Energy Transition in Thailand:
Challenges and Opportunities

Dr. Puree Sirasoontorn and Professor Dr. Praipol Koomsup

FRIEDRICH EBERT STIFTUNG

Contents

List of Figures II

List of Tables II

List of Abbreviations III

List of Units III

Foreword IV

I. Background 1

I.1 Thailand and Climate Change 1

I.2 Energy Markets 3

I.3 Energy Institutions and Governance 6

I.4 Energy Policies 7

I.5 Energy Consumption and Production 10

II. Social Aspects of the Energy Transition in Thailand 15

II.1 Access to Energy 15

II.2 Energy Prices and Affordability 15

II.3 Energy & Jobs 17

II.4 Perceptions of Energy 18

III. Political Economy of the Energy Transition 20

III.1 Proponents of the Energy Transition 20

– Government agencies 20

– Civil Society 21

– Public and Private Collaboration 21

– International Organizations 22

III.2 Barriers to the Energy Transition 23

– Fragmented authority and capacity limitations 23

– Policy uncertainty and discontinuity 23

– Lack of coordination between public and private sectors 24

– Distorted fiscal and regulatory policy 25

– Weak governance 25

– Unsuccessful energy reforms 25

IV. Thailand-specific Characteristics 26

V. Policy Conclusions and Recommendations 28

VI. Recommendations for the FES Office 29

Notes 30

Bibliography 34

List of Figures

Figure 1.1 Structure of Electricity Supply Industry in Thailand in 2016 4
Figure 1.2 Share of Electricity Generation Classified by Producers in Thailand in 2015 4
Figure 1.3 Final Energy Consumption during 1994 - 2015 11
Figure 1.4 Electricity Consumption during 1994 - 2015 11
Figure 1.5 Share of Electricity Consumption Classified by Sectors in Thailand in 2015 12
Figure 1.6 Power Generation Classified by Fuel Type during 2010 - 2015 13
Figure 1.7 Proportion of Power Generation Classified by Fuel Type in 2015 13

List of Tables

Table 1.1 Operating Statistics of Electricity Distribution Companies in 2016 5
Table 1.2 Share of Electricity Generation Classified by Fuel Types 8
Table 1.3 The AEDP Targets of Renewable Energy 9
Table 1.4 Status and Target of Power Generation Classified by Types of Renewable Energy 10
Table 1.5 Renewable and Alternative Energy Consumption during 2012-2015 14

List of Abbreviations

AEDP	Alternative Energy Development Plan
APERC	Asia Pacific Energy Research Centre
ADB	Asian Development Bank
BOI	Board of Investment
BGET	Border Green Energy Team
BAU	Business-as-usual
CSO	Civil Society Organization
DEDE	Department of Alternative Energy Development and Efficiency
EGAT	Electricity Generating Authority of Thailand
EGCO	Electricity Generating Public Company
ESI	Electricity Supply Industry
EEAP	Energy Efficiency Action Plan
EEF	Energy Efficiency Finance
EEP	Energy Efficiency Plan
EERF	Energy Efficiency Revolving Fund
EFAI	Energy Fund Administration Institute
EPPO	Energy Policy and Planning Office
ERS	Energy Reform for Sustainability
ERC	Energy Regulatory Commission
ESCO	Energy Service Company
FiT	Feed-in Tariff
Ft	Fuel adjustment mechanism
GEF	Global Environment Facility
GHG	Greenhouse Gas
GDP	Gross Domestic Product
HPPF	Healthy Public Policy Foundation
ICS	Improved cook stove
IFCT	Industrial Finance Corporation of Thailand
IPP	Independent Power Producer
IPPU	Industrial processes and product use
INDC	Intended Nationally Determined Contribution
IEA	International Energy Agency
LNG	Liquefied Natural Gas
MEA	Metropolitan Electricity Authority
MOE	Ministry of Energy
MOF	Ministry of Finance
NAMA	National Appropriate Mitigation Action
NCCC	National Board of Climate Change Policy
NESDB	National Economic and Social Development Board
NEPC	National Energy Policy Council
NDC	Nationally Determined Contribution
PAER	People's Alliance for Energy Reform
PV	Photovoltaic
PDP	Power Development Plan
PPA	Power Purchase Agreement
PEA	Provincial Electricity Authority
PTT	PTT Public Company Limited
RATCH	Ratchaburi Electricity Generating Holding Public Company Limited
RAC	Refrigeration and Air Conditioning
RE	Renewable Energy
REDP	Renewable Energy Development Plan
SPP	Small Power Producer
SOE	State Owned Enterprise
SDG	Sustainable Development Goal
TSRI	Thai Solar PV Roadmap Initiative
TIEP	Thailand Integrated Energy Plan
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
VSPP	Very Small Power Producer

List of Units

Ktoe	kilotonnes of oil equivalent
$MtCO_2e$	metric tons of carbon dioxide equivalent

Foreword

Tackling climate change will not be possible without a significant contribution from Asia. Although most Asian countries currently have relatively low levels of per capita greenhouse gas emissions and historically Asia's contribution to global climate change has been limited, Asia now contributes already substantially to global greenhouse gas emissions. This is both because of the region's large population and relatively robust economic growth. According to economic forecasts, Asia's share of global greenhouse gas emissions will grow dramatically in the coming decades. At the same time, millions of people in the region will be affected by climate change. Serious environmental pollution has resulted from the burning of fossil fuels. Health risks due to air pollution already affect millions of Asians.

There are signs of growing interest in renewable energies in many parts of Asia out of energy security and environmental concerns as well as to bring electricity to energy poor regions. With dropping renewable energy prices there is growing investment in the sector in Asia. This makes it increasingly possible to talk about the beginning of energy transitions, which are occurring in the region. Greater use of renewable energy may lead to more socially and environmentally just energy structures. We still know, however, little about the actual social and political contributions, costs and implications of renewable energy expansion.

The Friedrich-Ebert-Stiftung decided to examine these questions with a series of country studies in Asia. The studies address the political and social factors that drive, but also hamper socially just energy transitions. To this end, authors from China, India, Indonesia, Japan, the Philippines, the Republic of Korea (South Korea), Thailand, and Vietnam worked together with Miranda Schreurs, Professor of Environmental and Climate Policy in the Bavarian School of Public Policy, Technical University of Munich to provide an in-depth analysis of the situation in their respective countries. The preparation of the country studies and their review was supported by Julia Balanowski.

The studies provide insights into the status of climate and energy policies, their socio-economic implications and the actors involved in developing and implementing those policies. Two of the important questions that motivated this comparative study were whether renewable energy development was contributing to a more socially just energy structure and which factors foster and impede political acceptance of renewable energy development.

We hope that this study provides a starting point for further analysis to foster a learning process on a transition towards renewable energy in Thailand and will provide useful information to policymakers, academics and civil society to work together towards low-carbon development in Thailand and beyond.

Yvonne Blos
Friedrich-Ebert-Stiftung Vietnam
Regional coordinator for climate and energy in Asia

Stine Klapper
Friedrich-Ebert-Stiftung Thailand
Resident Director

I. Background[1]

There are two objectives of this study. The first objective is to study how an energy transformation can be implemented in a socially just manner. From a social point of view, a just energy transition would lead to an equal access to energy for all Thai people and socially equitable energy tariffs. Moreover, the shifting of jobs from people employed in the fossil fuel-based energy branch to new positions in "green energy" is a central aspect of justice in the energy transition. The second objective is to study how an energy transformation can be politically accepted and implemented, and how 'green energy policies' are implemented.

This study is based on extensive documentary research from various academic literature and government agencies, media information and in-depth interviews with experts, government officials, private investors and operators, and civil society organization (CSO) staff.

I.1 Thailand and Climate Change

Before the 1960s, the Thai economy was agriculture-based with a relatively small industrial sector. With a limited private sector, the government had a major role in the country's economy. In order to achieve multiple socio-economic and political goals, one of the major changes in the economy and politics was the creation of the National Economic and Social Development Board (NESDB) to prepare five-year economic development plans known as the National Economic and Social Development plans. These plans contributed to Thailand's transformation from an agricultural to an industrial economy over the period between 1961 and 2001, and they contributed to enhancing the engagement of the private sector and reduction in government interventions in the economy.

From the First Plan (1961–66) to the Eighth Plan (1997–2001), import substitution and export promotion policies were prioritized, while neither environmental concerns nor overexploitation of natural resources was recognized serious issues. The expansion of industries and unbalanced growth-oriented development in different parts of Thailand caused severe environmental damage and contributed to the depletion and deterioration of natural resources, deforestation, and exacerbated land use and pollution problems.

In the formulation of the Eight Plan (1997–2001), the philosophy of a "Sufficiency Economy" was adopted and applied to Thai society at all levels, ranging from families and communities to the nation as a whole. Sufficiency Economy places emphasis on the middle path as a key principle for appropriate conduct by Thai people and at the same time calls for national development and administration to modernize in line with the forces of globalization. Sufficiency Economy allows society members to live together in harmony, seek justice and have equal opportunities to better themselves to improve their quality of life[2]. With the philosophy of Sufficiency Economy, resilience of the country will be achieved through utilizing the nation's economic, social and environmental capital.

In the Ninth plan (2002-2006), policies on a knowledge-based economy were promoted in order to upgrade labor and capital-intensive industries to higher value-added industries. In order to reduce income inequality and to empower the Thai people, the government planned to build a strong and balanced society through decentralization, education, and research and development promotion policies.

Although environmental aspects were mentioned in the previous plans, they were not among the central goals. It was not until the Tenth plan (2007-2011) that sustainable economic growth was emphasized together with sustainable management of natural resources and the environment.

In the Eleventh plan (2012-2016), a strategy for managing natural resources and the environment towards sustainability was included as one of the six key development strategies of Thailand. It was the first plan which identified continuously increasing greenhouse gas (GHG) emissions in Thailand as a serious problem and promoted Thailand's engagement in the international community as a means to tackle climate change problems. Although no numerical target regarding a GHG emission reduction was set, it was the first plan in

which the Thai government acknowledged that a target ought to be set to enhance the adaptive capacity to meet climate change challenges and improve the efficiency of GHG mitigation.

The overall vision of the Thai government in the Twelfth plan (2017-2021) is "Security, Prosperity and Sustainability". This plan was formulated at a time of rapid change in the world economy as well as reform in Thailand. Apart from the Sufficiency Economy Philosophy, vital elements of Thai development strategies are, the 20-year National Strategy Framework (2017-2036), Thailand's Sustainable Development Goals (SDGs) and the Thailand 4.0 policy focusing on the development of a digital economy.

The objectives and targets in the Twelfth plan are diverse. The government still relies on indicators such as the economic growth rate, the export growth rate, and public and private investment to ensure security and prosperity of the country. The government plans to promote research and development together with innovation and a digital revolution in small and medium enterprises as vital elements for sector growth. A people-centric approach is also planned, with the goal to foster human capital that has a good quality of life, is educated and embodies skills that are acquired through ongoing learning and development.

Some of the development strategies in these plans focus on environmentally friendly growth for sustainable development and competitiveness. The Twelfth plan is the first which sets a quantified target to reduce GHG emissions in the energy and transport sectors, by seven percent from a business-as-usual (BAU) scenario by 2020. This short-term target of GHG emission reduction is part of the long-term Intended Nationally Determined Contribution (INDC) under the United Nations Framework Convention on Climate Change (UNFCCC).

According to Thailand's INDC submitted to the UNFCCC in 2015,

> "Thailand intends to reduce its greenhouse gas emissions by 20 percent from the projected business-as-usual (BAU) level by 2030. The level[3] of contribution could increase up to 25 percent, subject to adequate and enhanced access to technology development and transfer, financial resources and capacity building support through a balanced and ambitious global agreement under the United Nations Framework Convention on Climate Change (UNFCCC).[4]"

The government of Thailand is increasingly becoming aware of the severe impacts of climate change to the world and to Thailand itself.

According to CAIT Climate Data Explorer, in 2013 Thailand's total GHG emissions[5] was 369.43 metric tons of carbon dioxide equivalent (MtCO2e), representing 0.85 percent of the global emissions. GHG emissions per capita in Thailand was 5.48 tCO_2e, while the emission intensity was 410 tCO2e per million US dollars, which is both lower than the world average of 6.14 tCO2e per capita and 440.39 tCO2e per million US dollars in 2013 respectively. The energy sector is a key contributor to GHG emissions in Thailand, accounting for 71.6 percent of total GHG emissions, and is followed by the agricultural sector with 18.3 percent. The energy sub-sectors contributing most to GHG emissions are electricity and heating, transportation, manufacturing and construction, and other fuel combustion, which account for 43.3, 23.59, 19.1 and 10.62 percent of GHG emissions respectively in Thailand's energy sector.

As a result, mitigation efforts in Thailand's INDC in 2015 have focused primarily on the energy and transport sectors. Thailand's INDC reported that after a preliminary analysis, in 2015 Thailand has already achieved a 4 percent reduction its GHG emissions from the projections in its 2020 target compared to BAU. It claims that Thailand is progressing well on its pledge to achieve its 7 percent reduction target through voluntary domestic efforts by 2020. However, at the time of writing, there is no official or scientific report to support this claim.

Under the lead of the Thai Military Government, the Prime Minister has stepped up the level of Thailand's commitment to tackling climate change vis-à-vis the international community by signing the Paris Agreement on April 22, 2016. Thailand ratified the Paris Agreement on September 21, 2016, turning the INDC into its Nationally Determined Contribution (NDC). This action reflects the acceptance of the significance of the effects of climate change, and implies that Thailand is willing

to join international community to deal with climate change issues. Thailand went forward with keeping the INDC and adding agriculture, forestry and land use components into the NDC.

Thailand's National Board of Climate Change Policy (NCCC) is responsible for the development of the NDC. Mitigation planning covers the sectors of energy and transport, waste, industrial processes and product use (IPPU), and agriculture, forestry and land use. To implement the NCCC, line ministries and related agencies are assigned to be in a working group on mitigation planning and to develop and draw the NDC roadmap in order to seek approval from the Cabinet. Afterwards, the NDC Roadmap on Mitigation during 2021-2030 will be implemented. For the period 2021-2030, the GHG emissions reduction target is 115.6 MtCO2e or 20 percent from BAU levels by 2030. Contributions of GHG emissions reduction in energy and transport, waste, and IPPU sectors are 113, 2 and 0.6 MtCO2e, respectively.

By the time of writing, the Cabinet has formulated Thailand's NDC based on the following plans, in order to achieve the targets:

- ▪Power Development Plan, 2015-2036 (PDP2015).
- ▪Thailand Smart Grid Development Master Plan, 2015-2036.
- ▪Energy Efficiency Plan, 2015-2036 (EEP2015).
- ▪Alternative Energy Development Plan, 2015-2036 (AEDP2015).
- ▪Master Plan for Sustainable Transport System and Mitigation of Climate Change Impacts.
- ▪National Industrial Development Master Plan, 2012-2031.
- ▪Waste Management Master Plan (2016-2021)
- ▪Environmental Quality Management Plan, 2017-2021.
- Montreal Protocol Implementation.
- ▪Refrigeration and Air Conditioning (RAC) National Appropriate Mitigation Action (NAMA) Project.

The energy sector makes an enormous contribution to Thailand's GHG emission growth, which makes tackling this sector critical for effective GHG emission mitigation. Thailand has to balance the issues of energy security and economic development, with climate change and environmental degradation.

I.2 Energy Markets

As shown in Figure 1.1, the electricity supply industry (ESI) in Thailand comprises state owned enterprises (SOEs), independent power producers (IPPs), small power producers (SPPs) and very small power producers (VSPPs). The Electricity Generating Authority of Thailand (EGAT) is the largest state-owned, vertically integrated utility, and plays the key role in electricity generation and transmission in the Thai power sector.

In the electricity generation business, EGAT is the largest power producer with a 38 percent market share in 2015. It is followed by IPPs, SPPs and VSPPs with shares of 37, 15, and 3 percent of power generation respectively, as shown in Figure 1.2. The final 7 percent is made up of electricity imports from Malaysia and Lao PDR through the EGAT's network. Although there are many IPPs and SPPs providing power to the EGAT's grid, the two largest IPPs are Ratchaburi Electricity Generating Holding Public Company Limited (RATCH) and Electricity Generating Public Company (EGCO), with shares of 14 and 11 percent of power generation respectively. They are both partially owned by EGAT, which maintains shares of RATCH and EGCO at 45 and 25 percent, respectively.[6] As a result, EGAT remains the controlling authority in the electricity generation business in Thailand.

According to its 2016 annual report, the proportion of domestic electricity transmitted through domestic natural gas fueled power plants is 66 percent, which is then followed by coal power plants with about 18.5 percent of generation. Only 4.24 percent of the electricity in the EGAT's grid was generated by renewable energy, which includes solar, wind, biomass and hydropower.

EGAT owns 100 percent of transmission assets nationwide and performs the role of a system operator.[7] IPPs and SPPs produce and sell electricity to the high-voltage transmission system solely owned by the single buyer, EGAT. Under the enhanced single buyer model of Thailand's electricity supply industry, EGAT's system operations are ring-fenced from EGAT's remaining activities to maintain transparency and to ensure that electricity generated by IPPs is dispatched equally with EGAT-owned generation. However, system operation remains within EGAT's organizational structure. Without

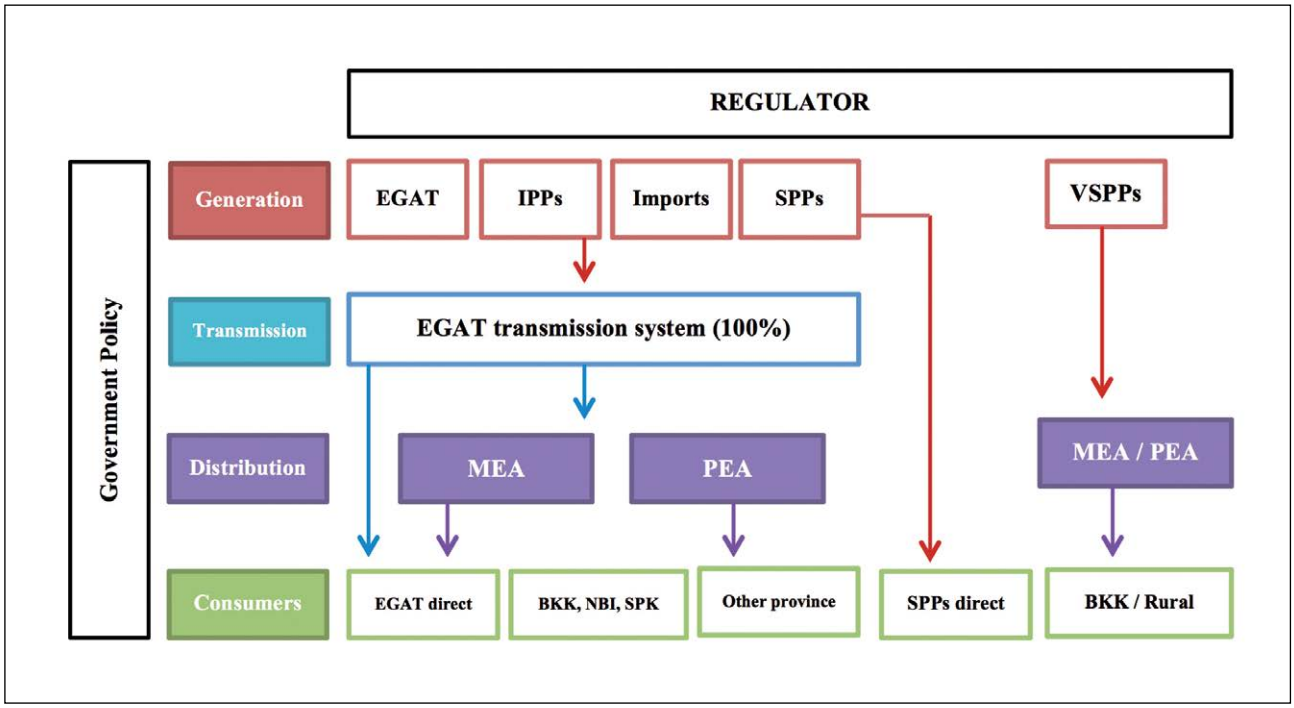

Figure 1.1. Structure of Electricity Supply Industry in Thailand in 2016.

Source: International Energy Agency (2016).

Legend: ***EGAT:*** *Electricity Generating Authority of Thailand;* ***MEA:*** *Metropolitan Electricity Authority;* ***PEA:*** *Provincial Electricity Authority;* ***IPPs:*** *Independent Power Producers;* ***SPPs:*** *Small Power Producers;* ***VSPPs:*** *Very Small Power Producers;* ***EGAT direct:*** *EGAT's direct customers;* ***SPPs direct:*** *SPP's direct customers;* ***BKK:*** *Bangkok;* ***NBI:*** *Nonthaburi;* ***SPK****: Samut Prakan.*

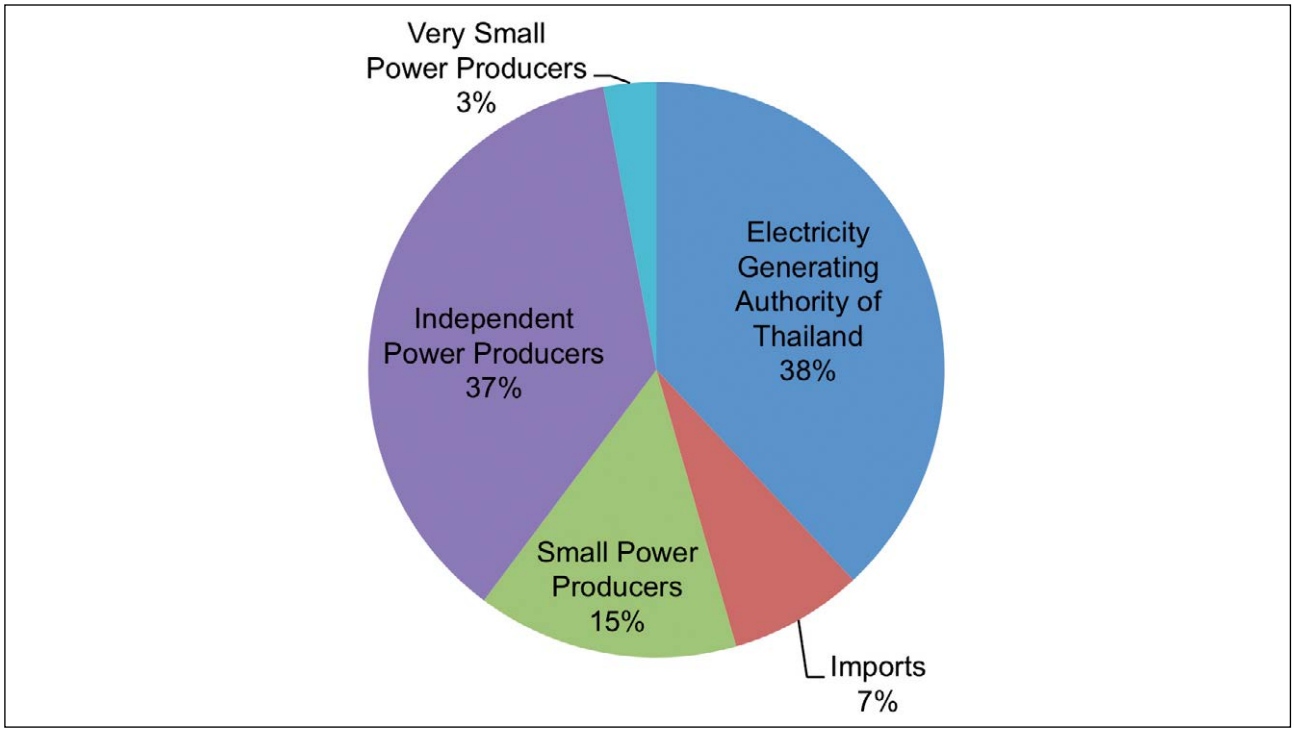

Figure 1.2. Share of Electricity Generation Classified by Producers in Thailand in 2015.

Source: Energy Statistics of Thailand 2016 by EPPO .

structural and organizational unbundling of EGAT and ring-fencing guideline from the Energy Regulatory Commission, it is still unclear whether private power producers are treated with nondiscriminatory practices.

The EGAT sells power to two distribution companies, the Metropolitan Electricity Authority (MEA) and Provincial Electricity Authority (PEA). The EGAT also undertakes limited direct sales to certain large retail customers. Figure 1.1 shows that VSPPs can sell power directly to the MEA and PEA whereas SPPs can sell directly to their own customers. However, the share of electricity through direct sale in Thailand is negligible. As a result, the energy market in Thailand can be considered as an oligopoly, as there are a few producers generating and supplying power for the entire domestic consumption. The overall structure is demonstrated in Figure 1.1.

The MEA and PEA are electricity distribution and retailing SOEs, each operating in different areas as monopolists. As shown in Table 1.1, the MEA operates electricity distribution and retailing activities in Bangkok, Nonthaburi, and Samut Prakarn, covering an area of 3,192 square kilometers. The MEA does not generate electricity itself, but instead purchases it from the EGAT or directly from VSPPs. It is directly responsible for the high-voltage distribution network within its responsible areas, and is involved in the design, installation and maintenance of high-voltage as well as low-voltage electrical systems.

The PEA's primary responsibilities include generation, procurement, distribution and retailing of electricity to the public, business and industrial sectors in 74 provinces, over a nationwide area of 510,000 square kilometers, or 99.4 percent of Thailand. The PEA does not own or control any of the high-voltage lines within its service territory.

Although the MEA covers a much smaller area than the PEA, in 2016 MEA accounted for disproportionately high 28.38 percent of all electricity sales, including public lighting in Thailand, while the PEA's share was 71.62 percent, as shown in Table 1.1. In addition, energy sales per customer in the MEA's operating area were 14,142.42 kWh, which is more than double that of the PEA (6,863.2 kWh). It is clear that electricity usage in metropolitan areas is much higher than in other areas in Thailand.

As approximately two-thirds of Thailand's electricity generation is sourced from natural gas, the PTT Public Company Limited (PTT) plays a key role in securing fuel supply for the majority of Thailand's power plants. PTT is the largest fully integrated oil and natural gas company in Thailand. It operates upstream oil and gas exploration and production, the import and export of crude oil, condensate[8], petroleum feedstock and petrochemical products, and midstream oil and gas storage and transportation, refining and marketing of refined products. The PTT is an SOE majority owned by the Ministry of Finance (MOF) with a share of 51 percent.

The financial performance of energy-related SOEs is excellent. They are highly profitable, partly due to their monopoly power.

Table 1.1. Operating Statistics of Electricity Distribution Companies in 2016

At September 30:	Metropolitan Electricity Authority	Provincial Electricity Authority
Distribution area (square kilometers)	3,192	510,000
Maximum power demand (MW)	9,296.57	20,854
Energy purchase (million kWh)	53,179.84	137,078
Energy sales (million kWh)	51,375.49	129,672.60
Number of customers (customers)	3,632,722	18,893,916
Number of employees (persons)	8,413	30,114

Source: Metropolitan Electricity Authority and Provincial Electricity Authority annual reports in 2016.

Other institutions which play a major role in energy regulation and policy are the Energy Regulatory Commission and political bodies such as the NEPC and the MOE. Their role and responsibilities will be discussed in the subsequent sections.

I.3 Energy Institutions and Governance

The major institutions and stakeholders in the Thai energy structure comprise of government agencies, SOEs, private sector companies, international organizations, and national and international civil society organizations.

The National Energy Policy Council (NEPC) was established in 1992 to develop, manage and regulate national energy policy. The NEPC consists of the Prime Minister as a Chairman, a Deputy Prime Minister designated by the Prime Minister as Vice-Chairman, the Ministers for Energy, Transport, Interior, Defence, Foreign Affairs, Finance and Agriculture, as well as the Secretary-General of the NEPC. The NEPC is the main and final decision maker on all energy policies, plans and activities in Thailand.

The Ministry of Energy (MOE) was established in 2002. It has the authority to conduct the procurement, development and management of energy in Thailand. The MOE proposes and implements all policies related to energy, including electric power, renewable energy and energy efficiency policies. In addition, the MOE has control over the energy-related SOEs: EGAT, MEA, PEA, PTT, Bangchak Petroleum Public Company Limited and further public organizations, namely the Energy Fund Administration Institute (EFAI) and the Energy Regulatory Commission (ERC).

Under the MOE, the role of the Department of Alternative Energy Development and Efficiency (DEDE) is to promote renewable energy and energy efficiency, while the Energy Policy and Planning Office (EPPO) is the key government agency to recommend energy policies, including the Power Development Plan (PDP), energy management and development plans of the country, and also acts as Secretariat to the NEPC. Both government agencies play crucial roles in Thailand's energy transition towards a low-carbon society.

In 2007, the ERC was established in order to separate roles and functions of policymakers, regulators and operators, and to centralize regulatory functions. Essentially, the ERC has the authority and duty to regulate electricity tariffs, to issue licenses for energy industry operation in the ESI and energy network system business, to issue regulations for power procurement, customer service standards and quality, including measures to protect energy consumers against adverse impacts resulting from the energy industry operation and levies for Power Development Fund, and to provide comments on energy-related plans to the MOE and the NEPC.

According to the Energy Industry Act enacted in 2005, the ERC was designed to be independent and to work separately from the MOE with guidance from the NEPC.[9] However, the MOE still retains certain controlling power over the ERC, particularly in the area of consideration for the ERC's operating plan and budget, and the nominations for the ERC's commissioners. To date, the ERC's regulatory governance has been questioned, particularly in the area of autonomy and independence from political interference[10,11].

Apart from the permanently assigned authorities, some committees on electricity are appointed occasionally and temporarily to deal with specific issues, such as tariff determination and the Power Development Plan. These committees consist of members from government agencies, SOEs, some interest groups from private sectors such as the Federation of Thai Industries and the Thai Chamber of Commerce, and various outside experts such as academics and civil society organizations (CSOs). The involvement from private sectors, academics and CSOs shows good endeavor to include non-governmental participation in the decision-making process.

Apart from key government agencies in the energy sector, there are other government agencies which take part in the implementation of energy policies and plans. For example, the Ministry of Finance (MOF) must approve all public electricity-related investment projects. Investment decisions must, therefore, gain the approval of two main Thai ministries: the MOF and the MOE.

The Ministry of the Interior is involved in the energy sector as two SOEs, namely the MEA and the PEA, are established under its authority and regulated by its

right of ownership. In addition, the development of the provincial electricity sector was formerly undertaken under the authority of the Ministry of Interior.

The Ministry of Industry is involved in the electricity sector as it supervises and coordinates the activities of industrial business operations by applying the guidelines on environmental protection, safety and hygiene, and energy efficiency. At certain sizes, industrial business operators in the power generation business must register with the Ministry of Industry.

The decision-making structure within the Thai energy sector is complex. Since there are a number of government agencies performing various policymaking and regulatory functions under their own jurisdiction, coordination and transaction costs are high. Moreover, some of their roles and responsibilities overlap. For example, the ERC, as a regulator in the energy sector, is required to seek approval from the NEPC for certain issues, such as tariff determination. Any policy and regulation relating to the PDP is undertaken by the NEPC. In some areas such as energy efficiency, the operator EGAT still plays a more important role to promote energy efficiency than the government agencies.

Civil society in Thailand covers citizen organizations with political, social and economic motivations, and environmental concerns. The concerns of some Thai CSOs may simultaneously cover multiple issues. Each CSO may represent a diverse and wide variety of groups of people, ranging from academics, intellectuals, political elite to grassroots and local peoples. They are often organized based on their geographic areas, reflecting their own characteristics and local interests.

The CSOs in the Thai energy sector are very dynamic, and often employ communication technology and the internet, such as social media, to disseminate information or publicize their causes. They evolved from social protest movements to groups organizing environmental protests in the 1990s,[12] and in the 2000s they have continued to work on energy-related issues, especially ESI reform, energy policy and regulation, governance, environment and local community livelihood sustainability. They tend to oppose problematic projects, particularly the construction of coal-fired power plants, support progressive and liberal energy policies, pursue public participation and accountability in the PDP process, and propose alternative plans, values and visions for Thailand's electricity sector.[13] CSOs in Thailand will continue to be a catalyst for a sustainable energy transition.

The exact number of local and international CSOs working on various energy issues cannot be identified because there is no mandatory registration mechanism for CSOs based in Thailand, and some CSOs were established and dissolved quickly as they were solely focused with specific agendas or for local issues.

In Thailand, there are international CSOs such as Greenpeace, and Thai CSOs such as Energy Reform for Sustainability (ERS), People's Alliance for Energy Reform (PAER), Thai Health Promotion Foundation, Green World Foundation together with Thai academics. Although Thai CSOs do not always share equal causes, values and visions for the Thai energy sector, and sometimes have conflicting ideas, they are strong supporters of an energy transition towards a low-carbon society and sustainable development.

The examples of international donors which strongly support Thailand's energy transition are the Asian Development Bank (ADB), United States Agency for International Development (USAID), and GIZ, the German Development Corporation. They play important roles in fostering energy transition by providing financial and non-financial incentives, technology transfer, training and education, and research and development in the areas of energy conservation, renewable energy and energy efficiency.

I.4 Energy Policies

For decades, Thailand has formulated energy policies which follow the NESDB plans focused on economic growth and development. Energy plans were drawn and implemented separately by type of fuels, such as the PDP, the Gas Plan and the Oil Plan. Energy conservation has been a priority since the enactment of the 1992 Energy Conservation Promotion Act, which aimed to promote energy efficiency and renewable energy in Thailand.

Following national plans and policies, including the National Security Plan (2013-2021), the 20-year National

Table 1.2. Share of Electricity Generation Classified by Fuel Types.

	2015	2036
Total electricity generation (GWh)	190,285	326,119
Share of Electricity Generation (%)		
Natural Gas	64	37
Coal	10	17
Lignite	10	6
Renewable Energy	7	18
Hydro power- Domestic	3	2
Hydro power- Foreign	6	15
Nuclear	0	5
Total	100	100

Source: Power Development Plan by EPPO.

Strategy Framework (2017-2036), the Twelfth NESDB plan (2017-2021), the Thailand 4.0 policy and Thailand's Sustainable Development Goals (SDGs), Thailand has combined various plans connected to energy issues into a long-term Energy Master Plan, called the "Thailand Integrated Energy Plan (TIEP)" covering the period from 2015 to 2036. In contrast to its name, however, the TIEP is not a single integrated plan, but it is a set of five plans developed in the same period of time.[14] These are the Power Development Plan (PDP) (2015-2036), the Energy Efficiency Plan (EEP) (2015-2036), the Alternative Energy Development Plan (AEDP) (2015-2036), the Gas Plan (2015-2036) and the Oil Plan (2015-2036). Out of these, the PDP, EEP and AEDP are key plans in Thailand's NDC. All plans and policies support the NDC of reducing GHG emissions by 20 percent from BAU level by 2030. Each plan will consequently establish its targets in accordance with the NDC commitments.

The guideline principles of the PDP and key energy policy objectives are 'energy security,' to cope with increasing power demand and to take into account fuel diversification; 'economy' to maintain an appropriate cost of power generation for long-term economic competitiveness; and 'ecology' to lessen the carbon intensity of power generation.

Thailand's PDP places emphasis on power system reliability in both risky and conflicting areas in the South of Thailand, and in growing and high demand areas in the central metropolitan regions of Thailand. Moreover, it aims to reduce dependence on natural gas power generation, to increase the share of coal power generation via efficient coal technology, and expand transmission and distribution infrastructure to support renewable energy and smart-grid development.

The PDP was designed based on the long-term load forecast which was related to the average growth of the Thai Gross Domestic Product (GDP) from 2014 to 2036, estimated at 3.94 percent by the Office of the National Economics and Social Development Board. The forecast was further based on the average population growth, the energy saving target from EEP and the renewable energy target from AEDP.

The PDP aims to achieve a share of 20 percent of electricity generated from domestic renewables[15] by 2036 as shown in Table 1.2.

The PDP aims to diversify the fuel mix of power generation from natural gas to renewable energy, coal and lignite in order to improve energy security and to reduce dependence on fuel imports in the future. There is a small section included in the PDP on nuclear power, however the necessary planning has so far been negligible. Nuclear power remains unfeasible in Thailand, largely due to resistance in Thai society stemming from

Table 1.3. The AEDP Targets of Renewable Energy.

	Share of RE (%)		
Energy	**Status As of 2014**	**Target by 2036**	**Final Energy Consumption at 2036**
Electricity: Electricity	9	15 - 20	27,789
Heat: Heat	17	30 - 35	68,413
Bio-fuels: Fuels	7	20 - 25	34,798
RE: Final Energy Consumption	12	30	131,000

Source: Alternative Energy Development Plan by EPPO.

the Fukushima Daiichi nuclear power plan accident in Japan in 2011. However, the government still decided not to drop nuclear power from the prospective fuel mix of power generation in its PDP.

Table 1.2 shows that the target of electricity generated by natural gas will reduce from 64 percent of total electricity generation in 2015 to 37 percent in 2036 while it will aim to rely more on coal and lignite (24 percent) and domestic renewable energy (20 percent).

In terms of total capacity, the target by 2036 is 70,335 MW comprising the existing capacity of 37,612 MW as of 2014, new capacity of 57,459 MW, and retired capacity during 2015-2036 of 24,736 MW (PDP, 2015). The target of new capacity of renewable power is 21,648 MW, which accounts for 37.7 percent of total newly added capacity. Domestic renewable energy is about 12,105 MW, while renewable power purchases from neighboring countries is about 9,543 MW, most of which is hydropower.

To ensure energy security, new capacity of power generation will come from fossil-fired power plants, including combined cycle power plants (17,478 MW) and thermal power plants (12,113 MW). By 2036, the government plans to build 31 new power plants, comprising of 15 combined cycle power plants fueled by natural gas and 16 thermal power plants, including 9 coal-fired power plants, 5 natural gas power plants and 2 nuclear power plants.

Power system security was reinforced with the stipulation that the level of national reserve margin be not less than 15 percent of the peak power demand. Policies regarding the IPPs and the SPPs pursuant to committed contracts of private-sector power plants were also given due consideration. Investment plans of the Power Utilities for development of transmission and distribution systems were also made to be compatible with the ASEAN Power Grid and Smart Grid development, in order to enhance efficiency of power generation from renewable energy.

In 2013, carbon emissions in the power sector were 0.506 $kgCO_2$/kWh. In 2015, the PDP was developed to reduce carbon emissions more aggressively than the previous PDPs through the promotion of renewable energy and fuel diversification, and aimed for an emission reduction of 37 percent compared to 2013 levels (0.319 $kgCO_2$/kWh).

The AEDP aims for the proportion of renewable energy to reach 30 percent of total final energy consumption by 2036. This total final energy consumption from renewable energy includes electricity, biofuel and heating. Targets of AEDP are shown in Table 1.3.

The government has set the share of renewable energy in total electricity generation at 20 percent by 2036 in both the PDP and AEDP. It demonstrates an attempt to integrate the AEDP with the PDP in order to achieve objectives of fuel diversification and renewable energy promotion outlined in the Power Master Plan. By 2036, the main sources of power from renewable energy are expected to target solar power, biomass and wind power, as shown in Table 1.4.

Under the AEDP, a feed-in tariff is employed to promote renewable energy. Further, it states the need for a transmission and distribution system, alternative energy

Table 1.4. Status and Target of Power Generation Classified by Types of Renewable Energy.

Renewable Energy	Status at end of 2014* (MW)	Target at 2036 (MW)
1. MSW	65.72	500
2. Industrial Waste	-	50
3. Biomass	2,451.82	5,570
4. Biogas (WW/SW)	311.50	600
5. Small Hydro	142.01	376
6. Biogas (Energy Crop)	-	680
7. Wind	224.47	3,002
8. Solar	1,298.51	6,000
9. Large Hydro	-	2,906.40**
Total install capacity (MW)	4,494.03	19,684.40
Electrical Energy (Million Units)	17,217	65,588.07
Total Electrical Energy Demand (Million Units)	174,467	326,119
Share of RE in Electricity Generation (%)	9.87	20.11

Source: Alternative Energy Development Plan by EPPO.

Note:
** Including off grid power generation and not including power generated from large hydro.*
*** It is the existing capacity and the generation from large hydro was included in the target of AEDP.*

sources can be injected without the need for reverse power and with minimal power loss.

Thailand's EEP aims to decrease the country´s energy intensity by 30 percent from 15.28 in 2010 to 10.7 in 2036 and to reduce final energy consumption by 51,700 ktoe in 2036, particularly in the energy intensive transport, large building, industrial, and commercial and residential sectors.

I.5 Energy Consumption and Production[16]

For decades, the NESDB's five-year development plans have had an emphasis on the objective of economic growth. As a result, energy consumption has increased Thailand in order to achieve the goals of social and economic development. As shown in Figure 1.3, since 2000, Thailand's final energy consumption rose on average 3.8 percent per year to 84,846 kilotonnes of oil equivalent (Ktoe) in 2015. Petroleum[17] accounted for the largest share with 45 percent of the final energy consumption, followed by electricity[18] (17.8 percent), renewable energy[19] (16.54 percent), coal and lignite (10.44), and natural gas (10.36 percent).

Figure 1.4 demonstrates that electricity consumption has been increasing since 2000 at an average rate of 5 percent per annum to 174,831.7 GWh in 2015. The peak demand for electricity rose from 22,045 MW in 2009 to 27,346 MW in 2015 with an average growth rate of 2.86 percent per year.[20] However, during the period between 2009 and 2015, the load factor has fluctuated, ranging between 74.4 to 76.5 percent. Although the high load factor showed that Thailand has utilized electricity generation efficiently, these figures also demonstrate the potentially higher power demand in subsequent years which may lead to the problem of electricity shortages.

In Thailand, electricity is largely consumed by the industrial sector, which accounted for 42.77 percent of total electricity consumption in 2015, followed by

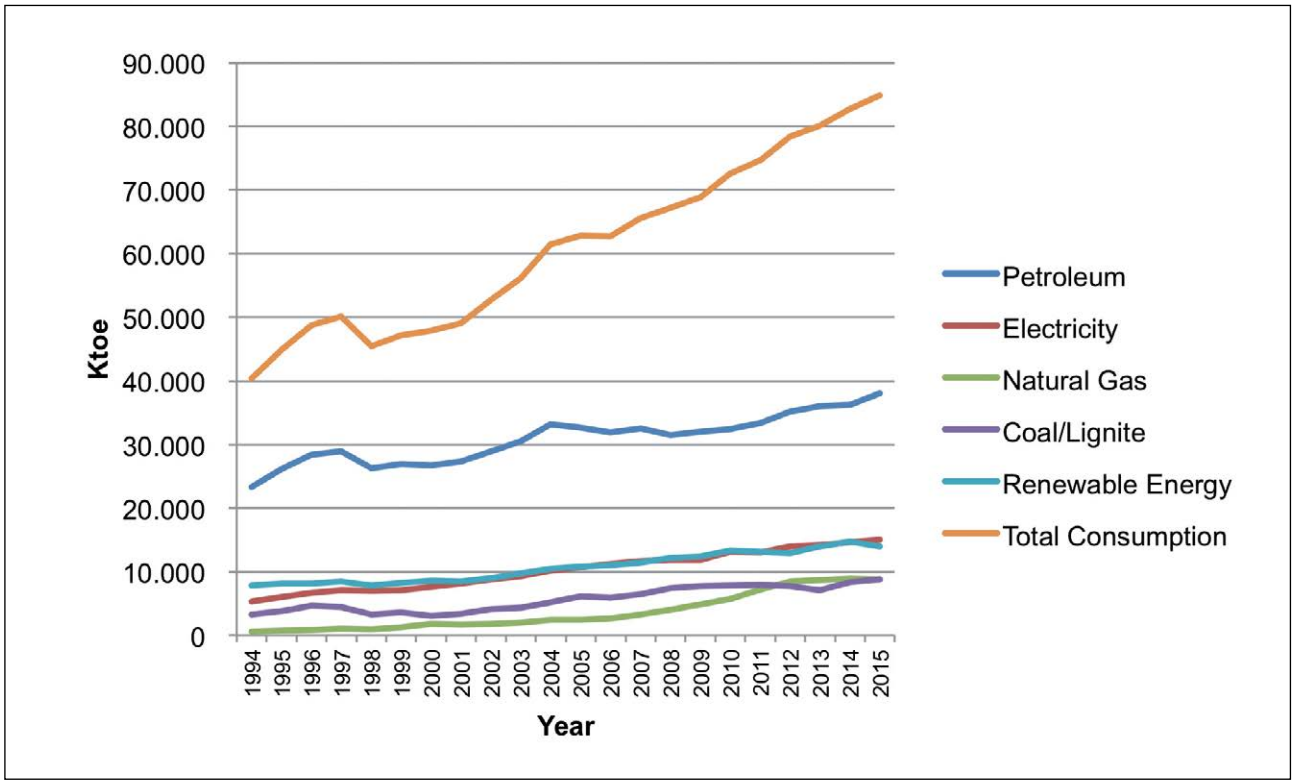

Figure 1.3. Final Energy Consumption during 1994 - 2015.
Source: Energy Statistics of Thailand 2016 by EPPO.

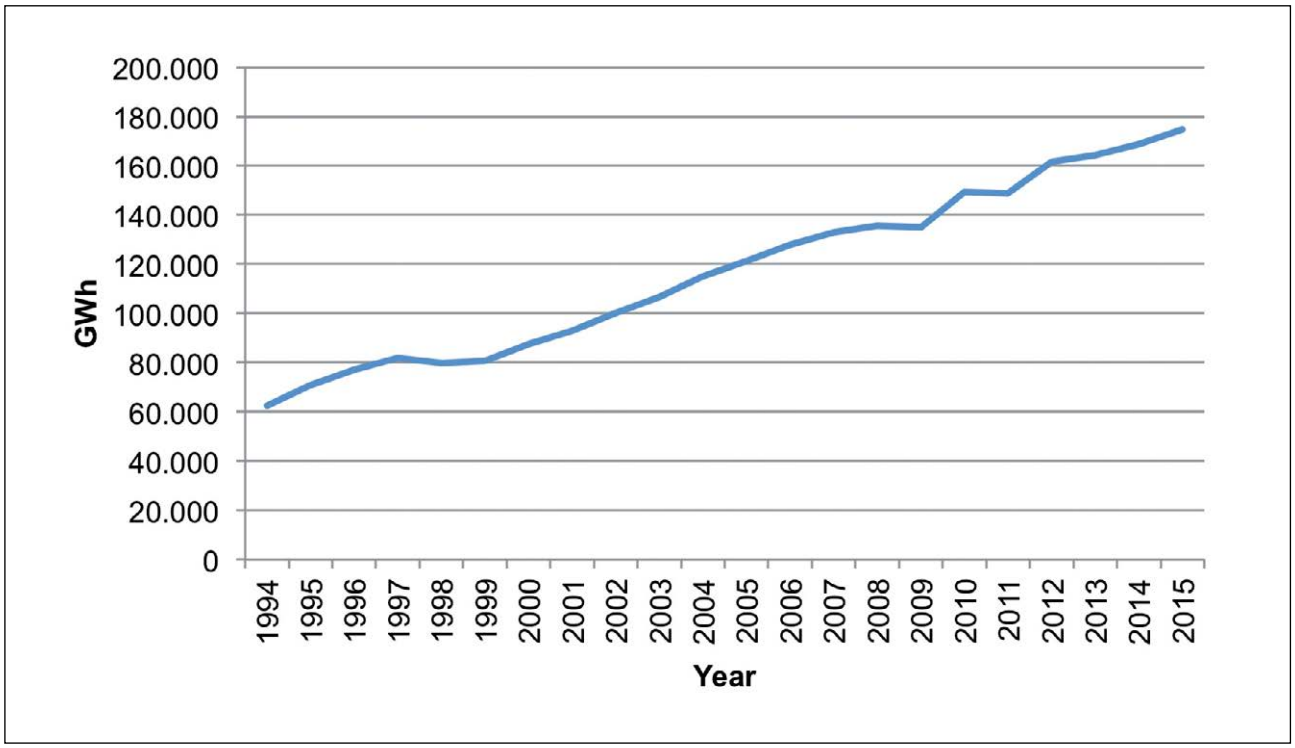

Figure 1.4. Electricity Consumption during 1994 - 2015.
Source: Energy Statistics of Thailand 2016 by EPPO.

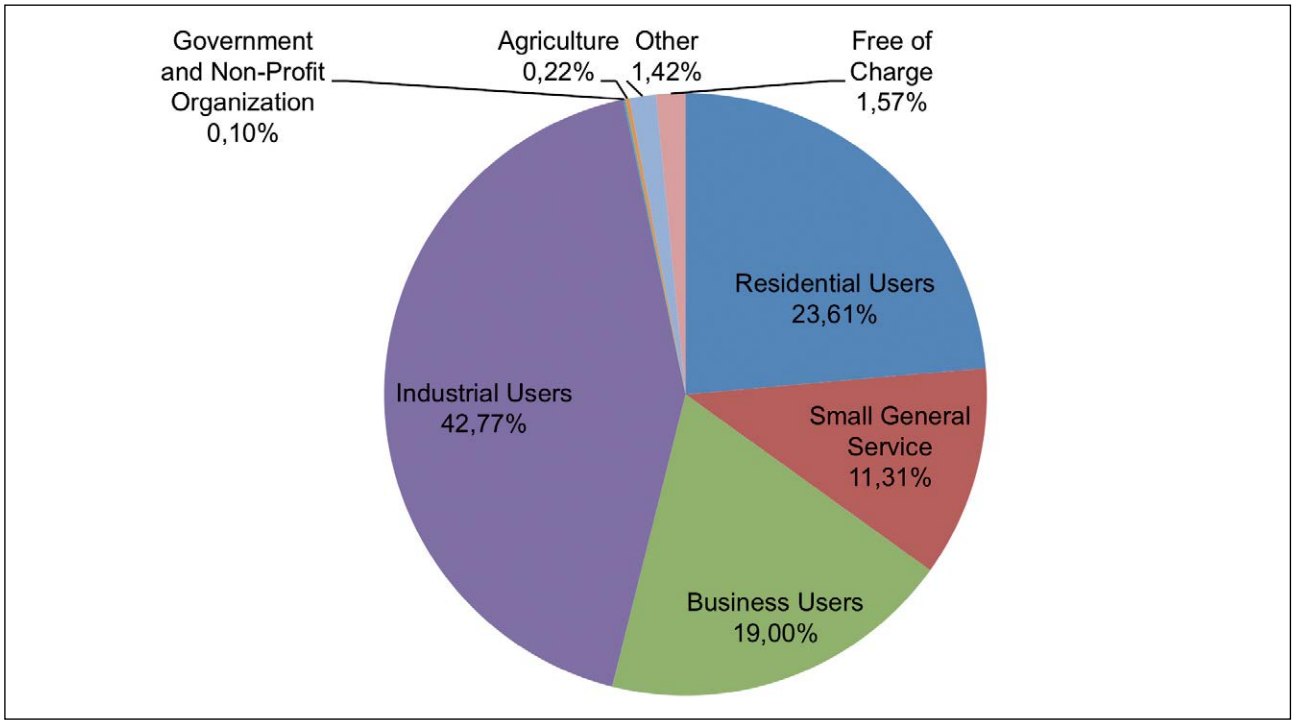

Figure 1.5. Share of Electricity Consumption Classified by Sectors in Thailand in 2015.
Source: Energy Statistics of Thailand 2016 by EPPO.

residential users, business users and small general services sector with shares of 23.61, 19 and 11.31 percent, respectively, as shown in Figure 1.5. It should be noted that Thailand has implemented a free electricity policy for under-privileged electricity users since 2010.[21]

As a result, electricity consumption in the user group "free of charge" has rocketed by 10.42 percent from 1,843 GWh in 2009 to 2,067 GWh in 2010. In 2015, this group accounted for 1.57 percent of total electricity consumption.

Figure 1.6 shows that Thailand has relied heavily on natural gas for electricity generation. In 2015, Thailand produced 192.19 TWh of electricity, with 66.9 percent from natural gas and 18 percent from coal and lignite, as shown in Figure 1.7. In recent years, hydroelectricity has been produced to serve the peak period and its share of total power generation in 2015 was only 2 percent. Because of the rising power demand and delays in building fossil-fired power plants, Thailand has increasingly imported electricity from neighboring countries, which accounted for 7.5 percent of the total power generation in 2015. Although concerns on energy security and environmental damage are increasingly becoming an issue in Thailand, renewable energy contributed only 5.2 percent of the total energy mix for power generation in 2015.

The government of Thailand has initiated the 15-year Renewable Energy Development Plan for the period of 2008-2022 (REDP 2008-2022), its long-term renewable energy plan. When the plan was released, it aimed to increase the share of renewable energy (RE) to 20 percent of final energy consumption by 2022. Later, the REDP 2008-2022 was revised and renamed the 10-year Renewable and Alternative Energy Development Plan for the period of 2012-2021, with an increased RE target of 25 percent of final energy consumption by 2021. The AEDP was revised again in 2015, and extended for a period of 20 years. This 20-year AEDP set a renewable energy target of 30 percent of final energy consumption and target of 20 percent of electricity consumption by 2036.

The share of renewable energy in Thailand has been increasing steadily and slowly, and reached 12.94 percent of final energy consumption in 2015. The main

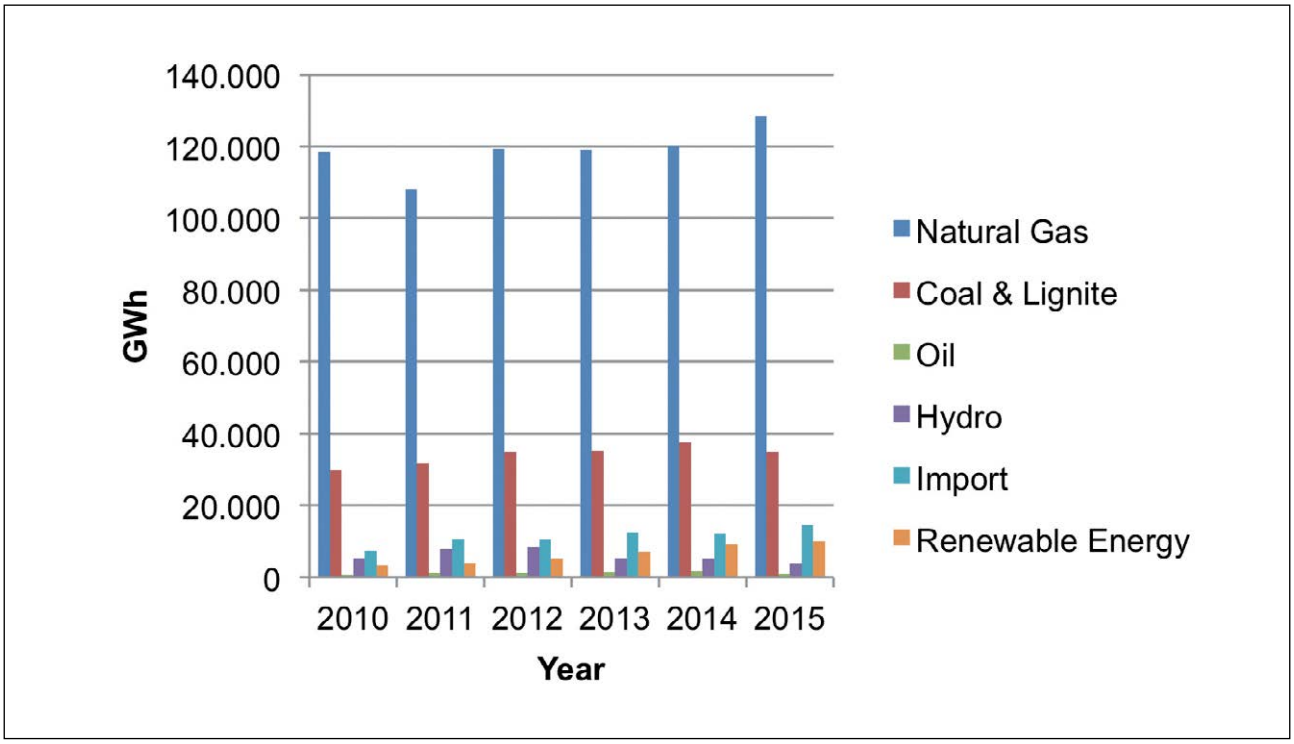

Figure 1.6. Power Generation Classified by Fuel Type during 2010 - 2015.
Source: Energy Statistics of Thailand 2016 by EPPO.

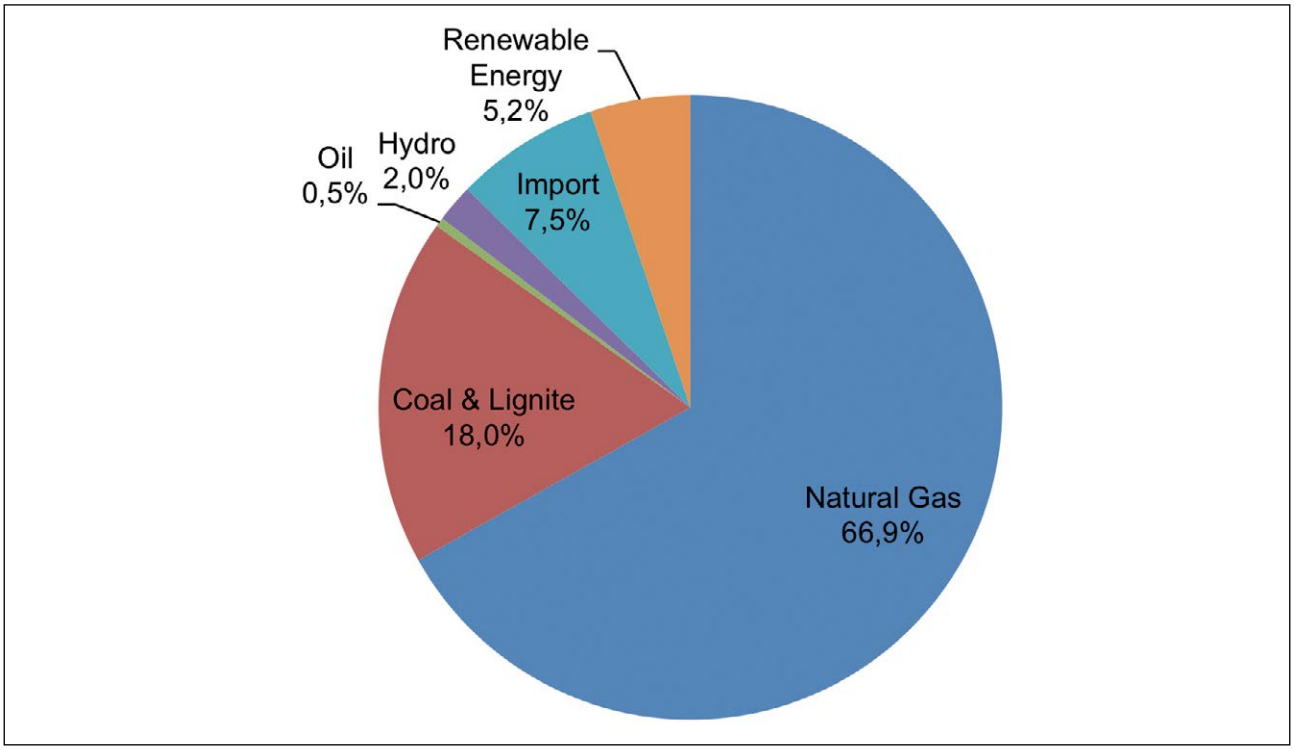

Figure 1.7. Proportion of Power Generation Classified by Fuel Type in 2015.
Source: Energy Statistics of Thailand 2016 by EPPO.
Note: Oil includes of fuel oil and diesel oil. Hydro refers to large hydro power.

Table 1.5. Renewable and Alternative Energy Consumption during 2012-2015.

Renewable Energy	Unit	Target	2012	2013	2014	2015
Electricity1/2/	MW	9,684.40	2,786	3,788	4,494	7,962.79
	ktoe	5,588.44	1,138	1,341	1,467	1,556
Solar Energy	MW	6,000.00	376.72	823.46	1,298.51	1,419.58
Wind Energy	MW	3,002.00	111.73	222.71	224.47	233.9
Small Hydro Power3/	MW	376	101.75	108.8	142.01	172.12
Biomass	MW	5,570.00	1,959.95	2,320.78	2,451.82	2,726.60
Biogas4/	MW	1,280.00	193.4	265.23	311.5	372.51
Waste5/	MW	550.00	42.72	47.48	65.72	131.68
Large Hydropower6/	MW	2,906.40	-	-	-	2,906.40

Source: Department of Alternative Energy Department and Efficiency.

Notes :
1/ Including off grid power generation.
2/ Including on grid power generation with capacity ≤ 1 MW & ≥ 1 MW.
3/ Including hydro power plants ≤ 12 MW & hydro power plants using the water downstream.
4/ Including waste water / waste dumping and energy crops.
5/ Including municipal solid waste and industrial waste.
6/ The existing installed capacity.

contributor is the consumption of renewable energy for heating in the industrial sector. The share of electricity from renewable energy is 10.07 percent of final electricity consumption, or 21.38 percent of the total installed power capacity in 2015.

Thailand has the capacity for producing electricity from numerous renewable sources such as solar power, biomass and wind power. Located close to the equator, solar power is becoming the dominant alternative to be implemented and potentially to be exported to nearby Asian countries. The target of solar power for electricity in 2036 is set at 6,000 MW, as shown in Table 1.5, while the targets of biomass and wind power are at 5,570 and 3,002 MW respectively. To achieve these targets according to the AEDP, the government supports RE development through various fiscal and non-fiscal measures, and investment promotion. Moreover, technological innovation and adoption has been emphasized in order to enhance the competitiveness of renewable alternatives, particularly solar, so as to achieve the final goal of 20 percent of renewable energy share of electricity consumption by 2036.

II. Social Aspects of the Energy Transition in Thailand

II.1 Access to Energy

Since 1990, the electrification rate in the metropolitan areas in Thailand has been 100 percent. PEA's service area is 510,000 sq.km., of which 99.9 percent has been electrified since 2008. In 2016, the PEA can provide electricity to 99.99 percent of 80,055 villages and to 99.7 percent of the 21.07 million households in its responsible area. It can be said that Thailand has reached 100 percent electrification since 2008 through the transmission and distribution network by three SOEs and stand-alone grids in certain areas such as industrial estates.

In 1972, when only 10 percent of rural villages had access to electricity, the government adopted the 'Accelerated Rural Electrification Programme,' which was implemented by the PEA during 1972-1994. The rate of access to electricity in rural areas grew from 20 percent in 1975 to 98 percent in 1994. Between 1995 and 2006, the 'Rural Household Electrification Project' was implemented and increased the rate of access to electricity for rural villages to 99.98 percent in 2006.

Since 2010, the PEA has implemented the 'New Rural Household Electrification Project' to ensure that all villages and households in rural areas can access electricity. By the time of writing, the PEA is able to provide electricity to at least 99 percent of villages and households in its area.

Before the PEA's implementation of these rural electrification programs, in remote rural areas there were some cooperatives to provide electricity with micro-hydroelectric systems in their villages. The villagers were able to generate electricity and maintain their systems for their own use without a grid connection. Once the programs started with main funding from the World Bank and some funding from other agencies, the PEA was able to grid-connect rural villages nationwide. The arrival of the PEA's grid ended the cooperatives in villages because it was clear that electricity sales from the PEA were more stable, cheaper and free of maintenance compared to running individual micro-hydroelectric systems.

However, electricity supply to rural areas has been heavily subsidized through a uniform tariff policy. In addition, the construction of the PEA's grid nationwide required direct subsidy from the MEA, EGAT and the government to support the rural electrification projects. The subsidy in fact was financed by taxpayers and electricity ratepayers. Although Thailand has achieved a goal of energy access nationwide, this achievement was expensive and has contributed to PEA's monopolistic role with regards to long-term power distribution.

II.2 Energy Prices and Affordability

In Thailand, the average household income was 26,915 baht[22] per month in 2015. Household expenditure is estimated on average at 21,157 baht per month. Energy expenditure is 2,135 baht per month, accounting for 10.1 percent of total monthly household expenditure and 7.9 percent of total monthly household income in 2015.[23] Out of this household energy expenditure, a Thai household spends the most on petroleum products, followed by electricity, and charcoal and firewood, accounting for 67.3, 31.1, and 1.6 percent, respectively.

Compared with households in other regions, households in Greater Bangkok[24] spend the most on electricity. Their average expenditure on electricity was 1,144 baht per month, whereas households in the Central, Southern, Northern and Northeastern regions spend only 706, 566, 448 and 423 baht per month, respectively. It is generally assumed that the households in Greater Bangkok represent high and middle-income groups. The numbers imply that in households with higher income, more is spent on electricity, which is reflected in the positive correlation of average monthly total income and energy expenditure per household.[25]

Households in Greater Bangkok own a variety of electric household appliances which consume more electricity than in other regions, such as air conditioners, microwave ovens, electric cooking stoves, electric irons and personal computers; whereas electric fans, fluorescent lamps, televisions, and refrigerators are common household appliances nationwide. The affordability of electricity is

closely related to the ability to pay for and own electric household appliances.

The affordability of electricity in Thailand is also a result of implementation of the national uniform tariff and cross-subsidization policy. Thailand has adopted the national uniform tariff policy nationwide for each user group. To implement the uniform tariff policy, cross-subsidization for certain types of user groups is required. This type of cross-subsidization among user groups is implemented through the Power Development Fund. It should be noted that the key source of the Power Development Fund is contributions from the ERC's licensees at the stipulated rates.

In Thailand, the electricity tariff structure has been separated into a base tariff and a fuel adjustment mechanism (Ft). The base tariff is determined by long-run marginal cost concepts and financial models of each SOE. The marginal cost-based tariff covers costs of three SOEs' generation, transmission, distribution and retailing business. It varies by the voltage levels and time of uses. In the financial model, the base tariff is calculated to fully compensate three SOEs' financial burden incurred from investment and operating expenditures.[26]

Via the Power Development Fund, the ERC has collected tariffs at a rate higher than the marginal cost from industrial user groups or Power Development Fund contributors to cross-subsidize for user groups who pay at a rate lower than the marginal cost. This cross-subsidization supports small residential and commercial users, uniform tariff adjustment for the PEA's non-commercial activities such as rural electrification and decentralization programs, public street lighting, agricultural pumping customers and non-profit organizations, non-commercial provision of services to provincial areas, direct payments to affected localities from activities of power licensees, and direct payments to education programs. Promotion of renewable SPPs and VSPPs in the form of a feed-in tariff is financially supported by the Power Development Fund as well. In addition, the Power Development Fund financially supports the government's electricity policy to help the underprivileged.

Apart from the base tariff, the fuel adjustment mechanism (Ft) was designed to pass through uncontrollable costs from operators to consumers. The uncontrollable costs include changes in prices of fuels used in electricity generation that differ from cost projections, costs incurred from currency rate changes and inflation rates, and costs from unplanned and irregular policies policy, such as populist free electricity policies. The Ft is reviewed and adjusted every four months, mostly due to changes in fuel costs of electricity generation, particularly from fluctuating prices of natural gas and diesel oil.

However, Thamsereekul and Wangiraniran found that during 2009-2013, the affordability of electricity for Thai people has decreased. The main reason is that the average retail electricity price has been increasing as a result of higher costs of natural gas, of which Thailand's electricity generation is disproportionately reliant upon. Thailand now has to import liquefied natural gas (LNG) for domestic use because of delays in petroleum bidding. Moreover, renewable energy subsidies via the feed-in tariff mechanism are being passed on directly to electricity users, which has pushed up average electricity prices.[27]

In terms of affordability and availability, coal-fired power plants seem to gain support and are increasingly preferred over gas power plants, largely due to the downward trend of global coal prices and the belief in government of the viability of new, efficient coal technology.

Nuclear energy has been included in the PDP because of its potentially low costs for energy consumption. Nevertheless, nuclear power remains one of the most unfavorable energy sources and faces criticism from the public, particularly since the incident in Fukushima, Japan. Thailand is still in the decision phase with the option to postpone respective planning, which is contingent on overcoming the critical factor of public acceptance before implementation of nuclear power can go ahead.[28]

Renewables-based electricity has excellent technical and resource potential in Thailand.[29] The Thai government has started to realize the opportunities of a raised share of renewables, such as energy security and environmental benefits, slower growth in energy imports and reduced local air pollution, and has thus expanded renewables development.

In Thailand, solar power and biomass have been abundant as renewable energy sources at a cost-competitive price. However, without ESI restructuring and non-discriminatory third-party access, the growth of renewable-based electricity is limited. Moreover, somehow there are concerns on how to balance between agricultural energy and food security once biomass has large-scale application in Thailand.[30]

Wind power is being considered as a cost-competitive energy source compared to other renewables. Although there are land areas suitable for turbine generator installation, there remain difficulties in wind turbine installation.[31] In the past, wind farms have been constructed on the *Sor Por Kor* land, which is legally defined as land for businesses which economically and socially serve or relate to the livelihoods of farmers in the land reform areas. From a legal point of view, renting Sor Por Kor land to build wind farms instead of using it for farming is an illegal misuse of land in contravention to the agricultural land reform scheme. In 2017, the Thailand Supreme Court ordered the revocation of the registered long-term land lease contracts for wind farms, leaving the future of 19 out of the 22 wind farms uncertain, even though power purchase agreements with government agencies have already been signed. Further investment in wind farms is uncertain, particularly in the *Sor Por Kor* land.

Hydropower seems to be an attractive source of electricity generation in Thailand,[32] however, concerns have intensified regarding the question of the sustainability of its continued development, particularly its related environmental, fishery and social impacts (Costanza et al., 2011).[33] Therefore, the government has dismissed any plans to build new hydropower plants. In the future, the major share of new hydropower in Thailand will be imported from neighboring countries.

To sum up, it is a dilemma to guarantee socially equitable and socially acceptable electricity prices in Thailand at the same time. Actual cost-based electricity tariffs vary with time of use, geographical area, amount of electricity usage and voltage level. It is not possible to charge an electricity tariff at its actual cost, otherwise certain user groups would not be able to afford to pay for their electricity. Although the national uniform electricity tariff policy has led to socially equitable retail rates in the same user groups, it is not equitable among the different user groups and cross-subsidization cannot be avoided. Certain user groups must pay electricity bills higher than their actual costs to cross-subsidize other groups of users. Moreover, they indirectly contribute to the government's free electricity, populist policy.

II.3 Energy & Jobs

There is no publicly available data to demonstrate the numbers of jobs in the energy sector, particularly in sub-sectors such as renewables and energy efficiency. However, job loss is a major concern in Thailand during periods of energy reform.[34] Any attempt to restructure ESI and privatize three SOEs was strongly opposed by the SOEs employees because they were concerned that any changes in ESI and ownership of SOEs would create loss of employment, job security and benefits afterwards.[35] This perception seems to persist.

ADB research has shown that during the transition to a low-carbon economy, investment in clean and green energy can create the co-benefits of jobs and green growth. Nuclear power and fossil fuel technology are the most capital-intensive and create net reductions in employments, whereas renewable energy and energy efficiency projects are more labor-intensive. They provide the potential to create more jobs and develop a highly skilled workforce and economy in local communities.[36] However concerns with job security still remain in Thailand, particularly for those employed in SOEs.

Although the effects of the energy transition and its impacts on job loss and creation in the Thai economy is difficult to quantify, Suerkemper et. al. attempted to estimate the effects of the implementation of the 20-year Energy Efficiency Action Plan (EEAP)[37,38], on employment, which covers the period from 2011 to 2030. The EEAP aimed to reduce energy intensity by 25 percent by 2030 compared to 2010 levels, which is equivalent to a reduction of final energy consumption of 38,000 ktoe relative to the BAU baseline projection by 2030. In the EEAP, there were a combination of 34 different energy efficiency measures to promote energy efficiency, particularly in transportation and industry. These measures included mandatory measures such as laws, regulations and standards, and promotional measures

such as research and development, incentive provision, public awareness and behavior change campaigns, and human resources and capacity building. They found that if the EEAP was successfully implemented, it would generate additional employment in the Thai economy of approximately 230,000 to 430,000 employees by 2030.[39]

In Thailand, green jobs, the identification of green skills needs, and green skill development are mainly carried out by entrepreneurs, representatives of the private sector such as the Federation of Thai Industries and some government agencies which are not directly responsible for labor policies such as the Department of Alternative Energy Development and Efficiency and the Ministry of Industry.[40] Green skills and green jobs can be found in the automotive industry, construction industry, refrigerating and air-conditioning industries and, in the production and application of alternative energy.

During the transition towards a low-carbon economy, in the case of Thailand, the developments of green competencies and skills have been executed by line ministries, business establishments and representatives of private companies. For example, the DEDE, under the Ministry of Energy, has organized training courses on energy management and technology for efficient energy conservation, and energy end-use systems. The Ministry of Industry organized training courses for industries, industrial establishments and SMEs on green curriculums, while the Ministry of Tourism and Sports has organized various training courses on eco-tourism. The Federation of Thai Industries also offers training courses on clean technology, the application of a value engineering approach in energy conservation, and various environmental standards. The Electric and Electronics Institute in collaboration with the Department of Skill Development provides training to build capacity for workers in the electrical and electronic industries to address labor shortages and challenges associated with rapidly changing technology.

Anuchitworawong et al. found that the industrial sector and the service sector offer high potential for generating green jobs. To promote green jobs, the development of skills in energy and industrial sectors is required, such as in training on energy management for efficient energy conservation in factories and buildings, training on renewable energy technology installation and maintenance, and training on energy conserving materials, equipment and machinery, whereas for the service sectors, the skills to improve energy efficiency and for development of eco-tourism are needed.[41]

Despite the efforts and initiatives in the private and public sectors, by the time of writing there is still no integrated national plan or policy at the national level on green jobs and green skills.[42]

Anuchitworawong et al. also found that CSOs have played an important role in creating green jobs and green skills, particularly at the local or community level. For example, the Border Green Energy Team (BGET) has proactively provided hands-on technology training and financial supports to village innovators in ethnic minority areas on both sides of the Thai-Burma border. BGET has also demonstrated how renewable energy and sustainable technologies are integral in improving livelihoods.[43]

II.4 Perceptions of Energy

Energy is essential for economic and social development. For several decades, Thailand has expanded its electricity generation capacity to meet increasing demand. However, fuel diversification is not well planned. Natural gas has emerged as the main fuel for electricity generation in Thailand for decades because of its environmental appeal, low capital intensiveness, shorter gestation period, and the higher efficiency of gas-based power plant technology.

Thai people have had a negative experience with Mae Moh's lignite mine-mouth thermal power plants. The Mae Moh lignite mine is an open-pit lignite mine, the operation of which causes both direct and indirect adverse environmental impacts on land use, quality of life, forests and wildlife, air quality and the climate. Based on this, there has been strong public opposition to coal-fired power plants in Thailand. Amid these conflicts and the need for fuel for power generation, the Gulf of Thailand was explored and found to have significant reserves of natural gas. During the 1980s, the government decided to use natural gas from domestic sources for power generation to reduce the negative environmental impacts of power generation. Since then,

most thermal power plants have been fired by natural gas. As a result, natural gas becomes the dominant fuel for electricity generation.[44]

Although natural gas power plants create less negative externalities and environmental damage than lignite power plants, the overuse of natural gas has led to a declining supply from domestic sources. During the 2000s, the government set the objective of fuel diversification in the PDP, aimed at reducing reliance on natural gas for power generation. By the time of writing, natural gas supply has been depleted in Thailand, and the country now has to import LNG for power generation. Prices of imported LNG are higher than those of domestic natural gas, leading to concerns about an increase of power tariffs.

In the South of Thailand, the demand for electricity has been increasing and surpassed the supply of electricity, causing concerns about electricity shortages. The EGAT has planned to build a coal-fired power plant in Krabi, which is a tourist destination in the Southern part of Thailand, to meet the local demand. It is expected to be located in Nua Kong district, which is part of the Krabi Environment Protection Zone. On its announcement in 2016, anti-coal power protesters from around the country rose up to oppose the construction of the power plant. Their opposition was so strong that the government lifted up the order on the construction of the power plant and the EGAT postponed its investment and eventually will choose another location for the plant.

The local community in Krabi has realized its own needs for energy and the potential of local renewable resources meet their demands. Thailand's economic vision of a "Sufficiency Economy" is fundamental to the idea of energy independence and energy self-sufficiency based on available renewables in specific areas.

In recent years, the EGAT was confronted with "Not In My Back Yard" protests around the country and has not started a new fossil power plant project since 2004, which has exacerbated authorities' concerns of electricity shortages and blackouts in the near future. Meanwhile, local communities have learnt to realize their renewable potential. For example, in case of Krabi, there is the potential to generate electricity from wind, solar and biomass up to 1,700 MW, which is eleven-times the peak demand at 150 MW. The major obstacles of building small-scale renewable power plants is seeking and granting permission for construction, slow licensing processes, and obscure third-party access rules access the power grid.

Proponents of coal-fired power plants concerned that without substantial coal in the base load generation mix, it will be harder for Thailand to keep electricity rates low. As shown in Figure 1.3, the amount of natural gas for power generation has increased steadily. Heavy reliance on natural gas will lead to significant increases in electricity tariffs, as the price of gas is expected to increase substantially over the next decade. Increased gas demand for power will put continued pressure on PTT to secure gas resources regionally or in the form of LNG. Historical Gulf of Thailand volumes and their associated attractively priced contracts have been on the decline since 2010. This has resulted in the requirement to tap new, more expensive gas sources, including imports from Myanmar, LNG, from the Joint Development Area, the region offshore administered by both Malaysia and Thailand, from the Overlapping Claims Area, the region jointly claimed by both Thailand and Cambodia, and from new finds in the Gulf of Thailand itself.

The Thai people's perception on energy prices and expenditures is that they should be stable and stay at a low level. While they are concerned with their livelihoods, environmental problems and pollution, and prefer clean energy, their energy expenses remain of prime concern. Increases in Ft due to rising fuel costs have caused dissatisfaction among electricity users. Any increase in fuel costs of electricity is passed through directly to electricity users via the Ft mechanism. Consequently, the EGAT, MEA and PEA do not bear any of the costs of and their excessive profits are not impacted by fuel price fluctuation. Questions of tariff calculation in favor of the three SOEs and IPPs arise often and have not yet been satisfactorily answered by the regulator.

Moreover, the lifestyle of people who value personal comfort over than the environment and energy saving and efficiency is another issue. Thailand is a tropical country with a hot climate. The excessive use of cooling systems without concern for energy wastage is common during summer time. Many Thai people are willing to pay a higher energy bill in exchange for comfort.

III. Political Economy of the Energy Transition

III.1 Proponents of the Energy Transition

In Thailand, some first steps towards an energy transition were undertaken in the 1990s, when the government began emphasizing energy conservation, which finally led to the enactment of the Energy Conservation Promotion Law in 1992. Prior to the establishment of the MOE, the Department of Energy Development and Promotion (now the DEDE) was mandated by law to be the lead implementation agency. The National Energy Policy Office (now the EPPO) wanted to control the energy conservation fund, which was set up by the law, but the actual implementation of the demand-side management program (now the energy efficiency program) and renewable energy projects was transferred to the EGAT. At that time, the implementation of energy conservation policies and measures was not systematically pursued to deploy the existing potential.

When the MOE was established in 2002 to unify more than 20 government agencies in nine ministries and SOEs directly related to the energy planning policy, it was hoped that regulation and implementation of the energy transition would move forwards. In 2002, the MOE announced that it set a target for new and renewable energy to make up 8 percent of total primary energy by 2011, but this was not backed up by any convincing strategies to meet the target.[45] Since then, targets, promotion policies and measures for renewable energy and energy efficiency have been included in Thailand's energy plans.

Although the energy transition in Thailand has progressed slowly, the idea of a low-carbon society is a widely and politically accepted ideology. Thailand has joined the international community to tackle the problems of climate change. Targets to reduce GHG emissions are included in national development plans in various sectors, including the energy sector.

The energy transition towards a low-carbon society requires collaboration from people to reduce total GHG emissions. Proponents of the energy transition in Thailand can be classified as government agencies, the private sector, local communities, CSOs and their respective collaborations.

Government agencies

In the energy sector, the NEPC, MOE and ERC are the key government agencies directly supporting renewable energy and energy efficiency in Thailand, as demonstrated in the TIEP. In this section, only the key measures of renewable energy and energy efficiency will be mentioned.

In 2015, the main forms of the government's financial support for renewable energy development in Thailand were feed-in tariffs (FiTs). FiTs guarantee clean-energy producers a fixed price which creates a favorable investment climate to investors in renewable energy. Renewable power producers receive a price premium over the purchase rate of SOEs, based on avoided generation costs, which is called the "feed-in adder."[46] Eligible technologies comprise of biomass, biogas, municipal solid waste, wind, mini- and micro-hydropower, and solar.

Before the feed-in adder policy was implemented, there was little VSPP generation on-line even though the VSPP program had been in operation since 2002. Additional per-kWh subsidies are provided for projects that offset diesel-powered electric generation in remote areas, and to offset political risks in southern provinces that have suffered in recent years from violent conflicts.[47] The technology-specific feed-in adder has created technology diversity in electricity generation. As a result, solar power is now firmly established in Thailand due to huge financial and fiscal incentives.[48]

In addition, there are other mechanisms which support renewable energy in Thailand. For example, the MOE provides financial incentives in the form of grants and low-interest loans supporting biogas, municipal solid waste, and solar thermal projects, ranging from 20 percent to 100 percent of the capital investment, but up to a maximum of 50 million baht per project. According to the EEP, grants are sourced from the Energy Conservation Fund, which also provides low-interest loans up to a

maximum of 50 million baht and 7 years in support of small and medium-sized projects. Another financial mechanism is the Power Development Fund under the supervision of the ERC, which allows renewable energy developers to opt for credit guarantees or government shareholder participation up to a maximum of 50 million baht.[49]

To enhance energy efficiency in the industrial sector, the MOE has provided grants for factories to replace existing production processes and technologies to those which are more advanced and efficient. Examples are energy efficiency improvements in the pulp and paper process, the plastic industry, as well as high energy efficiency machines for SMEs such as in the tobacco curing process, ceramic shuttle kilns, and Chinese sausage dryers.

Another example is EPPO's promotion of renewable energy and energy efficiency through the clean energy and green city approach. EPPO has initiated the "Smart City" project to develop a detailed strategic and architectural plan of a Smart City that suits the Thai society, way of life and culture.[50] This project is financially supported by the Energy Conservation Promotion Fund in 2016 with a budget of about 115 million baht. A number of organizations from the public sector, local administration and non-profit organizations have participated in a contest to showcase how their respective cities could become Thai "Smart Cities."

Other government agencies such as the Board of Investment (BOI) play an important role of promoting investment in renewable energy and energy efficiency projects by providing tax incentives including exemption from or reduction of import duties on machinery and essential materials, exemption from or reduction of income tax, and special corporate tax allowances. The BOI also supports investment in green industry and industrial transformation to produce low-carbon emission products. For example, in order to promote the production and adoption of environmentally friendly vehicles to improve energy efficiency in the transport sector, the BOI approved tax incentives to promote the production of three types of electric cars in Thailand, namely hybrid electric vehicles, plug-in hybrid electric vehicles and battery electric vehicles.

Civil Society

In Thailand, CSOs worked with policy research institutes and academics to engage with government agencies when they developed renewable energy policies and drew the PDP.[51] In addition, they have urged more transparency from government agencies and use opportunities to provide input into national energy planning and decision-making processes.

For example, Jairaj and Seeley found that Thai CSOs had an influence on the 'National Solar Policy Initiative.' Collaboration between policy research organizations and CSOs succeeded in including VSPPs in the national PDP in 2007. The Thai CSO, namely 'Healthy Public Policy Foundation' (HPPF), has worked with the 'Thailand Energy Research Institute' to include community perspectives in the National Solar Photovoltaic (PV) Roadmap.[52]

Collaboration between Thai academics, CSOs, private-sector representatives, and civil servants, helped set out the Thai Solar PV Roadmap Initiative (TSRI) with the objectives of providing the Thai government with recommendations on how to effectively and inclusively pursue greater solar power development and implement solar policies in the country. The HPPF is involved in the TSRI and brings other CSOs, community leaders, local governments, and media together to discuss key issues to consider in the roadmap. The HPPF has been working with these stakeholders to conduct research on the development and use of solar energy at the local level, as well as to understand its costs and benefits, in order to provide input into Thailand's Solar PV Roadmap.[53]

Public and Private Collaboration

Koh Samui is a small island town and famous tourist destination in Southern Thailand with population of 65,000 and non-registered population of 180,000 people in 2016. It has been the site of a well-structured collaboration and coordination between central authorities and the local community, and provides a good example of public and private collaboration to promote energy conservation.

APERC found that *Koh Samui* has a large renewable energy potential with regard to solar PV and wind. In addition, as a tourist destination *Koh Samui* generates a

lot of municipal solid waste, a significant proportion of which is suitable for biogas generation. Further potential exists with regard to new renewable technologies, which are currently under research and development in *Koh Samui*, including geo-thermal, tidal energy, hydrogen and fuel cell energy. These projects are supported by government funding.[54]

In addition, in *Koh Samui* there are many possible renewable energy related projects which are designed to fit into the town structure and lifestyle of living and tourism, such as the production of electricity from solar PV, solar hot water on rooftops of public and private buildings, fresh water production using solar energy, and biomass fuel for households.

APERC reported that *Koh Samui* developed its own vision, plan and strategy including quantified targets for the reduction of carbon emissions. *Koh Samui* has the "Index and target: Moving *SAMUI* to Low-Carbon" strategy. The strategy claims to be "people oriented" and aims at becoming "the First Low-Carbon Island in the Asia-Pacific". According to APERC, the high-level vision includes social and human value for low-carbon and eco-friendly lifestyle; environment and resource value for low-carbon emission and preservation of natural resources; and economic value for land, local economy and investment.[55]

According to APERC, the total targets for the reduction of carbon emission intensity (tCO_2e/GDP) on the island are 20 percent by 2020 and 40 percent by 2030. Carbon emissions in Koh Samui are expected to reach 509,229 CO2e ton in 2020 and 806,192 CO_2e ton in 2030 under the BAU Case. *Koh Samui* has a target for carbon emission reductions of 32.7 percent in 2020 and 30.8 percent in 2030 compared to the BAU Case. By the time of writing, these targets are not yet evaluated.[56]

Apart from the economic policy and strategy to reduce GHG emissions, the town structure of *Koh Samui* plays an important role for the promotion of a low-carbon society. The plan and work of the *Koh Samui* Tourism Association aims to increase the walkability of the town in order to reduce the reliance on motor transportation, and increase the ratio of green to development areas in the island.

The establishment and promotion of an eco-lifestyle on *Koh Samui*, including the low-carbon school initiative[57], hotels and resorts working with the local community to transfer knowledge and expertise in low carbon practices, a solid eco-tourism strategy, development and promotion of eco-branding of products and eco-centers[58] on the island, and the possible introduction of an eco-points system[59] on the island have been implemented.

Some businesses, in particular those within the tourism sector, have developed low-carbon buildings that incorporate passive design techniques and energy efficient solutions. In most commercial buildings and many homes, efficient light sources, in particular compact fluorescent lamps, have largely replaced incandescent bulbs.

Koh Samui is a good example of the potential for collaboration of private sectors, local communities and local governments, supported by central government funding, for an energy transition towards a low-carbon society. However, it should be noted that the *Koh Samui* model still has weaknesses with regards to evaluating the effectiveness of programs and tracking the quantified outcome of carbon emission reductions. Some practical and realistic implementations are still nontransparent.

International Organizations

International organizations and their collaborations with government agencies is another important proponent of the energy transition in Thailand.

In order to encourage communities to use more energy efficient and environmentally friendly cooking and heating methods, the UNDP in Thailand in partnership with the Mae Hong Son Governor's Office, the DEDE, and the MOE has implemented a project of Promoting Renewable Energy in Mae Hong Son Province, which is the poorest province in the country.[60] This project was financially supported by the Global Environment Facility (GEF), and was carried out as an improved cook stoves (ICS) experiment to provide communities with better access to new and affordable household renewable energy. This case is an example of a project being initiated by an international organization in collaboration with various central government agencies.

In Thailand, people in rural areas tend to use traditional cooking stoves which release toxic pollutants. The more efficient ICS helped the local population to reduce the consumption of fuel wood and expenditures on firewood, thereby decreasing air pollution and health damages. In 2015, the project distributed new ICS to 130 participants who came from three sub-districts of two districts in Mae Hong Son province. With the collaboration of international organizations and Thailand's government agencies, the ICSs are widely sold and used in the North of Thailand. Lessons learnt from projects like these include the know-how to communicate with local people and to change rural communities' perspectives about new sources of energy, and the impact of traditional energy sources on the environment.

III.2 Barriers to the Energy Transition

The energy transition in Thailand has moved forward slowly since the enactment of the Energy Conservation Promotion Law in 1992 and the establishment of the MOE in 2002. Even though the energy conservation promotion policy, and its measures and programs have been designed and have been included in various energy plans in order to coincide with national development plans, Thailand's achievements still lag behind the renewable energy and energy efficiency targets as stipulated in the PDP, EEP and AEDP.

Fragmented authority and capacity limitations

In Thailand, the NEPC and MOE together with the EPPO are policymakers, drawing the TIEP in 2015, whereas the ERC is a regulator, and three SOEs are operators in the electricity supply industry. Following the NEPC's resolution, the ERC together with the MOE is responsible for tariff determination and financial incentives for energy conservation projects, particularly the determination of the FiT. In addition, the ERC issues licenses to the operators in the ESI. Moreover, the other ministries are involved in energy conservation programs directly related to their jurisdiction such as the Ministry of Finance, the Ministry of Industry, the Ministry of Interior, the Ministry of Natural Resources and Environment, and the Ministry of Transport. Each government agency needs to build up capacity to pursue the TIEP as well as the plans under their jurisdictions. There are various key performance indicators that are required to achieve each plan.

Under the enhanced single buyer model, the SOEs in the energy sector are dominant players in the ESI. At the beginning periods of the adoption and implementation of energy conservation programs, three SOEs were assigned to lead, conduct and evaluate pilot projects which have to be consistent with Thailand's location, specific resources and government targets. However, some of the incentive structures for the SOEs to promote energy conservation are in conflict with their primary roles and responsibilities. As operators, they have a genuine interest maximizing electricity sales, whereas successfully conducting energy conservation programs together with renewables promotion could reduce their revenue.

Due to the lack of coordination among energy institutions, mismanagement and poor implementation and incentives in Thailand, the renewable energy targets are unlikely to be achieved by the time of writing. Only solar power has been successfully promoted through initiatives and cooperation from private operators.

Responsibility in energy policy, planning and implementation is fragmented and contradictory. It requires a strong government agency to be a focal point in order to coordinate among all bodies involved, and to conduct comprehensive policy analysis and performance evaluation.

Policy uncertainty and discontinuity

An energy transition is a long-term process. Policy certainty and continuity is required to create a favorable investment environment, specifically for the private sector to reduce investment risk. In Thailand, policy uncertainties and discontinuities have been a major obstacle with regards to a smooth energy transition.

For example, as a tropical country, Thailand has a great potential to produce electricity from solar power. The government has provided financial incentives or an adder rate for solar power since 2007 through VSPP power purchase agreements (PPAs). The financial incentive was so attractive that applications for licensing exceeded Thailand's solar power targets in terms of capacity.

Nevertheless, not all of solar power license holders started the project after having been granted licenses for several years.

When solar power capacity cannot be anticipated accurately, the EGAT, MEA and PEA do not have incentives to expand their capital-intensive investment in the transmission and distribution network to serve an unforeseen demand. In 2010, the EGAT, MEA and PEA announced that they would no longer accept applications for solar PPAs due to network constraints until they could identify projects for which applications have been lodged, but which are unlikely to proceed, before reopening the application process. As a result, it led to the pause of solar power support between 2010 and 2013.[61]

After this pause, the Thai government launched a new feed-in tariff (FiT) scheme for rooftop solar systems in July 2013, in which a fixed rate per kWh is paid during the life of the PPA. The new scheme has a fixed-price structure that is paid for 25 years. The tariffs are paid based on the amount of energy generated from the solar PV systems and sold to MEA and PEA.

For this fixed-price feed-in tariff scheme, the government set a total target of 200 MW with 100 MW allocated to residential-scale (0–10 kW) installations and another 100 MW allocated to commercial- and industrial-scale installations (10 kW–1 MW). In addition, the government allowed a short application submission period between October and November 2013.

The response from private investors was overwhelming for commercial- and industrial-scale investment. However, residential-scale applications did not reach the target of 100 MW. After the application process closed, residential applications amounted to around 55 percent of the residential target and about half of these applications were approved.

Tongsopit found that early adopters to residential PV systems came mainly from the high-income segment of the population—those who are financially ready to invest in the technology. About half of the residential applications were accepted, and the major reason for rejection was incomplete applications. By the time of writing, the growth in rooftop solar capacity due to the FiT scheme has not yet been announced.[62]

There are several reasons why the new FiT scheme cannot create significant growth in the residential rooftop market through incentives. Firstly, characteristics of Thailand's 2013 feed-in tariffs for rooftop solar, including a short application period, a lack of widespread campaigns, and complicated permit processes, resulted in a slow response by the residential market.[63] Secondly, the system costs used as assumptions for the calculation of FiT did not match available system costs in the market after the launch of the FiT, thereby resulting in a lack of feasibility for residential-scale systems.

Policy uncertainties and discontinuity have been the main causes of slow growth of solar PV in the residential market. Policymakers do not realize the benefits of continuous domestic solar market expansion. Therefore, they have justified discontinuing support on the grounds that the continuous payment to finance solar FiT would be a burden for electricity users.[64]

However, to realize the tangible benefits of solar PV to communities and economic and social development, parallel initiatives should include solar PV R&D programs, technology transfer, installers training and certification, the simplification of the permitting process, and financing for communities and low-income households.[65] Tongsopit also found that if implemented successfully in combination with another solar subsidy programs, these kinds of initiatives can produce benefits in the long-term that help outweigh the cost of the solar subsidy.[66]

Lack of coordination between public and private sectors

To pursue an energy transition, the government alone cannot provide endless financial support, particularly in energy efficiency projects, from which the private sector, such as the manufacturing sector, can enjoy financial benefits in the form of energy cost savings. Coherence and coordination between public and private sectors to develop projects in both technical and financial aspects is needed. Moreover, financial institutions need to be included in project implementation to ensure bankability and project funding in the long-term.

During 1992-1997, energy efficiency finance (EEF) in Thailand was initially supported by the public sector, such as the Energy Conservation Fund and Industrial Finance Corporation of Thailand (IFCT) projects. From 1997, public-private partnerships in energy efficiency projects were initiated and implemented, mainly in the form of shared investment programs, the ESCO fund, BOI incentives for energy efficiency projects and energy efficiency revolving fund (EERF) until 2012.

Later in 2012, the government has tried to shift away from public financing mechanisms towards support for direct incentives, and shifted to market measures and a reliance on private finance through the private sector and energy service companies (ESCOs). However, the public efforts, so far, have failed to transfer energy efficiency financing measures into the private financial sector, because energy efficiency projects have a small investment size and a stream of invisible and intangible benefits coming from resource savings.[67] The behavior of banks in Thailand was considered as conservative and risk averse. In addition, to realize the benefits from energy efficiency investments and projects, a number of supportive players such as project developers, equipment suppliers, ESCOs, technology experts and insurance companies have to coordinate effectively.

Distorted fiscal and regulatory policy

The promotion of energy conservation in Thailand faces various distorted fiscal and regulatory policies which hampers implementation of measures. Energy efficiency programs in public schools are a good example.

Kiatruangkrai and Leelarasmee have evaluated energy efficiency programs in government-owned public middle schools in Bangkok and found that schools' energy saving policies have no clear objectives, the is a lack of control and enforcement by the government and the chain of command, and there is a lack of cooperation between government agencies.[68]

The educational fiscal and regulatory policy is designed to promote public education directly by focusing on schools' performance projects such as lecturer training and classroom maintenance. The policy has indirectly disincentivized public schools to save energy. Energy saving projects in public schools is given lower priority than the direct educational and school performance projects. In addition, some public schools have no responsibility to pay for their energy bills, which is absorbed by government budget, so the leading staffs do not care much about energy consumption behavior.[69] Public schools tend to be situated in old buildings in need of refurbishment, which makes it additionally difficult for schools to meet energy saving and efficiency goals.

Weak governance

An energy transition concerns all stakeholders in the society. However, in Thailand, energy policy and planning has been centralized to government agencies, regulators and the SOEs for decades. Thailand's governance in the energy sector is weak, particularly with regards to independence, transparency, public participation and accountability.[70]

Lack of transparency and accountability in the power planning and development process creates doubt among the public, leading to a prolonged lack of trust regarding decisions made by government. This perception contributes to the establishment of groups of protestors and CSOs rallying against the government's decision on various energy issues. One example is the PDP development process and planned construction of coal-fired power plants. Although the PDP participatory process was conducted, only a limited number of stakeholders were involved with meetings and open consultations.[71]

Unsuccessful energy reforms

The ESI in Thailand is predominantly operated by three SOEs in a monopolistic manner. In the past, many attempts to pursue structural reforms in the electricity sector have failed. The EGAT is a vertically integrated operator in generation and transmission activities, whereas the MEA and PEA operate the distribution network and retailing business solely in their responsible area. To promote decentralized renewable energy across the whole country, the unbundling of state operators is required to allow access for new stakeholders, particularly renewable VSPPs. Constraints related to the grid infrastructure of the transmission and distribution network are a bottleneck for renewable power producers to sell power back to the grid, leading to the pause of new solar projects during 2010-2013. Regulation by the ERC on renewable electricity licensing and trading mechanism is too bureaucratic and creates administrative hurdles.

IV. Thailand-specific Characteristics

The challenge for Thailand to reduce GHG emissions comes along with the MOE's key mission, which is to ensure energy security. In the belief that energy security can only be guaranteed through the reliance on fossil fuels-based generation, the MOE has initiated a shift from natural gas to efficient modern coal power plants. Although the target share of renewable energy in the total final energy consumption was set at 30 percent in 2036 in the AEDP, this target and time horizon is not sufficiently ambitious to tackle the issue of climate change.[72]

In Thailand, researchers found a number of obstacles and barriers regarding the energy transition, for example, the instability of renewable energy prices from the energy supply side, especially biofuel energy, unacceptable public perception towards alternative nuclear power after Fukushima accident, and an anxiety among stakeholders about the effects of dam creation for hydro-power.

Banerjee found that problems hindering Thailand's reduction in GHG emissions are the high investment and operating costs, and capacity constraints in the energy sector[73]. Costs of technologies and infrastructure can serve as significant barriers to investments in renewable energy because Thailand, as a developing country, lacks the high technical capacity and effective coordination required to support energy efficiency reforms. To address this problem, Thailand has launched a series of incentive mechanisms such as feed-in tariffs, tax incentives and access to investment grants and venture capital to promote renewable energy expansion. However, Thailand still has a long way to prove the effectiveness of these energy policies and measures.

An energy transition requires parallel collaboration between public and private sectors, and should be supported by the expertise of diverse stakeholders in society to overcome the various challenges linked to it. From some stakeholders' perspectives, the energy transition path in Thailand has been slow due to the lack of continuity in policies, measures and implementations, lack of financial support from the central authority or financial institutions, weak policy coherence and coordination among government agencies, conflict between local communities and authorities, inadequate facilities and infrastructure, and weak mindsets of energy users on energy conservation.

Under Thailand's controversial PDP, the MOE aims to increase system reliability by reducing dependence on natural gas, increase the use of coal via 'clean coal technology', import power from neighboring countries and develop renewable energy. In the meantime, awareness has been raised among the local population regarding the adverse impacts of fossil-fired power plants, which affects the implementation of the PDP and forces government authorities to respond to the increasing opposition.

The Krabi coal-fired power plant in Southern Thailand is a good example. The Thai Military Government has decided to put it on indefinite hold until new health and environmental impact assessments are finalized in accordance with the relevant laws.[74] The Prime Minister instructed the MOE and Ministry of Natural Resources and Environment to work together to build better public understanding of what future fuel sources, both fossil fuels and renewable energy, is best suited for the country.[75]

To continue the dialogue on its controversial energy policy, the Thai Military Government has set up a committee to gather public feedback and promote understanding. On 22 March 2017, the Royal Gazette website published the National Council for Peace and Order (NCPO)'s Order No. 5/2017 to establish a committee on energy policy in Southern Thailand. The committee's main task is to foster public understanding of the government's controversial plans to build coal-fired power plants in Southern Thailand, as well as to listen to opinions from civil society groups and local people in the region.[76] However, out of the 31 committee members, 17 are high-ranking military officers while the rest are governors of Southern provinces. The fact that more than half of the committee members are military officers has led to concerns regarding their expertise on power plant technology, the electricity network, system and market, and the impact the power plants could have on health and the environment.

All debates on energy transition in previous sections are visibly serious concerns. Keeping every stakeholder satisfied in every circumstance may not be possible, but compromise and negotiation from relative parties through open, transparent and informative dialogue could make some positive step-by-step changes. Energy transition will create winners and losers, but a clean energy transition will create more winners, at Thailand as a whole will benefit greatly from the long-term benefits of the energy transition.

V. Policy Conclusions and Recommendations

For an energy transition in Thailand to be successfully implemented, policy recommendations are as follows:

- ▪Structural reform and unbundling in ESI should be carried out in order to alleviate market power and dominance of the three SOEs, particularly in electricity network, and to allow fair competition in the generation business for renewable energy.
- ▪Decentralized renewable energy should be promoted in order for local communities to be self-reliant and self-sufficient.
- ▪Electricity tariff with cross-subsidization which creates market distortions, sends the wrong price signals and does not promote energy efficiency should be revised. Inefficient populist policies, particularly free electricity policies, should be reconsidered and removed. Implementation of these policies are costly and costs are passed through directly to electricity users.
- ▪While the TIEP opened up new possibilities for energy planners, it involves institutional challenges, including building technical, human and regulatory capacity. These institutions are comprised of energy-related government agencies, regulators, public and private operators, local community, and CSOs, as well as the interactions between them. A strong government agency is required as a focal point in order to coordinate among them.
- ▪The TIEP is an integrated plan with ambitious targets. To achieve these targets, the action plans should be evaluated from time to time. The comprehensive evaluation and assessment report should be disseminated publicly. Moreover, policy continuity and certainty is needed to incentivize power operators and users to transition to low a carbon society.
- ▪Good governance in energy policy, planning, regulation, and operation in the Thai energy sector should be enhanced in order to improve transparency and accountability, to encourage public participation and to create trust among various stakeholders. Although gaining trust from every stakeholder is almost impossible, compromise and negotiation from relative stakeholders through openly informative dialogue could make some positive, gradual changes.
- ▪To alleviate conflict during the energy transition, governments should establish and strengthen partnerships for different stakeholders. Coordination and information exchange among government agencies will facilitate progress in transition. Private-public partnerships should be addressed for energy access. Policies, plans and regulations should be developed through more cooperation from research institutions, academics, national and international CSOs.
- ▪Infrastructure and grid-related issues and regulatory and administrative hurdles which are major impediments to the deployment of renewable energy should be overcome.
- ▪Potential for energy efficiency in Thailand is in fact very high. Barriers to improve energy efficiency such as attitudes and life style for comfort; market barriers that prevent consumers and companies from purchasing the most energy saving appliances and equipment; and consumer attention to upfront costs rather than life-cycle costs require government attention and interventions, and effective law enforcement.
- ▪Promotion of private participation in investment in renewable energy and energy efficiency projects needs financial resources. Financial policies that improve the availability and affordability of financial resources should be developed, ranging from providing public finance to incentivizing private sector financing.
- ▪The efforts and initiatives in the power sector to move energy transition forwards cannot be realized in its entirety when job losses and job security are not addressed. An integrated national plan and policy on creation of green jobs and green skills in energy and non-energy sectors is needed.

VI. Recommendations for the FES Office

Recommendations for FES Office are as follows.

- ▪Government agencies: Consultation program; Best practice; Evaluation and assessment of policies, plans and regulations.
- ▪Academic and research institutions: Technology and knowledge transfer; Joint research projects; Training; Partnership building in the region and across regions among academic and research institutions; Exchange programs for students, lectures and researchers.
- ▪Private sector: Training and educational programs; Technology and knowledge transfer.
- ▪Civil society organizations: Partnership with other CSOs; Information exchange.
- ▪Local community: Working in the field; Training and educational programs.

Notes

1. This report is one of country studies of a socially just energy transition in Asia, which is commissioned and supported by the Friedrich-Ebert-Stiftung Thailand.
2. National Economic and Social Development Board, *The National Economic and Social Development Plan of 2007*. (Thailand: 2007)
3. Business-as-usual level was projected from reference year 2005 in the absence of major climate change policies. BAU level in 2030 is approximated to be 555 MtCO2e. Gases include of carbon dioxide, methane, nitrous oxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride.
4. United Nations Framework Convention on Climate Change, "Climate Change Newsroom from the UNFCCC," October 1, 2015, accessed April 3, 2016. http://newsroom.unfccc.int/unfccc-newsroom/thailand-submits-its-climate-action-plan-ahead-of-2015-paris-agreement/.
5. It should be noted that GHG emissions mean total GHG emissions excluding land-use change and forestry. According to Thailand's INDC submitted in 2015, inclusion of land use, land-use change and forestry will be decided later.
6. Pasapong Gamonwet, Shobhakar Dhakal, and Koranat Thammasiri, "The Impact of Renewable Energy Pricing Incentive Policies in Thailand," *GMSARN International Journal* 11, (2017).
7. Puree Sirasoontorn, "Energy Sector Reform in Thailand: Analyses and Future Challenges," In *The Annual Symposium on Global Energy Situation and Thailand's Adjustment*, Faculty of Economics, Thammasat University, Bangkok, July 9, 2008.
8. Condensate is the lightest and most valuable crude oils. It is used to produce products such as petrol, jet fuel, diesel and heating fuels.
9. Praipol Koomsup and Puree Sirasoontorn, "Energy Industry Act: Implications for the Energy Sector in Thailand," *Thammasat Economic Journal* 28, no. 2 (2010), 35.
10. Puree Sirasoontorn,"Electricity Tariff Regulation in Thailand: Analyses and Applications of Incentive Regulation," in *Infrastructure Regulation: What works, Why and How do we know? Lessons from Asia and Beyond*, ed. Jarvis S.L. Darryl, M. Ramesh, Xun Wu and Eduardo Araral, Singapore: World Scientific Publishing Company, (2011).
11. Puree Sirasoontorn, "Institutional Dynamics in Energy Regulation in Thailand", Paper presented at the Eight National Conference of Economists, Chulalongkorn University, Bangkok, 22 October, 2013.
12. Asian Development Bank, *Civil society briefs: Thailand*, Bangkok: Asian Development Bank, 2011, last modified October 2011, https://www.adb.org/publications/civil-society-briefs-thailand.
13. Carl, Middleton, "Sustainable Electricity Transition in Thailand and the Role of Civil Society," *Handbook on Sustainability Transition and Sustainable Peace. in Handbook on sustainability transition and sustainable peace*. edited by Brauch, Hans Günter, Ursula Oswald, John Grin, and Jürgen Scheffran. *Handbook on sustainability transition and sustainable peace*. Switzerland: Springer, 2016)
14. International Energy Agency (IEA), *Thailand Electricity Security Assessment 2016*, (Paris: IEA, 2016)
15. Domestic renewable energy comprises of renewable energy and hydropower.
16. In this section, data source is from Energy Statistics of Thailand 2016 by EPPO.
17. Final consumption of petroleum includes of energy from fossil fuels (95.5 percent) and biofuels (4.5 percent).
18. Final consumption of electricity includes of electricity generated from fossil fuels (80 percent), renewables (9.2 percent), imported hydro power (7.7 percent) and large hydropower (3.1 percent).

19. Final consumption of renewable energy includes of traditional renewable energy (60 percent) and new renewable energy (40 percent), which are fuelwood, charcoal, paddy husk, bagasse, garbage, saw dust, agricultural waste and biogas. The majority of renewables consumption is in the form of heat.
20. During 2009-2015, peak demand was recorded by net peak generation requirement on EGAT system. Before 2009, gross peak generation requirement was reported.
21. By the time of writing, the under-privileged electricity users are defined as electricity users whose electricity usage is less than 50 units per month.
22. It is equivalent to 785.78 US Dollar. The Bank of Thailand reference exchange rate is 34.2524 baht per US Dollar in 2015.
23. National Statistical Office. *Major Findings of the 2015 Household Energy Consumption*, (Bangkok, Thailand: Ministry of Information and Communication Technology Office, 2016) (in Thai), last modified 2016, http://service.nso.go.th/nso/nsopublish/themes/files/EnergyPocket58.pdf.
24. Greater Bangkok includes Bangkok, Nonthaburi, Pathum Thani and Samut Prakan.
25. National Statistical Office. *Major Findings of the 2015 Household Energy Consumption*, (Bangkok, Thailand: Ministry of Information and Communication Technology Office, 2016) (in Thai), last modified 2016, http://service.nso.go.th/nso/nsopublish/themes/files/EnergyPocket58.pdf.
26. Puree Sirasoontorn, "Electricity Tariff Regulation in Thailand: Analyses and Applications of Incentive Regulation," in *Infrastructure Regulation: What works, Why and How do we know? Lessons from Asia and Beyond*, ed. Jarvis S.L. Darryl, M. Ramesh, Xun Wu and Eduardo Araral, Singapore: World Scientific Publishing Company, (2011).
27. Molnira Thamsereekul and Weerin Wangiraniran W. "A Study on Energy Security Indicators for Thailand Power Sector: Utility Aspect," *Journal of Energy Research 12, no*.2, 2015).
28. Weerin Wangjiraniran, Raksanai Nidhiritdhikrai, and Bundhit Eua-Arporn, "Scenarios on Power Generation in Thailand: Uncertainty of Nuclear and Coal Options," Engineering Journal 17, no. 3, (2013).
29. Juthamanee Martchamadol, and S. Kumar, "Thailand's Energy Security Indicators." *Renewable and Sustainable Energy Reviews* 16, no.8, (2012).
30. Asian Development Bank, *Renewable energy developments and potential in the GreaterMekong Subregion*, Mandaluyong City, Metro Manila, Philippines: Asian Development Bank, 2015a, accessed 12 December 2016, https://www.adb.org/publications/renewable-energy-developments-and-potential-gms.
31. *Ibid*.
32. Louis Lebel, Tiran Foran, Po Garden, and Jesse Manuta, "Adaptation to climate change and social justice: challenges for flood and disaster management in Thailand," in *Climate Change Adaptation in the Water Sector*, ed. Fulco Ludwig, Pavel Kabat, Heng van Schaik, and Michael van der Valk, ZLondo (UK: Eathscan, 2007).
33. Robert Costanza, Ida Kubiszewski, Peter Paquet, Jeffery King, Shpresa Halimi, Hansa Sanguanngoi, Nguyen Luong Bach, Richard Frankel, Jiragorn Ganaseni, Apisom Intralawan, and David Morell, *Planning Approaches for Water Resources Development in the Lower Mekong Basin*, (Chiang Rai, Thailand and Oregon, United States: Mae Fah Luang University, Portland State University and USAID, 2011). http://web.pdx.edu/~kub/publicfiles/Mekong/LMB_Report_FullReport.pdf
34. Decharut Sukkumnoed, Chuenchom Sangarasri Greacen, Paisan Limstit, Thawilwadee Bureekul, Sairung Thongplon and Suphakij Nuntavorakarn, *Governing the Power Sector: An Assessment of Electricity Governance in Thailand*, (Bangkok, Thailand: WRI, 2006).
35. Supanika Wattana, Deepak Sharma, and Ronnakorn Vaiyavuth, "Electricity Industry Reforms in Thailand: A Historical Review," *GMSARN International Journal* 2, no.2, (2008): 41-52.

36. Asian Development Bank, *Cobenefits and Trade-Offs of Green and Clean Energy: Evidence from the Academic Literature and Asian Case Studies*, January 8, 2016, accessed February 2, 2016, https://www.adb.org/sites/default/files/publication/217001/ewp-502.pdf.

37. The EEP is a revised version of the EEAP.

38. Felix Suerkemper, Thema Johannes, Stefan Thomas, Florian Dittus, Monthon Kumpaengseth, and Milou Beerepoot. "Benefits of energy efficiency policies in Thailand: an ex-ante evaluation of the *energy efficiency* action plan." Energy Efficiency 9, no.1 (2016): 187-210.

39. Decharut Sukkumnoed, Chuenchom Sangarasri Greacen, Paisan Limstit, Thawilwadee Bureekul, Sairung Thongplon and Suphakij Nuntavorakarn, *Governing the Power Sector: An Assessment of Electricity Governance in Thailand*, (Bangkok, Thailand: WRI, 2006).

40. Chaiyasit Anuchitworawong, Prinyarat Leangcharoen, and Kannika Thampanishvong, "*Green Growth and Green Jobs in Thailand: Comparative Analysis, Potentials, Perspectives*," (Bangkok, Thailand: Friedrich EbertStiftung, 2012), accessed June 4, 2016, http://library.fes.de/pdf-files/bueros/thailand/09423.pdf.

41. Chaiyasit Anuchitworawong, Prinyarat Leangcharoen, and Kannika Thampanishvong, "*Green Growth and Green Jobs in Thailand: Comparative Analysis, Potentials, Perspectives*," (Bangkok, Thailand: Friedrich EbertStiftung, 2012), accessed accessed June 4, 2016, http://library.fes.de/pdf-files/bueros/thailand/09423.pdf.

42. *Ibid*.

43. *Ibid*.

44. Thanawat Nakawiro, Subhes C. Bhattacharyyaa, and Bundit Limmeechokchai, "Electricity capacity expansion in Thailand: An analysis of gas dependence and fuel import reliance." *Energy*, 33, no. 5 (2008), accessed June 2016. doi:10.1016/j.energy.2007.12.005.

45. Tira Foran, *Thailand's Politics of Power System Planning and Reform*, (Geneva, Switzerland: IUCN, 2006).

46. Sopitsuda Tongsopit, "Thailand's Feed-in Tariff for Residential Rooftop Solar PV Systems: Progress So Far" *Energy for Sustainable Development* 29, no. 1, 2015: 127–134.

47. Lutz Weischer, Davida Wood, Athena Ballesteros and Xing Fu-Bertaux, *Grounding Green Power: Bottom-up perspectives on smart renewable energy policy in developing countries*, (Washington DC : The German Marshall Fund of the United States, 2011).

48. Asia Pacific Energy Research Centre. *Follow-up Peer Review on Energy Efficiency in Thailand*, (Tokyo: APEC Energy Working group, 2015).

49. Energy Regulatory Commission (ERC), *Fact Sheet: Power Development Fund*, (Bangkok, Thailand:Office of Energy Regulatory Commission), last modified September 39, 2016, http://www.erc.or.th/ERCWeb2/Upload/DocumentFactSheetภาพรวมกองทุน@30Sep2016En.pdf

50. Energy Policy and Planning Office. *Energy Statistics of Thailand 2016*, (Bangkok, Thailand: Ministry of Energy, 2016),

51. Bharath Jairaj, and Sorina Seeley, "How Civil Society Groups Improved Electricity in Thailand," in *World Resource Institute*, last modified June 19, 2013, http://www.wri.org/blog/2013/06/how-civil-society-groups-improved-electricity-thailand.

52. Ibid.

53. Davida Wood, and Sarah Martin, *Sustainable Energy Access Forums: Strengthening Enabling Environments through Multi-Stakeholder Partnerships*, (Washington DC: WWF and Word Resources Institute, 2016).

54. Asia Pacific Energy Research Centre, *Policy Review for Low-Carbon Town Development Project in Koh Samui, Thailand*, Report for the APEC Energy Working group, Last modified June, 2013, http://aperc.ieej.or.jp/publications/reports/lcmt/Policy_Review_for_Koh_Samui_Thailand.pdf.

55. Asia Pacific Energy Research Centre (APERC). *Policy Review for Low-Carbon Town Development Project in Koh Samui, Thailand*. Report for the APEC Energy Working group, June 2013.

56. Ibid.

57. Low-carbon school initiative is an initiative to transfer knowledge and expertise from people in private sectors such as hotels and resorts to the young generation of Samui in school. Students learn how to incorporate low-carbon practices in their daily life.

58. Eco-centers are developed to be a platform for development of green ideas and practices of these ideas within the town. It aims to create more jobs and learning opportunities for the local community.

59. Eco-point is a program to collect points by using services from shops, hotels, restaurants that were part of eco-activities. Users can redeem the points to obtain gifts from the campaign.

60. United Nations Development Programme (UNDP). 'UNDP provides access to clean cooking solutions in northern Thailand,' last modified March 3, 2016, http://www.th.undp.org/content/thailand/en/home/presscenter/articles/2016/03/03/undp-provides-access-to-clean-cooking-solutions-in-northern-thailand.html.

61. Sopitsuda Tongsopit, "Thailand's Feed-in Tariff for Residential Rooftop Solar PV Systems: Progress So Far," in *Energy for Sustainable Development* 29, no. 1, (2015): 127–134.

62. *Ibid*.

63. *Ibid*.

64. *Ibid*.

65. *Ibid*.

66. *Ibid*.

67. Verena Streitferdt, Surapong Chirarattananon, and Peter Du Pont, "Lessons learned from studying public initiatives to support energy efficiency finance in Thailand from 1992 to 2014," *Energy Efficiency*, 10 no. 4, (2017), accessed March 10, 2017, https://link.springer.com/article/10.1007/s12053-016-9492-1.

68. Wuttipan Kiatruangkrai and Ekachai Leelarasmee, "Barriers to Energy Saving for Public Middle Schools in Bangkok: From School Management Perspective," *International Journal of Energy Economics and Policy 6, no*.3 (2016), accessed December 10, 2016. http://www.econjournals.com/index.php/ijeep/article/view/2393/1657.

69. *Ibid*.

70. Puree Sirasoontorn, "Institutional Dynamics in Energy Regulation in Thailand", Paper presented at the Eight National Conference of Economists, (Bangkok, Thailand: Chulalongkorn University, October 22, 2013): 271-293.

71. International Energy Agency (IEA). *Thailand Electricity Security Assessment 2016*. Paris: IEA, 2016),

72. International Energy Agency (IEA). *Thailand Electricity Security Assessment 2016*. (Paris: IEA, 2016).

73. Neebir Banerjee, "Thailand Emission Reduction Challenges," last modified August 30, 2016. http://climatescorecard.org/2016/08/30/thailand-emission-reduction-challenges/.

74. Bangkok Post, "Krabi coal plant has to go ahead for EGAT in Southern Thailand," last modified February 17, 2016, accessed March 02, 2017, https://www.bangkokpost.com/archive/krabi-coal-fired-power-plant-gets-go-ahead/1200265.

75. *Ibid*.

76. Bangkok Post, "Krabi coal plant to start anew," last modified May 1, 2017, accessed May 7, 2017, https://bangkokpost.com/news/politics/1206529/krabi-coal-plant-to-start-anew.

Bibliography

Anuchitworawong, Chaiyasit, Prinyarat Leangcharoen, and Kannika Thampanishvong. *Green growth and green jobs in Thailand: comparative analysis, potentials, perspectives*. Bangkok, Thailand: Friedrich-Ebert-Stiftung. 2012.

Asia Pacific Energy Research Centre. *Policy Review for Low-Carbon Town Development Project in Koh Samui, Thailand*. 2013. http://aperc.ieej.or.jp/publications/reports/lcmt/Policy_Review_for_Koh_Samui_Thailand.pdf.

Asia Pacific Energy Research Centre. *Follow-up Peer Review on Energy Efficiency in Thailand. Tokyo: APEC Energy Working group*, 2015. http://publications.apec.org/publication-detail.php?pub_id=1698.

Asian Development Bank. *Civil society briefs: Thailand*. Bangkok, Thailand: Asian Development Bank, 2011. https://www.adb.org/publications/civil-society-briefs-thailand.

Asian Development Bank. *Renewable energy developments and potential in the Greater Mekong Subregion*. Mandaluyong City, Metro Manila, Philippines: Asian Development Bank, 2015a. https://www.adb.org/publications/renewable-energy-developments-and-potential-gms.

Asian Development Bank Institute. *Sustainable energy for all: tracking progress in Asia and the Pacific: a summary report*. Mandaluyong City, Metro Manila, Philippines: Asian Development Bank, 2015b. https://www.adb.org/publications/se4all-tracking-progress-asia-pacific-summary-report.

Asian Development Bank. *Asian Development Outlook (ADO) 2016 Update: Meeting the Low-Carbon Growth Challenge*. Mandaluyong City, Metro Manila, Philippines, 2016a. https://www.adb.org/publications/asian-development-outlook-2016-update.

Asian Development Bank. *Cobenefits and Trade-Offs of Green and Clean Energy: Evidence from the Academic Literature and Asian Case Studies*. January 8, 2016. Accessed February 2, 2016b. https://www.adb.org/sites/default/files/publication/217001/ewp-502.pdf.

Banerjee, Nabir. "An interactive site where all concerned can participate in post Paris efforts to reduce emissions in the 25 top greenhouse gas emitting countries." Climate Scorecard. August 30, 2016. Accessed October 02, 2016. http://climatescorecard.org/2016/08/30/thailand-emission-reduction-challenges/.

Bangkok Post. "Krabi coal plant has to go ahead for EGAT in Southern Thailand." Last modified February 17, 2016. Accessed March 02, 2017. https://www.bangkokpost.com/archive/krabi-coal-fired-power-plant-gets-go-ahead/1200265.

Bangkok Post. "Krabi coal plant to start anew." Last modified May 1, 2017b. Accessed May 7, 2017. https://bangkokpost.com/news/politics/1206529/krabi-coal-plant-to-start-anew.

Costanza, Robert, Kubiszewski, Ida, Paquet, Peter, King, Jeffery, Halimi,Shpresa, Sanguanngoi, Hansa, Nguyen, Luong Bach, Frankel, Richard, Ganaseni,Jiragorn, Intralawan,Apisom and David Morell. *Planning Approaches for Water Resources Development in the Lower Mekong Basin*, Chiang Rai, Thailand and Oregon, United States: Mae Fah Luang University, Portland State University and USAID, 2011. http://web.pdx.edu/~kub/publicfiles/Mekong/LMB_Report_FullReport.pdf.

Electricity Generating Authority of Thailand. *Annual Report*, various issues.

Energy Policy and Planning Office. Alternative Energy Development Plan 2015-2036, Ministry of Energy, Bangkok, 2015.

Energy Policy and Planning Office. *Energy Efficiency Plan 2015-2036*, Ministry of Energy, Bangkok, 2015.

Energy Policy and Planning Office. Thailand Power Development Plan 2015 – 2036. Bangkok, Thailand: Ministry of Energy, 2015.

Energy Policy and Planning Office. *Energy Statistics of Thailand 2016*. Bangkok, Thailand:Ministry of Energy, 2016.

Energy Regulatory Commission (ERC). Fact Sheet: Power Development Fund, Office of Energy Regulatory Commission, 30 September, 2016.

Foran, Tira. Thailand's Politics of Power System Planning and Reform, Geneva, Switzerland: IUCN, 2006.

Gamonwet, Pasapong, Dhakal, Shobhakar, and Koranat Thammasiri. "The Impact of Renewable Energy Pricing Incentive Policies in Thailand," *GMSARN International Journal* 11, (2017): 51-60. Accessed August 31, 2017. http://gmsarnjournal.com/home/wp-content/uploads/2017/07/vol11no2-1.pdf.

International Energy Agency (IEA). Thailand Electricity Security Assessment 2016. Paris: IEA, 2016.

Jairaj, Bharath and Sorina Seeley, "How Civil Society Groups Improved Electricity in Thailand." In *World Resource Institute*. Last modified June 19, 2013. http://www.wri.org/blog/2013/06/how-civil-society-groups-improved-electricity-thailand.

Kiatruangkrai, Wuttipan and Ekachai Leelarasmee, "Barriers to Energy Saving for Public Middle Schools in Bangkok: From School Management Perspective," *International Journal of Energy Economics and Policy 6, no*.3 (2016): 513-521. Accessed December 10, 2016. http://www.econjournals.com/index.php/ijeep/article/view/2393/1657.

Koomsup, Praipol and Puree Sirasoontorn, "Energy Industry Act: Implications for the Energy Sector in Thailand." *Thammasat Economic Journal* 28, no.2. (2010): 30-75.

Lebel, Louis, Foran, Tira, Garden, Po, and Jesse Manuta. "Adaptation to climate change and social justice: challenges for flood and disaster management in Thailand." In *Climate Change Adaptation in the Water Sector*, edited by Fulco Ludwig, Pavel Kabat, Heng van Schaik, and Michael van der Valk, 125-142. London, UK: Eathscan, 2007.

Martchamadol, Juthamanee and S. Kumar. "Thailand's Energy Security Indicators." *Renewable and Sustainable Energy Reviews* 16, no.8: 6103-6122, 2012. https://doi.org/10.1016/j.rser.2012.06.021.

Metropolitan Electricity Authority. *Annual Report*, various issues.

Carl, Middleton,"Sustainable Electricity Transition in Thailand and the Role of Civil Society,", *Handbook on Sustainability Transition and Sustainable Peace*. In Handbook on Sustainability Transition and Sustainable Peace. Edited by Brauch, Hans Günter, Oswald,Ursula, Grin, John, and Jürgen Scheffran, 831-851. Switzerland: Springer, 2016.

Nakawiro, Thanawat, Bhattacharyya Subhes C, and Bundit Limmeechokchai. "Electricity capacity expansion in Thailand: An analysis of gas dependence and fuel import reliance." *Energy* 33, no. 5 (2008),712-23. Accessed June 2016. doi:10.1016/j.energy.2007.12.005.

National Statistical Office. *Major Findings of the 2015 Household Energy Consumption*, Ministry of Information and Communication Technology, Bangkok, 2015.

Office of the National Economic and Social Development Board. *Sufficiency Economy Implications and Applications*, Sufficiency Economy Movement Sub-committee, Office of the National Economic and Social Development Board, 2007.

Provincial Electricity Authority. *Annual Report*, various issues.

Rojvithee, Areeya. Skills for green jobs in Thailand: Unedited background country study. ILO Skills and Employability. Geneva: International Labour Organization, 2010.

Ratthanakwan, Sanchai. Thailand's Energy Policy Reform: The Need On The Conflict: A Case Study Of Krabi Coal Power Plant. Bangkok, Thailand: Suan Sunandha Rajabhat University, Bangkok, 2017.

Rujivanarom, Pratch. "Anti-coal groups protest against latest NCPO order." *The Nation*. (Bangkok, Thailand), January 27, 2016.

Sirasoontorn, Puree. "Energy Sector Reform in Thailand: Analyses and Future Challenges.' Paper presented at the Annual Symposium on Global Energy Situation and Thailand's Adjustment. Faculty of Economics Thammasat University,: 184-284. July 9, 2008.

Sirasoontorn, Puree. "Electricity Tariff Regulation in Thailand: Analyses and Applications of Incentive Regulation." in *Infrastructure Regulation: What works, Why and How do we know? Lessons from Asia and Beyond*, ed. Jarvis S.L. Darryl, M. Ramesh, Xun Wu, and Eduardo Araral. Singapore: World Scientific Publishing Company, 2011.

Sirasoontorn, P. "Institutional Dynamics in Energy Regulation in Thailand." Paper presented at the Eight National Conference of Economists, October 22, 2013, Bangkok, Thailand: Chulalongkorn University, (2013): 271-293.

Streitferdt, Verena, Chirarattananon,Surapong and Peter Du Pont, "Lessons learned from studying public initiatives to support energy efficiency finance in Thailand from 1992 to 2014," *Energy Efficiency*, 10 no. 4, (2017): 905-923. Accessed March 10, 2017. https://link.springer.com/article/10.1007/s12053-016-9492-1.

Suerkemper, Felix, Johannes, Thema, Thomas, Stefan, Dittus, Florian, Kumpaengseth, Monthon and Milou Beerepoot. "Benefits of energy efficiency policies in Thailand: an ex-ante evaluation of the energy efficiency action plan." *Energy Efficiency* 9, no.1 (2016): 187-210.

Sukkumnoed, Decharut, Sangarasri Greacen Chuenchom, Limstit, Paisan, Bureekul, Thawilwadee, Thongplon, Sairung and Suphakij Nuntavorakarn, *Governing the Power Sector: An Assessment of Electricity Governance in Thailand*. Bangkok, Thailand: WRI, (2006).

Thamsereekul Molnira and Weerin Wangiraniran. "A Study on Energy Security Indicators for Thailand Power Sector: Utility Aspect." *Journal of Energy Research*, 12 no.2 (2015): 2-19.

Tongsopit, Sopitsuda. "Thailand's feed-in tariff for residential rooftop solar PV systems: Progress so far." *Energy for Sustainable Development*, 29 no.1 (2015): 127–134.

United Nations Framework Convention on Climate Change. "Climate Change Newsroom from the UNFCCC." October 1, 2015. Accessed April 3, 2016. http://newsroom.unfccc.int/unfccc-newsroom/thailand-submits-its-climate-action-plan-ahead-of-2015-paris-agreement/.

United Nations Development Programme. "UNDP provides access to clean cooking solutions in northern Thailand." March 3, 2016. Accessed July 11, 2016. http://www.th.undp.org/content/thailand/en/home/presscenter/articles/2016/03/03/undp-provides-access-to-clean-cooking-solutions-in-northern-thailand.html.

Wangjiraniran, Weerin, Nidhiritdhikrai, Raksanai, and Bundhit Eua-Arporn. "Scenarios on Power Generation in Thailand: Uncertainty of Nuclear and Coal Options." *Engineering Journal* 17, no.3 (2013): 9-16.

Wattana, Supanika, Sharma, Deepak, and Ronnakorn Vaiyavuth. "Electricity Industry Reforms in Thailand: A Historical Review." GMSARN International Journal, 2 no.2 (2008): 41-52.

Weischer, Lutz, Wood, Davida, Ballesteros, Athena, and Xing Fu-Bertaux. Grounding Green Power: Bottom-up perspectives on smart renewable energy policy in developing countries. Climate & Energy Paper Series. Washington, DC: the German Marshall Fund of the United States, 2011.

Wood, Davida and Sarah Martin. Sustainable Energy Access Forums: Strengthening Enabling Environments through Multi-Stakeholder Partnerships. Washington DC: WWF and Word Resources Institute, 2016.

About the authors

Dr. Praipol Koomsup is a senior expert on energy and transport in Thailand. Formerly, he worked as Professor in Economics at Thammasat University, a member of the National Reform Council, and Vice Minister of Energy.

Dr. Puree Sirasoontorn is currently an assistant professor at Faculty of Economics at Thammasat University. Her extensive research experiences in the energy economics and regulatory field in Thailand have been well received among various international and national organizations.

Imprint

©2017 Friedrich-Ebert-Stiftung Thailand Office
Thanapoom Tower, 23rd Floor
1550 New Petchburi Road, Makkasan, Ratchathewi,
Bangkok 10400
Thailand

Responsible:
Stine Klapper | Resident Director
Kaptan Jungteerapanich | Program Manager

Phone: +66 2652 7178-9
Fax: +66 2652 7180
Website: www.fes-thailand.org
Facebook: Friedrich-Ebert-Stiftung Thailand

To order publication:
info@fes-thailand.org

Friedrich-Ebert-Stiftung is founded in 1925 and is the oldest political foundation in Germany.

The foundation is named after Friedrich Ebert, the first democratically elected president of Germany. With an international network of more than 100 offices worldwide, it contributes to fostering the core values of social democracy - freedom, solidarity and social justice. In 2010, FES established a new global working line on climate justice and social-ecological-transformation, after promoting sustainable development models for many decades.

Friedrich-Ebert-Stiftung has actively supported social democracy in Thailand since 1970. The work of the country office based in Bangkok aims at facilitating inclusive dialogue, participation, pluralism, rule of law, social justice and nonviolent conflict resolution.

www.fes-asia.org

EFQM
Committed to excellence