement in markets is weakened. It therefore becomes more difficult for governments to reflect their policies, including those relating to electricity mixes, on markets. If a large number of ASEAN member states were to liberalise their electricity markets, how should their governments implement their policies?

Fortunately, there are cases of electricity market liberalisation around the world and it is possible to learn from these. What can be learned from the experiences in Europe?

2. Lessons from Experiences in Europe

Electricity liberalisation in Europe began in the UK. After the Second World War, the Labour government placed the UK's major industries under the monopoly of state-run companies. As a result, there was insufficient competition and investment in modern facilities among others lagged behind, causing the UK to lose its global competitiveness. After taking office in 1979, Prime Minister Thatcher carried out structural reforms including the easing of regulations and by the time of the change of government in 1990 her administration had succeeded in resuscitating the UK economy.

As part of the shift towards unifying the European market from the latter half of the 1990s, the trend towards liberalisation that began in the UK spread through Europe in the form of energy market reforms aimed at creating a single pan-Europe energy market, encouraging competition and streamlining, and enhancing supply security. At the time, enhancing the fluidity of energy transactions through market liberalisation was thought to contribute to supply security.

Here we would like to touch upon the fact that when this liberalisation began in the 1990s, the electricity infrastructure that we see today was already in place. Similarly, electricity was

also available to all residents and industries, and each country already had sufficient electricity generation plants and transmission/distribution grids. It goes without saying that without this foundation it would not have been possible for competition to arise.

An electricity liberalisation directive issued in 1996 called for a third of the retail market to be liberalised and for account separation and fundamental separation in the electricity transmission sector. A second liberalisation directive was later issued in 2003, which called for liberalisation of all sectors other than domestic electricity by July 2004 and complete liberalisation including the domestic electricity sector by July 2007. The directive also called for implementation of legal separation in the electricity transmission sector. In 2009, a third liberalisation directive called for further unbundling in the electricity transmission sector.

As a result, new companies entered the electricity business in Europe creating competition and a wide range of new types of transactions began to take place. Market liberalisation was successfully carried out and competition was facilitated.

On the other hand, the liberalised electricity markets face a wide range of difficulties. The most significant effect was changes in investment in electricity generation plants. Free competition led to pressure to cut costs and the fact that it was difficult for companies to forecast their own long-term prospects hindered investment in electricity generation plants. In some countries, this led to problems such as reduced supply capacity.

Investment also tended to excessively favour more profitable low-cost coal-fired power plants leading to an imbalance in electricity mixes. As a result of policies that placed excessive emphasis on renewable energy, a large amount of renewable energy flowed into the wholesale market fuelling market distortions. As a result, the profitability of gas-fired power plants – which from the perspective of environmental load reduction ought to be prioritised over coal-fired power plants – began to worsen and they began to be decommissioned. Give that gas-fired power plants are easy to use for the purpose of adjusting the balance between supply and demand, the spate of plants being decommissioned resulted in insufficient adjustment capabilities.

With the introduction of market competition, electricity generation companies were forced to manage their businesses with a short-term perspective and the types of electricity

generation susceptible to fuel price fluctuations increased. In addition, there were concerns about medium- to long-term electricity generation supply deficiencies.

Hence, a large number of thermal power plants, particularly those degraded due to age, were decommissioned in Europe as a result of the introduction of competition through liberalisation and the promotion of climate change countermeasures. There are even electricity generation plants that have just come into operation that are at risk of being decommissioned.

An example of a response to these issues is the FIT/CfD (Feed-in-Tariff/Contract for Difference) scheme introduced in the UK to incorporate market principles into a regulated market. This scheme is an attempt to, on the one hand, guarantee the long-term stability of the prices of electricity generated using nuclear power, CCS, integrated gasification combined cycle, and large-scale offshore wind power to encourage the creation of low-carbon-oriented energy portfolios with a long-term perspective. On the other hand, it also aims to incorporate the Capacity Market concept centred on thermal power generation in order to solve the problem of short- to medium-term tight supply-and-demand situations.

While a diverse energy mix is necessary from the perspective of energy security, the experience in Europe indicates that this objective has not been easily achieved by leaving things up to market forces and that they are still in a trial and error stage. Rather, it would appear that governments in Europe are attempting to solve issues by incorporating a somewhat more regulatory approach.

Thus, unfortunately there are currently no electricity liberalisation models that make it possible to simultaneously achieve the 'three Es' (energy security, economic efficiency, and environmental sustainability). Although there are significant differences in the environment in Europe and the ASEAN region, when ASEAN member states aim to liberalise their electricity markets they should be sufficiently cognizant of such points.

3. Pros and Cons of Different Market Model

Many ASEAN member states currently employ a single buyer system which essentially involves a single buyer purchasing all generated electricity and selling this on to distribution companies in a monopolistic fashion. Conversely, Singapore and several other countries have also

introduced market principles into the retail sector. In this way, structural reform of traditional vertically integrated electricity systems is gradually progressing, but since the market structures and energy usage conditions vary widely by country, policies that suit each country need to be introduced.

Although there is a wide range of different market model types to select from, based on market models that exist in the East Asia Summit region we have roughly divided them into four main types: (*a*) The National Monopoly Model, (*b*) The Private Regional Monopoly Model, (*c*) The Liberalised Power Generation Sector + Single Buyer Model, and (*d*) The Fully Liberalised Model.

In this study, we looked at the advantages and disadvantages of each market model based on the following three perspectives:

1. Energy mix implementation
2. Economic efficiency
3. Financial capability

Table 4-2: Market Structure and Their Characteristics

	National Monopoly Model	**Private Regional Monopoly Model**	**Liberalised Power Generation Sector + Single Buyer Model**	**Fully Liberalised Model**
Energy mix implementation *	very easy	Easy	difficult	difficult
Economic efficiency	low	Medium	medium	high
Financial capability	high	High	low	low

*Power station and grid development along with policy direction.

Source: Study team.

3.1. Energy Mix Implementation

With the National Monopoly Model and Private Regional Monopoly Model, governments are able to intervene to a certain degree in electricity markets. For this reason, these models have the advantage of making it easy for governments to implement their energy policies and electricity source development plans.

In contrast, since in principle the Liberalised Power Generation Sector plus Single Buyer Model or Fully Liberalised Model leave the electricity generation sector to free competition, they make it difficult for governments to reflect their energy policies and electricity source development plans.

3.2. Economic Efficiency

With the Liberalised Power Generation Sector plus Single Buyer Model or Fully Liberalised Model, enhanced economic efficiency can be expected due to competition amongst those engaging in electricity generation and electricity generation plant construction.

With the Private Regional Monopoly Model, although there is no competition, if regulations give governments the ability to carry out price reviews as needed, economic efficiency can presumably be enhanced to a certain degree. Appropriate price reviews could minimise the necessary cost. As a result, the electricity price would not increase or even drop to a lower price range. However, it should be remembered that government officers need to have satisfactory capability to conduct cost assessment.

With the National Monopoly Model, on the other hand, there is no competition and the potential for reduced economic efficiency increases.

3.3. Financial Capability

With the National Monopoly Model, it is possible to procure funds based on the creditworthiness of the government. Official development assistance funds can also be utilised.

With regard to the Private Regional Monopoly Model, since it is based on regional monopolies it is possible to achieve a higher level of reliability than with competitive markets. Since it involves private sector companies, however, official development assistance cannot be used.

With the Liberalised Power Generation Sector plus Single Buyer Model or Fully Liberalised Model, fund procurement is left up to the private sector. Although domestic private sector companies cannot attain creditworthiness greater than that of government bonds, they may have more of an advantage when procuring funds when attempting to utilise foreign capital.

4. Policy Recommendation for ASEAN Member States

Based on consideration of the three perspectives above, we would like to propose that ASEAN member states introduce the market models that are most appropriate in light of their own policy priorities.

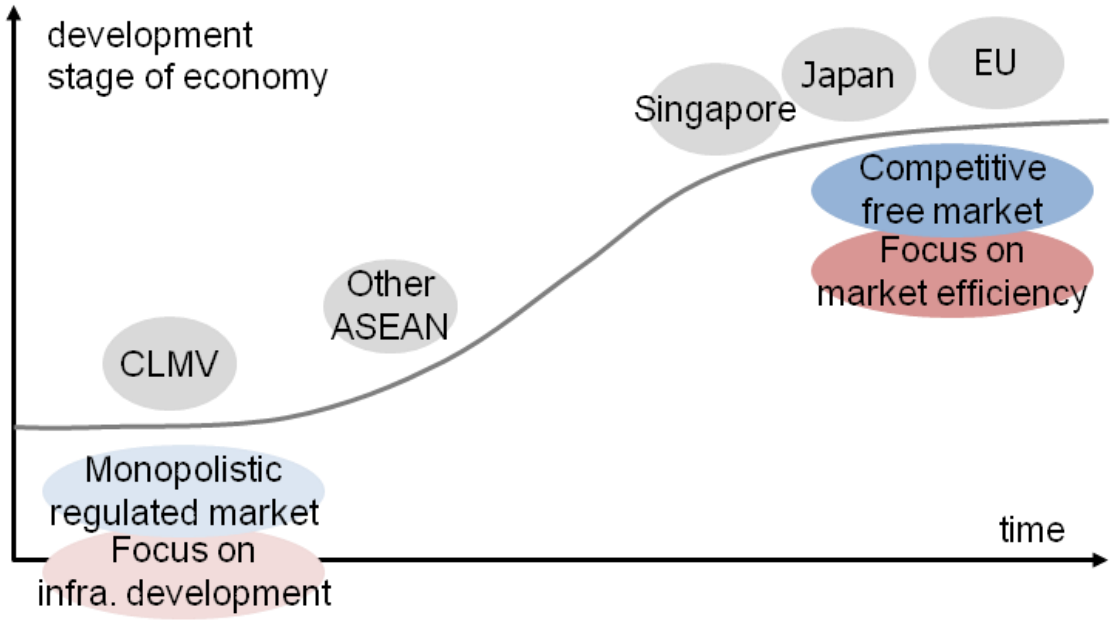
As mentioned, although a free market is highly likely to enhance economic rationality, it is unsuitable from the standpoint of creating electricity infrastructure and balanced electricity mixes. In other words, there are currently no electricity liberalisation models that make it possible to simultaneously achieve energy security, economic efficiency, and environmental sustainability.

As is well-known, apart from a certain number of countries, many ASEAN member states are still working on developing electricity infrastructure such as electricity generation plants and transmission/distribution networks. In addition, many countries are increasingly relying on imported energy, making the creation of balanced electricity portfolios more and more important. Responding to the issues of pollution and climate change has also become a crucial aspect of sustainable economic development.

Related to this, while current liberalisation models bring efficiency to markets, they also have the potential to cause imbalance in infrastructure investment or hinder it. That is to say, they may not be able to satisfy the requirements of the policies of ASEAN member states. Conversely, if infrastructure is fully developed and policies prioritise economic efficiency, electricity market liberalisation is an appropriate option.

Thus, based on the circumstances of ASEAN member states and the advantages and disadvantages of each market model, it could be considered desirable in many cases to first adopt a model such as the National Monopoly Model to prioritise the creation of infrastructure and a balanced electricity mix, and then later move forward incrementally with the creation of systems that emphasise economic efficiency (Figure 4-4).

Figure 4-4: Development Stage of Economy, Policy,and Appropriate Market Structure



ASEAN = Association of Southeast Asian Nations; CLMV = Cambodia, Lao PDR, Myanmar, and Viet Nam; EU = European Union.

Source: Study team.

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