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ANNEX 5

# THAILAND COUNTRY REPORT

FROM IDEAS TO ACTION: CLEAN ENERGY SOLUTIONS  
FOR ASIA TO ADDRESS CLIMATE CHANGE

**June 2007**

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## LIST OF ABBREVIATIONS

APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asia Nations
BMA	Bangkok Metropolitan Area
CDM	Clean Development Mechanism
CEPA	Committee on Energy Policy Administration
CHP	Combined Heat and Power
CNG	Compressed Natural Gas
CO <sub>2</sub>	Carbon Dioxide
DEDE	Department of Alternative Energy Development and Efficiency
DNA	Designated National Authority
DOE	Designated Operational Entity
DSM	Demand Side Management
EE	Energy Efficiency
EEl	Electrical and Electronics Institute
E for E	Energy for Environment Foundation
EGAT	Electricity Generating Authority of Thailand
ENCON	Energy Conservation
EPPO	Energy Policy and Planning Office
ESCO	Energy Services Company
FTI	Federation of Thai Industries
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GMS	Greater Mekong Sub Region
GW	Gigawatt
IIE	Institute of Industrial Energy
IPCC	Intergovernmental Panel on Climate Change
IPP	Independent Power Producer
IRP	Integrated Resource Planning
Ktoe	Kilotonnes of oil equivalent
LPG	Liquefied Petroleum Gas
MEA	Metropolitan Electricity Authority
MOEN	Ministry of Energy
MOI	Ministry of Industry
MONRE	Ministry of Natural Resource and Environment
MSW	Municipal Solid Waste
Mt	Million metric tons
Mtoe	Million tons of oil equivalent
MW	Megawatt
NGV	Natural Gas Vehicle
ONEP	Office of Natural Resources and Environmental Policy and Planning
NEPC	National Energy Policy Council
PCD	Pollution Control Department
PDD	Project Design Document
PEA	Provincial Electricity Authority
PM <sub>10</sub>	Particulate Matter < 10 microns, unit mg/m <sup>3</sup>
PV	Photovoltaic
RE	Renewable Energy
RPS	Renewable Portfolio Standard
SME	Small and Medium-sized Enterprise
SPP	Small Power Producer
TISI	Thai Industrial Standards Institute
TWh	Terawatt hours
UNFCCC	United Nations Framework Convention on Climate Change
USAID	US Agency for International Development
VSPP	Very Small Power Producer

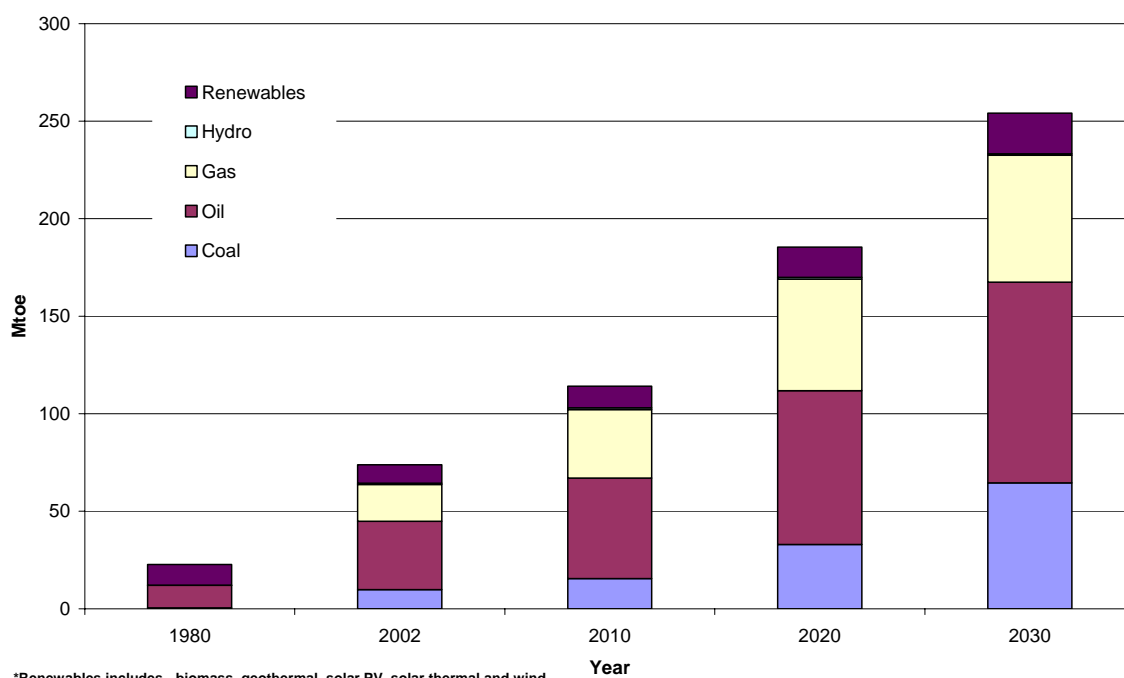
# I. THAILAND'S CLEAN ENERGY CHALLENGE

## I.1 TRENDS IN ENERGY RESOURCES

Thailand's primary energy consumption increased at a rate of 6.0 percent per year during 2000-2005, slightly slower than the 7.0 percent annual rate of increase in the 1990s. The growth of energy consumption was a result of robust consumption of natural gas for electricity generation. Currently, 70 percent of Thailand's electricity is generated by natural gas, which has led to concerns about energy security, in terms of price volatility and reliability of supply.

Thailand's total primary energy demand is projected to grow at an annual rate of 4.6 percent over the analysis period, from 74 Mtoe in 2002 to 258 Mtoe in 2030. Among the fossil fuels, coal is projected to grow fastest (7.0 percent per year), followed by natural gas (4.5 percent) and oil (3.9 percent). Figure I.1 shows primary energy demand by source projected to 2030.

**FIGURE I.1: THAILAND PRIMARY ENERGY DEMAND BY SOURCES**



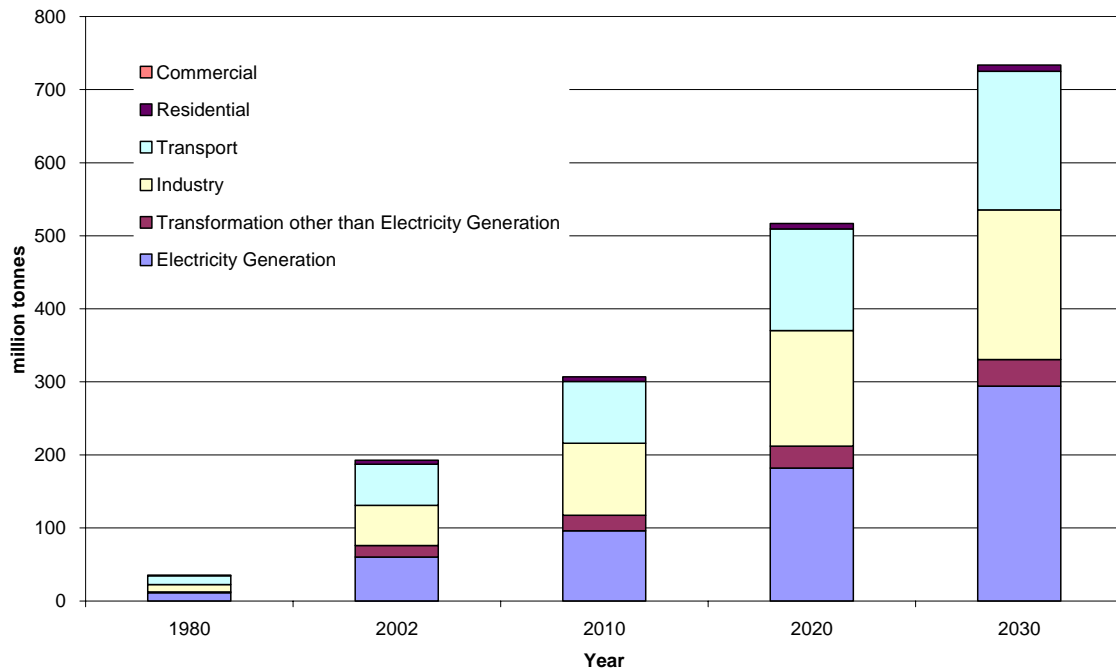
Source: APERC, 2006.

It is clear that with Thailand's projected high rate of economic growth, supply of the much-needed natural gas and oil will be a continuing challenge. Thailand has been very active in securing the economy's energy supply through various measures, including its efforts to build strong relations with neighboring economies, particularly those of the Greater Mekong Sub Region (GMS) for power interconnection and supply agreements.

## I.2 IMPACTS OF ENERGY USE

Emissions of CO<sub>2</sub> from the energy sector are expected to increase from about 192.6 million metric tons (Mt) in 2002, to 516.7 Mt in 2020, and more than 700 Mt in 2030, as shown in Figure I.2.

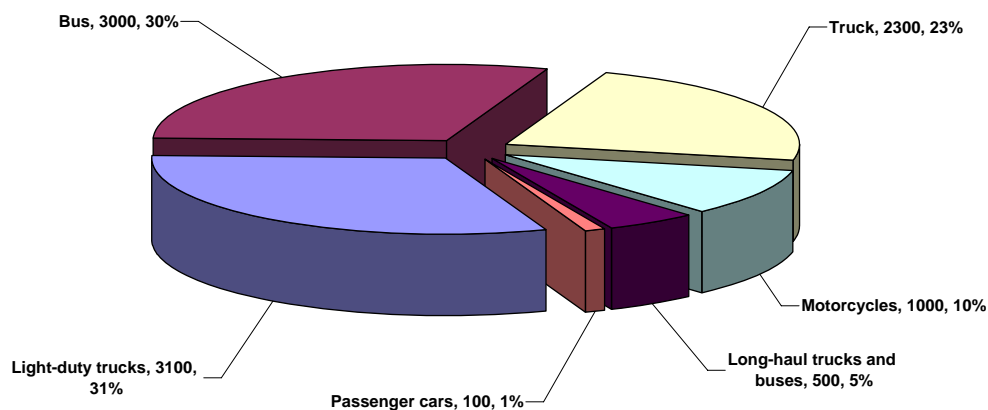
**FIGURE I.2: SHARE OF ENERGY-RELATED CO<sub>2</sub> EMISSIONS BY SECTOR**



Source: APERC, 2006.

Economic evaluation of air pollution in Bangkok has been well documented compared to other Asian cities. A World Bank-funded study found that Bangkok residents spent an average of 12.5 per cent of their total medical expenses on respiratory illnesses alone (WB, 2006). Figure 1.3 below shows the share of emissions released from different types of vehicles in Thailand.

**FIGURE I.3: BREAKDOWN OF VEHICULAR-RELATED EMISSIONS OF PARTICULATE MATTER IN BANGKOK (KILOTONS OF PM<sub>10</sub>)**



Source: ADB, 2006.

## 2. CLEAN ENERGY REGULATORY FRAMEWORK

### 2.1 KEY LAWS, DECREES, AND POLICIES

Since 1992, the Thai Government has issued numerous laws and decrees to promote and support energy-efficiency programs. Table 2.1 lists key laws and decrees.

Year	Title	Purpose
1992	Energy Conservation Promotion Act (ENCON Act)	Promotes energy conservation programs and establishes the ENCON Fund.
1993	Energy Conservation Promotion Fund (ENCON Fund)	Provides financial support for energy conservation and renewable energy programs. Can also be used to support agencies in research and development, technology demonstration, and pilot programs.
1995	Ministerial Decree for Designated Buildings	Specifies conservation standards, such as heat transfer into a building, efficiency of air-conditioning and lighting systems for the designated buildings.
1995	Ministerial Decree for Submission of Energy Consumption Data for Designated Buildings	Specifies procedures and methods for recording and submitting energy consumption data, and installing or modifying equipment that affects energy use.
1995	Ministerial Decree for Submission of Energy Conservation Targets and Plans for Designated Buildings	Specifies procedures for conducting preliminary and detailed energy audits, and for submitting energy conservation targets and plans.
1997	Ministerial Decree for Submission of Energy Consumption Data for Designated Factories	Specifies procedures and methods for recording and submitting energy consumption data, and installing or modifying equipment that affects energy use.
1997	Ministerial Decree for Submission of Energy Conservation Targets and Plans for Designated Factories	Specifies procedures for conducting preliminary and detailed energy audits, and submitting energy conservation targets and plans.
2005	Ministerial Decree for Submission of Energy Consumption Data for Designated Factories and Buildings (revision)	Simplifies procedures and methods for recording and submitting energy consumption data.
2005	Ministerial Decree for Submission of Energy Conservation Targets and Plans for Designated Factories and Buildings (revision)	Simplifies procedures for conducting energy audits and submitting energy conservation targets and plans.

Source: USAID ECO-Asia Clean Development and Climate Program, 2006.

#### 2.1.1 OVERARCHING FRAMEWORK

The ENCON Act was considered a major step for Thailand in the promotion and implementation of energy efficiency (EE) and renewable energy programs. Following the ENCON Act, the ENCON Fund was established by collecting a small levy on petroleum products. The annual inflow to the ENCON Fund is about 1,500 million Baht (US\$37.5 million). Through the ENCON Fund, the government has been able to promote and support hundreds of EE programs and projects since 1995.

To reduce the investment costs of the Electricity Generating Authority of Thailand (EGAT) in power supply, there are regulations to promote private sector investment. These include the independent power producer (IPP), small power producer (SPP), and very small power producer (VSPP) programs. The IPP program encourages the private sector, using conventional energy resources, to play an even stronger role in the electricity supply industry of the country. As of September 2006, the total installed capacity of IPPs was 3,136 MW (approximately 15 percent of total capacity).

In order to address Thailand's heavy dependence on imported oil, the government devised a National Energy Strategy in 2005. The main strategies include:

1. Establishing a regulatory framework for electricity and natural gas industries;
2. Enhancing energy supply for national energy security;

3. Promoting energy saving and energy efficiency;
4. Promoting renewable and alternative energy, and diversifying fuel types and sources;
5. Instituting market-based pricing structures to reflect true costs in a transparent manner and promote competition;
6. Setting a mandate on clean energy to lessen negative impacts on the environment; and
7. Promoting public and private participation in policy for sustainable development.

### **2.1.2 ENERGY EFFICIENCY**

There are three types of programs included in the ENCON Act: compulsory, voluntary, and complementary. The compulsory program, implemented primarily by the Department of Alternative Energy Development and Efficiency (DEDE), requires that designated factories and buildings conduct energy audits and submit energy conservation targets, plans, and reports every three years. The voluntary program, implemented primarily by the Energy Policy and Planning Office (EPPO), promotes and supports energy efficiency and renewable energy programs, such as energy conservation in tobacco curing and ceramic kilns. It also promotes energy conservation technology, enhances marketing of energy efficient equipment, demonstrates and disseminates PV grid connections for households and government buildings, PV-pumping for village water supply, and biogas from animal slaughter houses. Additionally, the EPPO supports a wide range of R&D projects. The complementary program aims to promote and increase competency of human resources in energy-related fields and to raise awareness on energy conservation through public campaigns, such as the “Divide by Two” campaign.

In addition to the three main programs above, EGAT has been conducting a labeling program since 1996. Many types of electrical appliances are involved in this program, such as compact fluorescent lamps (CFLs), air conditioners, refrigerators, electric fans, and rice cookers.

### **2.1.3 RENEWABLE ENERGY**

The Thai Government has also been trying to promote the utilization of renewable energy as another means to diversify energy sources. It aims to establish a 3-5 percent Renewable Portfolio Standard (RPS) for all new generating capacity installed, and the targeted share for renewable power generation has been proposed at 6 percent of total generating capacity by 2011. However, widespread diffusion of renewable resources has been hampered by their high cost relative to other energy sources, high initial capital costs, and the limitation of available renewable resources, especially biomass.

The SPP and VSPP programs were launched to support renewable electricity production from biogas, biomass, municipal solid waste (MSW), wind, solar, and other renewable energy sources. The SPP program was established to encourage interested investors using conventional and non-conventional energy or renewable energy as fuel. The range of capacity for SPP bidders is between 10 MW and 100 MW, and SPP investors receive electricity price subsidies from the government of about 0.17 Baht per kWh.

The VSPP program promotes distributed renewable energy generation. It is restricted to power generated from renewable resources with capacity less than or equal to 10 MW. The government subsidy for VSPP is an increment to the electricity purchase price, depending on the type of renewable energy, and as such is called an “adder”. As of September 2006, installed capacity of SPPs was 4,144 MW and VSPPs was 2,333 MW.

The ENCON Act and Fund also promote and support the use of renewable energy, such as biomass for heat and power (e.g., bagasse, rice husk, wood chip, palm oil bunch and coconut shell), biomass for

fuels such as gasohol and bio-diesel (e.g., cassava and palm oil), biogas from pig farms, and energy from MSW, PV, solar water heating systems, wind, and mini-hydro power.

### 2.1.4 CLEAN TRANSPORT

During 1990 to 2002, transportation energy consumption increased two-fold, mostly as a result of the increase in road transport. The number of passenger vehicles grew at an annual rate of 10.4 percent, and the number of freight trucks grew at an annual rate of 6.3 percent. As a result, the Thai Government is looking at the possibility of solving energy problems through the development of logistics systems, which includes oil transport through pipelines, improvement of mass transit systems, and switching the mode of freight transport from cars and light trucks to the railway and waterway systems.

The Thai Government has been promoting the use of gasohol and bio-diesel nationwide, and in 2006 it introduced compressed natural gas (CNG) vehicles. However, the share of alternative fuels, such as natural gas and ethanol, will not grow substantially, and is projected to account for only 1.0 percent of energy utilization in road transport in 2030. Conversely, the implementation of an energy labeling scheme for vehicles is expected to increase vehicular energy efficiency.

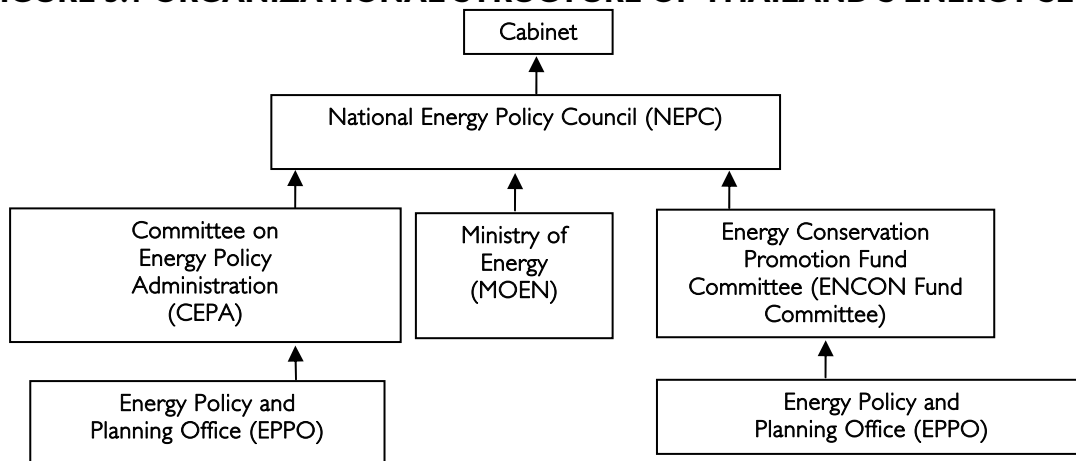
The government has been attempting to respond to environmental problems and has initiated several effective pollution control measures. These include controls for exhaust gas emissions, improvements in fuel and vehicle specifications, implementation of in-use vehicle inspections and maintenance programs, mass transit systems, and traffic management. The measures directed toward reducing vehicular emissions include fuel reformulation and control of vehicle emissions.

## 3. INSTITUTIONAL ANALYSIS

### 3.1 ORGANIZATIONAL OVERVIEW

Figure 3.1 shows the overall organizational structure of Thailand's energy sector. The main policies and plans, such as the price structure of petroleum products, energy exploration concessions, policies on IPP, SPP and VSPP, etc., must go through EPPO and be approved by the Committee on Energy Policy Administration (CEPA), the National Energy Policy Council (NEPC), and finally the Cabinet. National strategic plans and policies of the Ministry of Energy also have to be approved by NEPC and the Cabinet. Funding for all energy efficiency programs and activities has to be approved by the Energy Conservation Promotion Fund Committee.

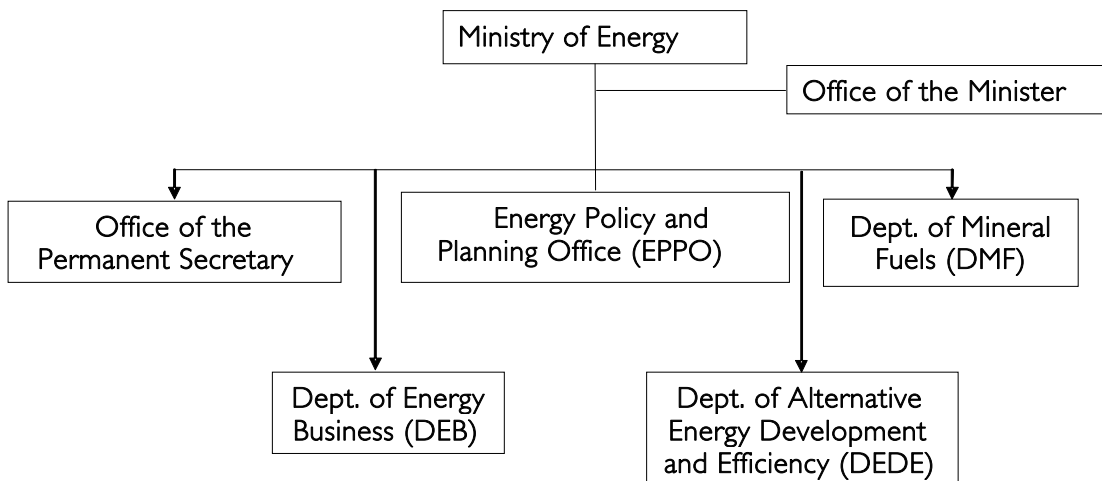
**FIGURE 3.1 ORGANIZATIONAL STRUCTURE OF THAILAND'S ENERGY SECTOR**



Source: Ministry of Energy.

The main government energy agency is the Ministry of Energy (MOEN), which was established in October, 2002. Under MOEN, there are six offices and departments, as shown in **Figure 3.2**. MOEN also oversees five state enterprises and one public organization, namely, EGAT, MEA, PEA, PTT Public Co. Ltd., Bangchak Petroleum Public Co. Ltd., and the Energy Fund Administration Institute.

**FIGURE 3.2: ORGANIZATIONAL STRUCTURE OF MOEN**



Source: Ministry of Energy.

Table 3.1 summarizes key government and quasi-governmental energy agencies, other key clean energy agencies, and their main functions.

<b>TABLE 3.1: CLEAN ENERGY INSTITUTIONS IN THAILAND</b>	
<b>Organization</b>	<b>Scope of Work</b>
<b>Ministry of Energy (MOEN)</b>	MOEN has overall responsibility for managing the energy sector and developing national strategic energy plans and targets. Its key duties are to supervise and promote the stability of the country's energy supply and to provide integrated services to the general public.
<b>Energy Policy and Planning Office (EPPO)</b>	EPPO's main responsibilities include recommending and setting energy policies, measures, and plans so as to effectively satisfy the energy needs of the country, and ensure sustainable energy security. EPPO implements voluntary energy conservation programs, such as public awareness campaigns and promotion of natural gas vehicles (NGVs) for the transportation sector.
<b>Department of Alternative Energy Development and Efficiency (DEDE)</b>	DEDE is the main implementing agency for compulsory and voluntary EE and renewable energy programs. DEDE is responsible for EE promotion, energy conservation regulation, development of alternative energy, and dissemination of energy technologies.
<b>Electricity Generating Authority of Thailand (EGAT)</b>	EGAT is a state enterprise responsible for generating and supplying electricity nationwide through two other state enterprises, the Metropolitan Electricity Authority (MEA) and Provincial Electricity Authority (PEA). EGAT also runs the Demand Side Management (DSM) Office, which promotes energy efficiency in appliances and equipment, primarily through a national standards and labeling program.

Source: USAID ECO-Asia Clean Development and Climate Program, 2006.

<b>TABLE 3.2 OTHER KEY CLEAN ENERGY INSTITUTIONS</b>	
<b>Ministry of Industry (MOI)</b>	MOI is responsible for overall policy-making, planning, and supervision for the industrial sector. Its Department of Industrial Promotion also promotes and supports EE programs in industries. The Thailand Industrial Standards Institute (TISI) and the Electrical and Electronics Institute (EEL) are key related institutions under MOI.
<b>Ministry of Natural Resources and Environment (MONRE)</b>	MONRE is responsible for conserving and developing natural resources and the environment. MONRE was assigned by the Government of Thailand to be a Designated National Authority (DNA) for CDM.

<b>Thai Industrial Standards Institute (TISI)</b>	TISI is the national standards body of Thailand under the Ministry of Industry. It is responsible for standardization activities.
<b>Electrical and Electronics Institute (EEI)</b>	EEI is an autonomous institute under the Ministry of Industry. It cooperates with TISI in developing, promoting, and testing various appliances and products. It also provides support to EGAT by testing electrical appliances for the energy labeling program.
<b>Energy for Environment Foundation (E for E)</b>	E for E, established in 2001, is a non-profit organization promoting energy efficiency and renewable energy in the public and private sectors. Its Biomass Clearinghouse section is a one-stop organization providing information and services relating to biomass (i.e. information, technical assistance, and promotion).
<b>Federation of Thai Industries (FTI)</b>	FTI is an organization under the supervision of the Ministry of Industry. It aims to strengthen industrialization. FTI comprises several industrial clubs and institutes. One of these institutes is the Institute of Industrial Energy (IIE), which provides services to members in the areas of energy efficiency and energy management systems.

Source: USAID ECO-Asia Clean Development and Climate Program, 2006.

### 3.2 INSTITUTIONAL NEEDS ASSESSMENT

Thailand’s energy sector has been consolidated under one ministry since 2002 as part of a major government restructuring plan. This consolidation was aimed at unifying energy-related agencies across nine ministries into one ministry, so that energy-related activities could be better managed, and directions and responsibilities of the departments and offices could be clarified. In practice, however, many of the same bureaucratic attitudes and procedures persist.

Needs for institutions include:

- Policy coordination among agencies;
- Implementation coordination among agencies;
- Coordination in monitoring and evaluating work among agencies; and
- Training for government staff in design of energy-efficiency programs, particularly in market research and economic analysis (i.e. cost-effectiveness of programs).

## 4. CURRENT STATUS AND POTENTIAL OF CLEAN ENERGY

### 4.1 OVERVIEW OF FUELS AND RESOURCES

#### 4.1.1 FOSSIL ENERGY AND NUCLEAR POWER

**Coal.** Coal is mainly utilized for electricity generation and accounts for 70 percent of the incremental growth in primary energy demand. The share of coal is projected to increase to 25 percent in 2030 from only 13 percent in 2002. Due to the low quality and quantity of Thailand’s coal resources, 91 percent of the total coal requirements in 2030 will need to be imported.

Currently, applications of clean coal technology are limited to the industrial sector (i.e. cement industry and paper manufacturing). Although clean coal technology would help to reduce environmental impacts, coal power generation has yet to be accepted by the public. DEDE has implemented the Clean Coal Technology Promotion Project in the industrial sector. In 2003 and 2004, a project using circulating fluidized bed (CFB) combustion technology was implemented at a paper factory to increase energy efficiency and reduce pollution generated by coal fuelling.

**Oil.** Thailand relies heavily on energy imports due to its limited energy resources. It imported 64 percent of its total primary energy requirements in 2005, mainly in the form of oil. Domestic procurement, however, has accelerated to cope with rising consumption. Crude oil production increased 15 percent a year from 2001 to 2005, from 62 thousand barrels per day (b/d) to 114 thousand b/d, but supplied only 10 percent of the economy's total crude oil consumption. Oil demand is projected to grow annually at 3.9 percent, from 35 Mtoe in 2002 to 103 Mtoe in 2030, mainly driven by the transport and industry sectors. Net oil import dependency is projected to increase from 89 percent in 2002 to 94 percent in 2030 as a result of increasing demand and declining domestic oil production. Various alternative fuels have recently been introduced to further reduce oil demand.

**Gas.** Currently, all natural gas utilized in the economy is produced domestically. However, production is projected to decline from a peak of 26.6 Mtoe in 2010 to 16.5 Mtoe in 2030. This expected production decline, coupled with the heavy reliance on natural gas for electricity generation (74 percent of total electricity generation capacity in 2002), has become a major concern for the government and has prompted the desire to diversify fuel sources in order to reduce the economy's vulnerability in the future. Alternative sources, such as imported coal and low calorific domestic lignite – with high sulphur content – are seen as a potential supply for the new capacity needed from 2011 onwards. However, because of opposition to the location of coal-fired power plants by local residents and the lack of deep-sea ports to handle coal deliveries, Thailand is expected to face difficulties in promoting coal. One example where local opposition influenced the construction of new coal-fired power plants was an incident in which high emissions of SO<sub>2</sub> from the Mae Moh power plant in Lampang caused substantial local health impacts and indirectly led to the cancellation of two coal-fired power plants at Bo Nok and Hin Krut in 2002.<sup>1</sup>

#### 4.1.2 NUCLEAR POWER

At present, the government has no official plans to employ nuclear power. Nuclear power was placed into the Power Development Plan in the early 1990s, but withdrawn after public opposition and concerns about financing. Recently, however, the Saha Group, the country's largest consumer product manufacturer, has been conducting a feasibility study for building a nuclear power plant. Nuclear power is viewed as an alternative source of power worth considering, as it would help decrease Thailand's reliance on natural gas and reduce greenhouse gas emissions.<sup>2</sup>

#### 4.1.3 RENEWABLE ENERGY AND DISTRIBUTED GENERATION

Currently, Thailand has about 560 MW of electricity from renewable energy that is sold to the grid. The vast majority of this comes from biomass from agro-industry, such as bagasse, rice husk, wood chips, biogas, and other agricultural residues. There is about 50 MW of installed mini- and micro-hydropower (DEDP, 1998), and a much smaller amount of wind power (0.2 MW) and grid-connected solar electricity (about 1 MW). In April 2005, total installed power capacity in Thailand was 26,430 MW (EGCO, 2005). Renewable energy accounted for about 2 percent of the total installed capacity. Clearly, there is sufficient renewable energy potential to meet the government's targets. The challenges lie in crafting a policy environment that encourages these renewable energy resources to be developed efficiently and cleanly. New and renewable energy is projected to contribute about 7 percent and 8.1 percent of the total primary energy supply, and will account for 12.9 percent and 18.9 percent of the total installed power capacity by 2011 and 2016 respectively, as shown on page 13 in **Table 4.1** (JGSEE, 2007).

1. These IPP projects were eventually converted to natural gas.

2. The Thai Minister of Energy, Dr. Piyasvasti Amranand, announced in early February 2007 that Thailand would consider building a nuclear power plant within the next 15 years, in order to reduce its reliance on natural gas for power production (*The Nation*, 1 February 2007).

**TABLE 4.1 ESTIMATED POTENTIAL AND CONTRIBUTIONS OF NEW AND RENEWABLE ENERGY (NRE) TO TOTAL PRIMARY ENERGY SUPPLY (TPES)**

Energy source	TPES (Ktoe)			Installed Capacity (MW <sub>e</sub> )			GWh Production			Assumed Capacity Factor
	2005	2011	2016	2005	2011	2016	2005	2011	2016	
<b>Total Primary Energy Supply</b>	105,357	152,282	202,847	26,400	37,443	48,000	134,826	197,482	259,659	
<b>Biomass</b>										
· Ethanol	55	1066	2799	-	-	-	-	-	-	
· Bio-diesel	13.3	540	1,375	-	-	-	-	-	-	
· Residues for heat	1,959	4,144	3,895							
· Residues for power	2,096	3,090	4,725	2,191	3,229	4,938	9,596	14,143	21,628	50%
· Short rotation plants	0	521	1,302	0	519	1,298	0	3,182	7,955	70%
· Biogas for H&P	50	323	345	28.8	181	193	227	1,475	1,580	90%
· Solid wastes for H&P	7	585	695	4	323	384	33	2,688	3,196	95%
<b>Small hydro</b>	45	285	285	53	338	338	204	1,308	1,308	44%
<b>Wind</b>	0	56	513	0.19	194	1,783	0	255	2,343	15%
<b>Solar</b>										
· PV	7.9	18.3	36.7	26	60	120	36	84	168	16%
· SWH (fuel oil equivalent)	20	78	156	-	-	-	-	-	-	
· Dryer	-	5		-	-	-	-	-	-	
<b>Sub-total</b>	<b>4,253</b>	<b>10,711</b>	<b>16,127</b>	<b>2,303</b>	<b>4,844</b>	<b>9,054</b>	<b>10,096</b>	<b>23,135</b>	<b>38,178</b>	
<b>% NRE</b>	<b>4.0%</b>	<b>7.0%</b>	<b>8.1%</b>	<b>8.7%</b>	<b>12.9%</b>	<b>18.9%</b>	<b>7.5%</b>	<b>11.7%</b>	<b>14.7%</b>	

Source: JGSEE, 2007.

Renewable energy has been also promoted through the VSPP program. The regulation classifies VSPPs as renewable resources with a capacity less than or equal to 10 MW. The government subsidy for VSPP is in the form of an “adder” to the electricity purchase price, which varies depending on the type of renewable energy.

#### 4.1.4 ENERGY EFFICIENCY

Since the establishment of the ENCON Act 1992 and the ENCON Fund, hundreds of energy-efficiency activities and programs in Thailand have been developed and implemented. Considerable progress has been made and there have been some outstanding program achievements. The ENCON Fund is the main driver providing financial support for most energy efficiency and renewable energy programs, as well as for R&D and public relations campaigns. Some of the successful programs are as follows:

- **The Demand Side Management Program:** EGAT established the DSM Office in 1993 with support from the World Bank, GEF, Australian and Japanese governments and through a fuel adjustment mechanism in the tariff called the “Ft”. The EGAT DSM Program has focused mainly on EE labeling schemes, including thin fluorescent tubes, refrigerators, air-conditioners, compact fluorescent lamps (CFLs), electric fans, low loss magnetic ballasts, rice cookers, and lighting reflectors. Cumulative power demand and energy savings as of March 2006 were 1,304 MW and 7,172 GWh respectively.
- **The 30 percent Subsidy Program:** This was one of the most successful DEDE programs. The objective is to help designated factories and buildings implement EE projects. During 2002 and 2003, DEDE shouldered 30 percent of the investment cost and the designated facilities paid 70 percent. Lifetime energy cost savings were about 15.6:1 per Baht of DEDE subsidy.
- **Energy Efficiency Revolving Fund:** The EERF was established in January 2003 to stimulate financial sector involvement in EE projects, and simplify project evaluation and financing procedures. ENCON Fund provided 2,000 million Baht (US\$50 million) for each of the two phases (2003-2005 and 2006-present). The funds are managed by commercial banks and supervised by DEDE. Lending banks have provided additional funds, which could reach 12,000 million Baht in Phase 2. The total estimated energy cost savings were about US\$20.13 million per year as of May 2005.

Despite these successes, many government EE programs were neither cost-effective nor successful and had to be modified or discontinued. One example is the compulsory energy audit program for designated factories and buildings. The designated facilities were supposed to submit energy audit reports every three years. However, 10 years after the Ministerial Regulations went into effect, fewer than 60 percent of the total facilities (about 4,500) had submitted reports, even though the ENCON Fund provided substantial subsidies. Therefore, in early 2005 DEDE revised the regulations by making the requirements simpler, and cancelled the subsidies for energy audits.

#### 4.1.5 CLEAN TRANSPORT

During 1990 to 2002, Thailand’s transportation energy consumption increased two-fold, mostly as a result of the increase in road transport. The number of passenger vehicles grew at an annual rate of 10.4 percent, and the number of freight trucks increased at an annual rate of 6.3 percent. One of the strategies implemented was to promote the use of gasohol, bio-diesel and compressed natural gas (CNG).

The Thai Government also has been attempting to respond to environmental problems, and has initiated several effective pollution control procedures such as fuel reformation, controlling vehicular emissions by setting emission standards, creating inspection maintenance programs, instituting roadside inspections, improving traffic management, and reducing vehicle kilometers traveled.

Both gasoline and diesel have been reformulated. Gasoline reformulation was accomplished as follows: leaded gasoline has not been available in Thailand since 1996, the benzene content is limited to less than 3.5 percent by volume, and the aromatic content must be lower than 35 percent by volume. Diesel reformulation has been accomplished by reducing the sulfur content from 1.0 to 0.5 percent by weight and by reducing the 90 percent volume distillation temperature from 370°C to 357°C.

## 4.2 COMPARISON OF ECONOMIC POTENTIAL AND COST EFFECTIVENESS

Table 4.2 shows the generating costs of several renewable energy sources (DEDE 2006c). The generating costs of mixed conventional energy, DSM, some EE programs, and CDM projects are also included for comparison. The DSM and EE programs are quite cost effective.

<b>TABLE 4.2: COST EFFECTIVENESS OF VARIOUS ENERGY RESOURCES</b>			
<b>Program/Technology</b>	<b>Capital Cost (US\$/kW)</b>	<b>Generating Cost (Baht/kWh)</b>	<b>Generating Cost (US cents/kWh)<sup>1</sup></b>
The 30 percent Subsidy Program <sup>2</sup>		0.14	0.34
DSM		0.52	1.30
EE Revolving Fund <sup>2</sup>		0.40	1.00
Biogas electricity generation	1,491	1.77	4.43
Mixed conventional energy (70 percent NG)	1,200	2.11	5.28
Mini hydro, 200 kW-6 MW	1,630	2.44	6.10
Biomass condensing, 20 MW	1,892	2.51	6.28
Micro hydro, < 50 kW	1,924	2.78	6.95
Biomass condensing, 10 MW	1,415	3.24	8.10
Wind farm, 20,000 kW	1,336	3.39	8.48
Biomass condensing, 5 MW	1,667	3.51	8.78
MSW incineration, 3,000 kW	5,736	7	17.50
Solar PV, large scale, 460 kW	4,084	11.88	29.70

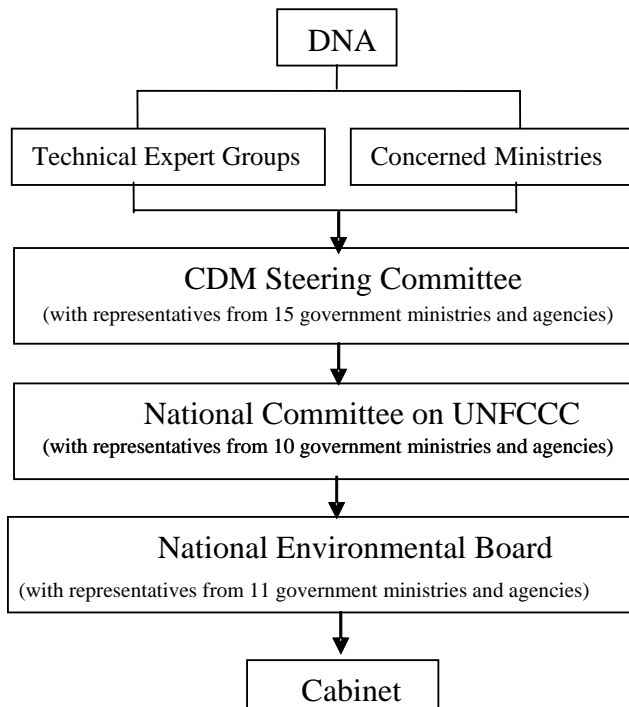
<sup>1</sup> Exchange rate: US\$1 = 40 Baht. <sup>2</sup> Total investments divided by average lifetime (seven years) energy savings. Source: DEDE, 2006c.

# 5. CARBON AND GREENHOUSE GAS ABATEMENT

## 5.1 STATUS OF ACTIVITIES IN THE CARBON MARKETS

The Climate Change Coordinating Unit, the Office of Natural Resources and Environmental Policy and Planning (ONEP), and the Ministry of Natural Resources and Environment (MONRE), are responsible for collaborating to support, prevent and mitigate impacts arising due to climate change. At present, Thailand is in the process of setting up a Climate Change Supporting Account to be used for CDM activities. It is proposed that revenues be collected from a 2 percent fee on the sale of carbon credits. The organization of the CDM permission process in Thailand is presented in **Figure 5.1** below:

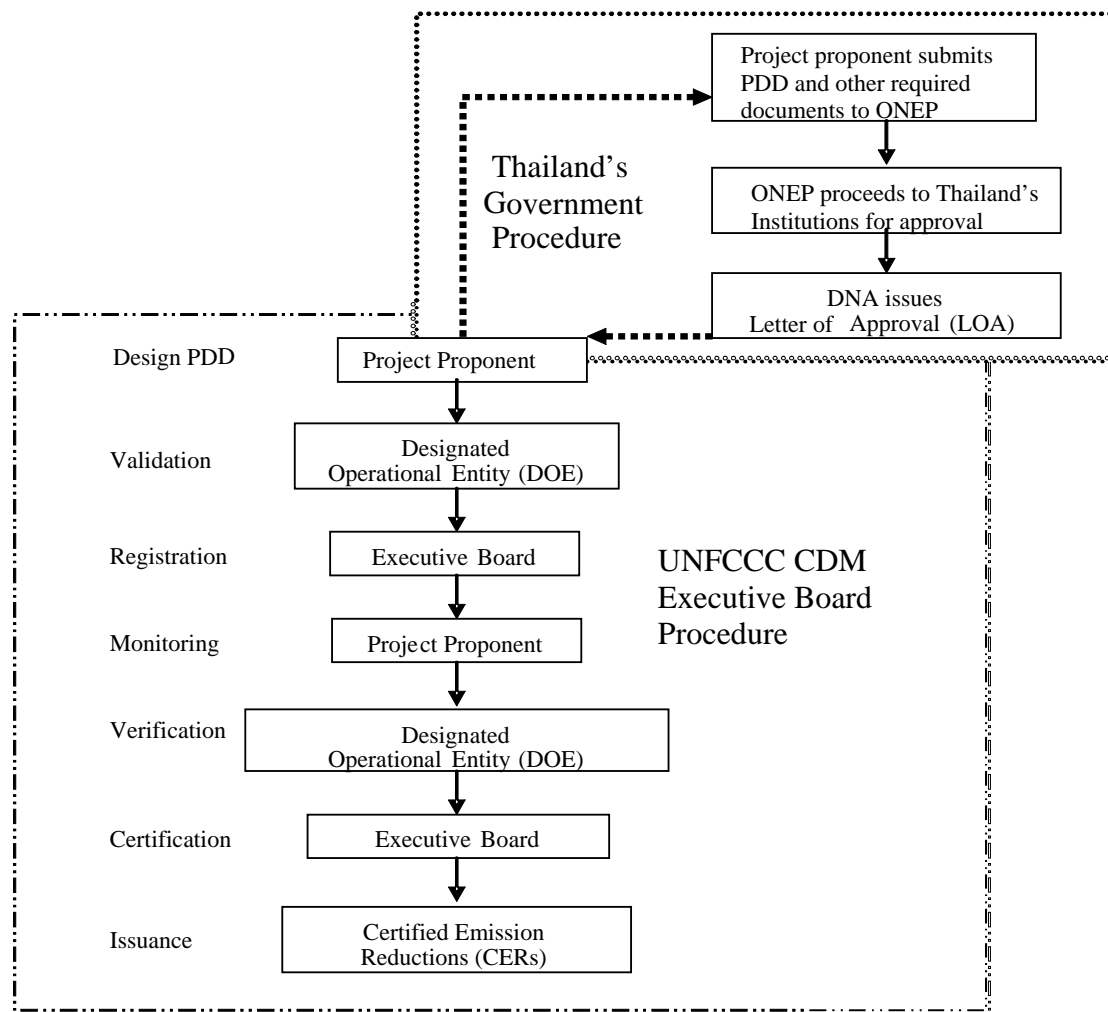
**FIGURE 5.1: CDM PERMISSION PROCESS**



Source: ONEP.

Thailand's CDM permit process is divided into two phases: CDM registration preparation and project operation. Currently, several CDM projects in Thailand have received a recommendation for approval by the DNA. The recommendations will be forwarded to the Thai Cabinet, which is responsible for signing the approval letters.

**FIGURE 5.2: FLOW CHART OF THE CDM PERMIT PROCESS**



Source: ONEP

## 5.2 INSTITUTIONAL CAPACITY FOR MEASURING AND REPORTING GREENHOUSE GAS ABATEMENT

At the project preparation stage, the calculation and measurement of GHG is done by the project owner and the local consultant. So far, there is no local Designated Operational Entity (DOE) to validate and verify GHG reductions.

## 6. DONOR ACTIVITY IN CLEAN ENERGY

Several international organizations have been actively assisting Thailand in a wide range of energy efficiency and renewable energy programs. These overseas development assistance (ODA) organizations include the European Union (EU), DANIDA of Denmark, GTZ of Germany, and JICA, METI and NEDO of Japan. The assistance programs aim to improve the efficient use of energy and water, and reduce GHG. **Table 6.1** summarizes ODA projects by type of clean energy program. Some of the major projects include:

- The EC-ASEAN COGEN Program** was the third and final phase of a multi-year economic cooperation effort initiated by the European Commission and the Association of South-East Asian Nations. The objective of COGEN 3 was to promote and create business opportunities for the use of co-generation to generate power and heat using biomass, coal or gas as fuel. This was achieved through partnerships between ASEAN industries and power producers and European equipment suppliers, and a grant program for implementation of a Full Scale Demonstration Project.
- Promotion of Renewable Energy Technologies in Thailand:** Action plans for the development of the RE market in Thailand were funded by DANIDA, with the overall objective of reducing GHG emissions through improved use of renewable sources of energy. By the end of the project, it is expected that various cost-effective strategies, including action plans for the promotion of specific renewable energy technologies with promising market potential in Thailand, will be adopted and implemented by the Thai Government.
- The E3Agro Project of GTZ** aims to strengthen the competitiveness of Thai agro-industries through the implementation of cost-effective production processes, technologies, and professional management techniques, as well as the promotion of the efficient use of energy and improvements in the utilization of biomass for energy production.

**TABLE 6.1: SUMMARY OF ODA ACTIVITY AND PROJECTS IN CLEAN ENERGY**

Agency and Project	Demand Side EE	Supply Side EE	Renewable Energy	Clean Fossil Fuels	Clean Transport
EU: COGEN 3 (multi-country)		✓	✓		
EU: Sol-Therm Project for Solar Water Heaters			✓		
DANIDA: Promotion of RE Technologies			✓		
4. Energy Planning	✓				
DANIDA: Energy Efficiency Promotion Strategy for Factories and Buildings	✓		✓		
DANIDA: Adjustment to Building Energy Codes	✓				
Denmark: CDM Promotion	✓	✓	✓		
GTZ: E3Agro	✓	✓	✓		
GTZ: Enhancing competitiveness of SME	✓		✓		
NEDO: Demonstration Project Utilizing Photovoltaic Power Generation Systems			✓		
JICA: Industrial energy Efficiency Demonstration Training Center	✓				
World Bank/GEF: Promotion of Electricity Energy Efficiency (EGAT's DSM Program) and ESCO Development	✓				

Source: USAID ECO-Asia Clean Development and Climate Program, 2006.

## 7. BARRIERS AND NEEDS ASSESSMENT IN CLEAN ENERGY

Thailand's primary energy demand is projected to grow by 4.6 percent annually over the next 28 years, from 74 Mtoe in 2002 to 258 Mtoe in 2030. Among the fossil fuels, coal is projected to grow at the fastest rate (7.0 percent per year), followed by natural gas (4.5 percent per year), and oil (3.9 percent per year) due to increasing demand in the transport and industrial sectors. Reducing the economy's heavy reliance on natural gas for electricity generation is a major challenge. This could be achieved by increasing the use of coal (both imported coal and low-calorific domestic lignite) and local renewable

energy sources. However, a barrier to the building of more coal-fired power plants is opposition from local residents and the lack of deep-sea ports to handle coal imports and deliveries. The negative image of coal stems in large part from the intensive local pollution caused by the Mae Moh power plant in Lampang province during the 1990s.

Electricity generation in Thailand is projected to increase annually by 5.5 percent, from 111 TWh in 2002 to 504 TWh in 2030. Throughout the analysis period, natural gas will continue to have the dominant share of the electricity generation mix, despite its expected decline from 74 percent in 2002 to 57 percent by 2030. According to the government's energy demand forecast, the economy's installed generating capacity is expected to increase from 23 GW in 2002 to 91 GW in 2030. During this period, the amount of coal-fired electricity generation is projected to dramatically increase, from 3 GW in 2002 to 26 GW in 2030.

Another way to improve the security of Thailand's electricity supply is through power interconnections with Laos, Cambodia, and Viet Nam. Thailand is building strong relations with neighboring economies, particularly those of the Greater Mekong Sub Region (GMS), for power interconnections (for hydro, natural gas, and coal) through GMS initiatives. Interconnecting these areas of supply and demand would make it possible to provide access to less expensive electricity, lower costs (through economies of scale), and reduce GHG emissions and other pollutants. However, a number of hurdles still need to be overcome (e.g., lack of transmission facilities for electricity transfer, regulatory protocols, cross-border tariffs, etc.). It should be noted that an investment of between US\$168 and US\$211 billion will be required during the analysis period to construct the infrastructure needed to meet Thailand's projected energy demand.

In addition to the above-mentioned projects, Thailand also aims to enhance energy conservation measures to reduce energy demand in all sectors. In its National Energy Strategy-2005, the government set a target to reduce total national energy consumption by 20 percent in 2009. In order to achieve this, the national strategy relies on improved technologies for energy conservation and development of alternative energy resources. In the transportation sector, oil consumption is targeted to be reduced by as much as 25 percent in 2009; It is envisioned that 180,000 vehicles powered by CNG will be deployed in a bid to reduce gasoline and diesel consumption by 10 percent. Furthermore, gasohol is to be utilized nationwide as a partial replacement for gasoline by 2008. In the industrial sector, energy consumption is targeted for reduction by as much as 20 percent through efficiency improvements and switching to natural gas, to be supplied via pipeline as compressed natural gas, or imported as liquefied natural gas. The government is also looking at the possibility of solving energy problems through the development and improvement of logistics systems, which include oil transport through pipelines, and the improvement of mass transit systems and freight transport by switching the mode of transport from cars and light trucks to the railway and waterway systems.

The government has been actively developing energy conservation targets and master plans since 2002. At the Energy Strategy for Competitiveness Conference held in August 2003, the Prime Minister set a target to reduce energy elasticity from 1.4:1 to 1:1 within five years (1.4 was the average value from 1985 to 2001).<sup>3</sup>

In summary, Thailand has adequate regulations, such as the ENCON Act, for promoting clean energy programs. However, there has never been any penalty to effectively enforce the regulations or to

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3. In 2004 the value was still 1.4; primary energy supply per GDP was 27.3 ktoe/1,000 Baht as compared to 26.7 ktoe/1,000 Baht in 2003; and primary energy supply per population was 1.7 toe/capita as compared to 1.6 toe/capita in 2003.

ensure that energy savings targets for large buildings and factories are met. Since Thailand also has the ENCON Fund to support clean energy programs on a continuous basis, there is no lack of funding for clean energy programs. Thailand's energy sector has been consolidated under one ministry since 2002, as part of a major government restructuring plan, whereby each department and office gained a clearer strategic direction and responsibility. The remaining barriers include the following:

- Lack of comprehensive and sustained EE programs that will have a substantial impact on energy savings;
- Lack of effective incentives programs to motivate (and penalize if necessary) the designated facilities to save energy; and
- Lack of a clear, short-term government policy and plan to substantially reduce energy consumption in the transport sector.

There is a need to scale-up clean energy activities in the following areas:

- Policy coordination among agencies;
- Coordination of implementation among agencies;
- Coordination and information-sharing on monitoring and evaluation coordination among agencies;
- Training in design of EE programs for government staff, particularly in the areas of market research and economic analysis (i.e. a cost-effective program);
- Effective incentive and awareness programs to promote EE in designated facilities and SMEs; and
- An increased focus on EE programs for the transport sector.

## 8. CONCLUSIONS

### 8.1 RECOMMENDATIONS FOR A CLEAN ENERGY STRATEGY

Beginning in mid-2005, the Energy Policy and Planning Office and the Ministry of Energy, along with the Thai Research Fund (TRF), assigned The Joint Graduate School for Energy and Environment to implement the Energy Policy Research Project. The multi-year project is designed to provide information, analysis, and policy recommendations on policies and programs that support and promote increased implementation of EE and renewable energy technologies and options. The important strategies included in this project can be divided into three types: strategies to reduce the rate of petroleum fuel consumption; strategies to improve energy efficiency in the industrial, commercial, and residential sectors, and; strategies to promote the use of renewable energy for electricity, heat, and power generation. The following tables summarize and provide details on potential opportunities.

<b>STRATEGIES TO REDUCE THE RATE OF PETROLEUM FUEL CONSUMPTION</b>	
<b>Strategy</b>	<b>Actions</b>
<b>Setting standards for fuel consumption and CO2 emissions of new vehicles</b>	<ul style="list-style-type: none"> <li>• Analysis of specific fuel consumption in the existing vehicle stock</li> <li>• Comparison of approaches to reduce vehicle fuel consumption by minimum standards and voluntary agreements for adopting such measures for Thailand</li> <li>• Measures on how to reduce fuel consumption of existing cars by introducing regular emission controls</li> <li>• Linking fuel consumption and emission standards of new cars to the tax regime</li> </ul>
<b>Taxation of vehicles according to engine size and</b>	<ul style="list-style-type: none"> <li>• Overview of current vehicle stock, use, and consumption</li> <li>• Examples of vehicle tax schemes in comparable countries</li> <li>• Comparison of different measures for reducing transport fuel consumption and their social,</li> </ul>

<b>STRATEGIES TO REDUCE THE RATE OF PETROLEUM FUEL CONSUMPTION</b>	
<b>Strategy</b>	<b>Actions</b>
<b>emissions</b>	<ul style="list-style-type: none"> <li>economic, and environmental effects</li> <li>Models for new taxation system based on engine size and emissions, including long-term scenarios on effects on certain consumer groups and the overall tax system</li> </ul>
<b>Substitution of gasoline and fossil diesel use by natural gas, bio-ethanol and bio-diesel</b>	<ul style="list-style-type: none"> <li>Analysis of the energy balance for bio-ethanol fuels from sugar-cane and other organic materials</li> <li>Analysis of the energy balance for bio-diesel from palms and other plants</li> <li>Potential analysis for bio-fuels and other alternative transport fuels</li> <li>Cost analysis for production of bio-ethanol and bio-diesel from different resources</li> <li>Socio-economic study of the large-scale introduction of bio-ethanol and bio-diesel</li> <li>Study of the large-scale use of indigenous oil plants (palm oil, coconuts, etc.) for the production of bio-oil and bio-diesel</li> <li>Market analysis for the introduction of bio-fuels, LPG and NG in the transport sector</li> <li>Strategies to stimulate the use of bio-fuels and other alternative fuels through adequate political measures and instruments</li> <li>Study of the long-term availability and supply security of alternative fuels from national and regional sources for the transport sector in Thailand</li> <li>Study of the external costs of the transport system on the basis of different modes and fuel scenarios</li> <li>Prospects for synthetic bio-fuels for the Thai transport market</li> </ul>
<b>Development of statutory labeling schemes for energy consumption of new vehicles</b>	<ul style="list-style-type: none"> <li>Assessment of current passenger car market and available information on fuel economy</li> <li>Strategy for setting up an appropriate fuel consumption labeling scheme for vehicles and accompanying information activities</li> <li>Collaborative efforts for a joint strategy to introduce a labeling scheme and supporting information measures for new passenger cars in ASEAN countries</li> </ul>
<b>Other measures to curb fuel/oil consumption for transport</b>	<ul style="list-style-type: none"> <li>Campaign to increase the attractiveness of the public transport system</li> <li>Introduction of fully floating gasoline and diesel prices and removal of any subsidies for conventional fuels in the transport sector</li> <li>Discourage the use of individual vehicles by appropriate urban planning</li> <li>Improve traffic management by avoiding unnecessary fuel consumption caused by congestion</li> <li>Obligatory procurement of EE vehicles by all state-dependent institutions and promotion of such procurement by major industrial and commercial enterprises</li> <li>Improved transport management for goods by modernizing EE transportation modes, specifically by rail and ship, and installation of logistical hubs at central locations for collection and distribution of transport goods</li> </ul>

<b>STRATEGIES TO IMPROVE ENERGY EFFICIENCY IN THE INDUSTRIAL, COMMERCIAL, AND RESIDENTIAL SECTORS</b>	
<b>Strategy</b>	<b>Actions</b>
<b>Energy Standards and Labeling</b>	<ul style="list-style-type: none"> <li>Database on energy performance of appliances and equipment, and expansion of the database into end-use information systems</li> <li>Benchmarking study for major end-use appliances and equipment</li> </ul>
<b>Building Energy Codes</b>	<ul style="list-style-type: none"> <li>Research and studies on properties of local building and construction materials</li> <li>Test facilities and certification of local building materials</li> <li>Training and capacity building of organizations responsible for enforcement of EE codes and standards</li> </ul>
<b>Tax Incentives</b>	<ul style="list-style-type: none"> <li>Benchmarking of energy consumption for production of the main energy-intensive products compared to international practices</li> <li>Database of technologies/equipment for tax credit prioritized by their first costs</li> <li>Analysis of economic impact and revenue losses for the lifetime of the tax incentive measure</li> <li>Analysis of benefit/cost ratio of measures</li> </ul>
<b>Rebate Programs</b>	<ul style="list-style-type: none"> <li>Research comparing cost effectiveness of rebate and tax incentive measures</li> <li>Development of computerized program tracking database</li> </ul>
<b>Consumer Awareness and Behavioral Changes</b>	<ul style="list-style-type: none"> <li>Study on how to manage and sustain consumer awareness, and establish effective monitoring and evaluation systems</li> <li>Study on factors influencing the adoption of energy-efficiency campaign and behavioral changes</li> <li>Analysis of the correlation between consumer awareness and government campaigns</li> </ul>
<b>Cogeneration</b>	<ul style="list-style-type: none"> <li>Analysis of national potential targets for cogeneration and available resources</li> </ul>

<b>STRATEGIES TO IMPROVE ENERGY EFFICIENCY IN THE INDUSTRIAL, COMMERCIAL, AND RESIDENTIAL SECTORS</b>	
<b>Strategy</b>	<b>Actions</b>
	<ul style="list-style-type: none"> <li>• Analysis of barriers preventing cogeneration investments in Thailand</li> <li>• Policy research and study on economic impacts for a fuel subsidy scheme for gas-fired CHP</li> </ul>
<b>Building Energy Rating and Labeling</b>	<ul style="list-style-type: none"> <li>• Identification of energy consultant training needs</li> <li>• Compilation and verification of existing building data to establish a benchmark</li> <li>• Development of routines for compiling and processing building data</li> </ul>
<b>Energy Audit and Management Scheme</b>	<ul style="list-style-type: none"> <li>• Improved segmentation and prioritization for the targeting of measures</li> <li>• International review of best practices and recommendations for policy and programmatic approaches</li> <li>• Establishment of innovative incentive mechanisms for both designated and non-designated facilities</li> <li>• Establishment of effective institutional, financial and human resource frameworks to support scaling-up of the value engineering concept</li> </ul>
<b>Loan Funds</b>	<ul style="list-style-type: none"> <li>• Investigation of the implementation of a guarantee fund in Thailand to solve the collateral issue</li> <li>• Study on what type of contract(s) are best suited for Thai customs and business relationships</li> </ul>
<b>Energy and CO<sub>2</sub> Taxes</b>	<ul style="list-style-type: none"> <li>• Rationalization of energy taxes</li> <li>• Sensitivity analysis of levee rates for energy and CO<sub>2</sub> taxes</li> <li>• Determination of the impact of energy and CO<sub>2</sub> taxes</li> </ul>
<b>Demand Response (DR) and Direct Load Control</b>	<ul style="list-style-type: none"> <li>• Behavior and perception of electricity end-users and customers in different end-use sectors</li> <li>• International review of DR best practices, with recommendations on applicable DR measures for Thailand</li> <li>• Technical studies on how different DR measures applicable for Thailand would contribute to energy conservation and grid reliability</li> </ul>

<b>STRATEGIES TO PROMOTE THE USE OF RENEWABLE ENERGY FOR ELECTRICITY, HEAT, AND POWER GENERATION</b>	
<b>Strategies</b>	<b>Actions</b>
<b>Interconnection Agreements</b>	<ul style="list-style-type: none"> <li>• Independent assessment of bottlenecks in current SPP and VSPP programs and their resolution</li> <li>• Survey of international best practices in interconnection arrangements</li> <li>• Analysis of strategies to provide incentives to utilities to encourage more evenly distributed generation</li> </ul>
<b>Power Purchase Agreements</b>	<ul style="list-style-type: none"> <li>• Study on the impact of changing tariff structure on basis on "time of generation" rather than "firm/non-firm" contracts for all new renewable energy generators.</li> <li>• Study impact on Thai economy and renewable energy generators of shifting from natural-gas price indexing to another index for renewable energy tariffs (e.g., biomass-indexed, flat-rate).</li> </ul>
<b>Feed-in Tariffs</b>	<ul style="list-style-type: none"> <li>• Study to cross-check feed-in values proposed by other studies against estimates from industry in Thailand and internationally</li> <li>• Study to draft feed-in tariff legislation</li> <li>• Study on externality costs of different power resources in Thailand</li> </ul>
<b>Externality Adders under IRP</b>	<ul style="list-style-type: none"> <li>• Integrated Resource Plan for Thailand, including consideration of risks (especially fuel price volatility risk), as well as social and environmental costs</li> </ul>
<b>Renewable Portfolio Standard (RPS)</b>	<ul style="list-style-type: none"> <li>• Study to determine whether it is possible to modify Thai RPS to ensure that EGAT's RPS obligations are met cost-effectively</li> <li>• Study to review policy options under consideration by the Thai government in light of international experience and Thailand's industrial structure and regulatory environment</li> </ul>

## 8.2 RECOMMENDED ACTIVITIES

Suggested activities from interviews with various government agencies and roundtable discussions with stakeholders, academics, and the private sector are summarized in **Table 8.1**.

<b>TABLE 8.1: ACTIVITY AND POTENTIAL IMPLEMENTING AGENCIES AND STAKEHOLDERS</b>	
<b>Initiating Agency and Activity</b>	<b>Potential Implementing Agencies and Stakeholders</b>
<b>Ministry of Energy</b>	
<ul style="list-style-type: none"> <li>Scale-up standards and labeling, energy efficiency, and clean energy programs such as ethanol, bio-fuels, and waste to energy</li> </ul>	EGAT, DEDE, MOI, TISI, PTT, and Ministry of Agriculture
<ul style="list-style-type: none"> <li>Set up national DSM office</li> </ul>	EGAT, DEDE, and TISI
<b>Energy Policy and Planning Office</b>	
<ul style="list-style-type: none"> <li>Support ASEAN energy labeling program</li> </ul>	EGAT, DEDE, TISI, ASEAN, and APEC
<b>Office of the Permanent Secretary of the Ministry of Energy and the Department of Alternative Energy Development and Efficiency</b>	
<ul style="list-style-type: none"> <li>Regional tax incentive program</li> </ul>	DEDE, Department of Revenue, ASEAN
<ul style="list-style-type: none"> <li>Regional standards for bio-fuels</li> </ul>	EGAT, DEDE, MOI, TISI, and PTT
<b>Electricity Generation Authority of Thailand</b>	
<ul style="list-style-type: none"> <li>Upgrade efficiency of label no.5 by 30-35 percent</li> </ul>	EGAT, DEDE and TISI
<ul style="list-style-type: none"> <li>Improve efficiency of existing power plants by using Combined Heat and Power (CHP)</li> </ul>	EGAT
<ul style="list-style-type: none"> <li>Regional information sharing of CHP</li> </ul>	EGAT and ASEAN
<b>Roundtable meeting with academics and private sector</b>	
<ul style="list-style-type: none"> <li>Strategy and scale-up campaign for CHP</li> </ul>	EGAT
<ul style="list-style-type: none"> <li>Government incentives: for manufacturers and for implementation of energy efficiency and renewable energy programs</li> </ul>	EPPO and DEDE
<ul style="list-style-type: none"> <li>Strategy to increase market penetration of clean coal technology</li> </ul>	MOEN, EPPO, DEDE, EGAT, MOI, ONEP
<ul style="list-style-type: none"> <li>Education program on benefits of biomass and bio-fuels at the village level</li> </ul>	EPPO, DEDE, and NGO
<b>UNESCAP</b>	
<ul style="list-style-type: none"> <li>Mainstreaming energy efficiency in energy plans and institutions</li> </ul>	MOEN, EPPO, DEDE, and ASEAN
<ul style="list-style-type: none"> <li>Regional strategies for promotion of clean coal and natural gas</li> </ul>	MOEN, EPPO, DEDE, EGAT, MOI, and ASEAN
<ul style="list-style-type: none"> <li>Regional Promotion of public-private partnerships</li> </ul>	MOEN, EPPO, DEDE, FTI, and ASEAN

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