

## *Incentives for Renewable Energy in Southeast Asia: Case study of Thailand*

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*Prepared by The Joint Graduate School of Energy and Environment (JGSEE)*

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*February 2013*

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## Table of Contents

|       |                                                                                                |    |
|-------|------------------------------------------------------------------------------------------------|----|
| 1.0   | Definitions .....                                                                              | 2  |
| 2.0   | Overview of the Power Sector .....                                                             | 3  |
| 2.1   | Energy Mix and Installed Capacity .....                                                        | 3  |
| 2.2   | Government Institutions in the Energy Sector .....                                             | 4  |
| 2.3   | The Role of the Private Sector .....                                                           | 5  |
| 2.4   | Key Legislation and Regulations.....                                                           | 7  |
| 3.0   | Investment Incentives for Renewable Energy .....                                               | 8  |
| 3.1   | Financial Incentives.....                                                                      | 9  |
| 3.1.2 | The ENCON Fund .....                                                                           | 11 |
| 3.2   | Fiscal Incentives.....                                                                         | 16 |
| 3.3   | Other Incentives .....                                                                         | 17 |
| 4.0   | Discussion and Analysis .....                                                                  | 19 |
| 4.1   | Stakeholder Impressions .....                                                                  | 19 |
| 4.2   | Prospects and Planned Developments for Investment Incentives.....                              | 19 |
| 4.3   | Positive or Negative Examples of Projects Where Investment Incentives Have Played a Role ..... | 21 |
| 4.4   | Estimates of the Costs and Benefits of Renewable Energy Investment Incentives.....             | 22 |
| 5.0   | Conclusions and Recommendations.....                                                           | 26 |
|       | References .....                                                                               | 27 |
|       | Appendix .....                                                                                 | 29 |

## Introduction

Global energy markets face rising challenges from the increasing scarcity of low-cost energy derived from fossil fuels. At the same time, there is a growing need to decouple economic growth from greenhouse gas emissions. Against this backdrop, developing countries face the additional challenge of increasing access to energy. These pressures have led to a growing focus on renewable energy technologies (RETs), as well as the introduction of support measures and incentives to encourage investment in renewable energy.

The governments of a number of Southeast Asian countries have started to address the economic and non-economic barriers to renewable energy deployment. They do this by introducing policies aimed at incentivizing renewable energy investment. However, information is often lacking as to what strategies are behind these policies, and to what extent they address the barriers.

Thailand is a good example, as it has introduced a number of incentives to encourage investment in renewable energy by way of capital grants for renewable energy equipment, such as solar thermal systems, biogas installations and municipal solid waste (MSW) energy projects (as of 2003). In addition, Thailand introduced a feed-in tariff in 2007, and since 2004 has offered tax exemptions for the import of renewable energy equipment.

This report aims to investment incentive policies and their effectiveness in addressing the perceived barriers to renewable energy deployment in Thailand. It begins by outlining the definitions and methodology used to define investment incentives and providing an overview of Thailand's power sector. It then describes policies to promote investment in renewable energy. Finally, it assesses the effectiveness of available incentives in addressing barriers and gives recommendations for increasing successful renewable energy deployment in Thailand.

## 1.0 Definitions

There is no one agreed definition of investment incentives. Thomas (2007) defines them narrowly as “a subsidy given to affect the location of investment,” while the United Nations Conference on Trade and Development (UNCTAD) (2004) defines them more broadly as incentives intended to attract foreign or domestic investment using: financial incentives (such as grants and loans at concessionary rates); fiscal incentives (such as tax holidays and reduced tax rates); subsidized infrastructure or services; and concessions or exemptions from regulations and standards.

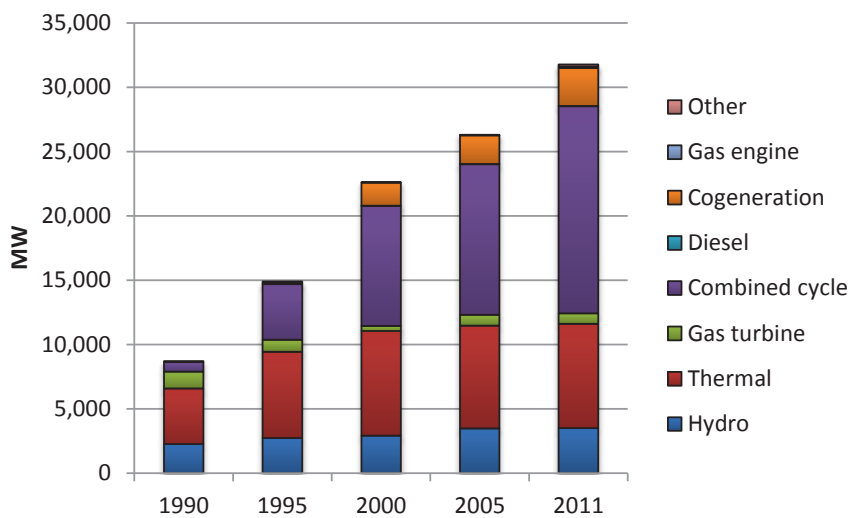
This study follows the broader UNCTAD definition, recognizing that the vast majority of renewable energy subsidies cannot focus merely on attracting investment to a particular location, but must also provide the financial support that makes such investments viable at all. Thus, in this report, the terms *investment incentive* and *subsidy* can be considered interchangeable, to the extent that the subsidy in question can be argued to affect investment decisions.

It should be noted, however, that these terms do not include measures intended to remove existing market distortions that are a barrier to renewable energy. For example, none of the following measures would qualify as investment incentives: the removal of fossil energy subsidies; regulation intended to remove barriers to renewable energy entering the energy market; or the use of taxation and payments to internalize positive and negative externalities. While such measures are not the focus of this report, they are identified and factored into assessments where relevant.

## 2.0 Overview of the Power Sector

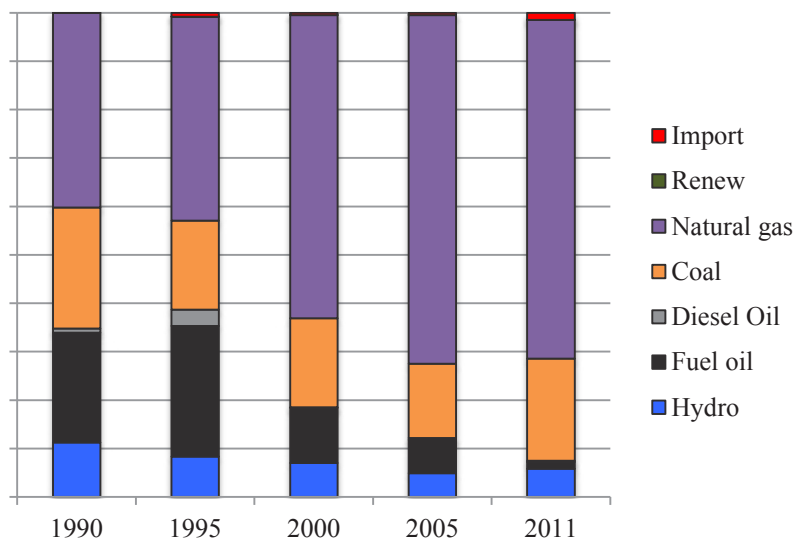
### 2.1 Energy Mix and Installed Capacity

Thailand's total installed electricity generation capacity in 2011 was 31,773 megawatts (MW). Combined cycle plants provided the largest share of the capacity, approximately 16,900 MW, or 53 per cent. The installed capacity of renewable energy was 2,156.9 MW, or about 6.8 per cent of the total installed capacity.



**FIGURE 1 - ELECTRICITY INSTALLED CAPACITY IN THAILAND FROM 1990 TO 2011**

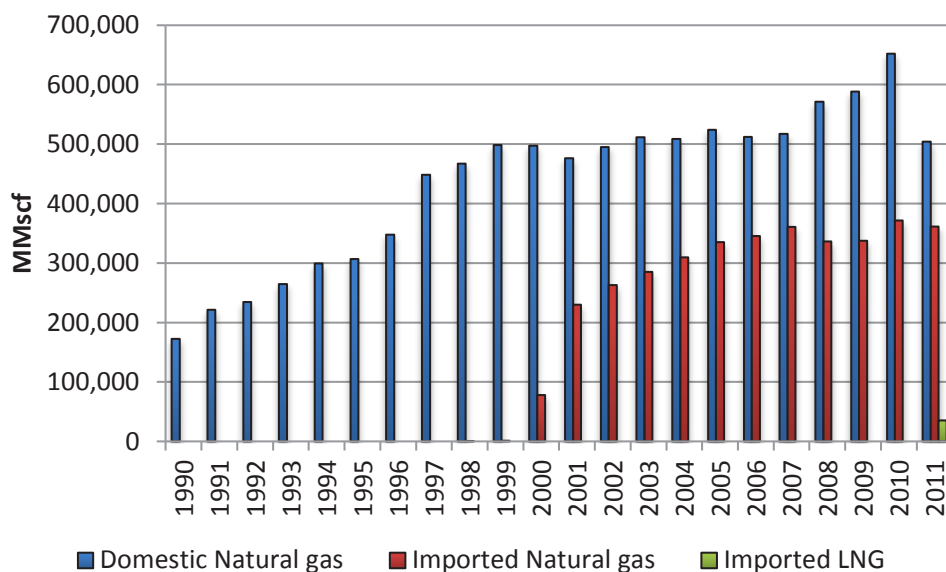
Source: Department of Alternative Energy Development and Efficiency (DEDE), 2011a.



**FIGURE 2 - ELECTRICITY GENERATION SUPPLY MIX BY FUEL FROM 1990 TO 2011**

Source: DEDE, 2011a.

Power generation in Thailand is predominately derived from fossil fuels, mainly natural gas. Coal-based power generation, which accounted for about 20 per cent of total electricity supply in 2011 was the second most important source of fuel, while the role of hydroelectric power generation was limited to about 4.8 per cent during the same period. Oil-based power generation played a limited role during this period due to increasing replacement of oil-based generation with natural gas and coal. Moreover, Thailand increased electricity imports from Laos from nearly zero to about 1.5 per cent of electricity supply in 2011. Imports are mainly generated from hydroelectric power.



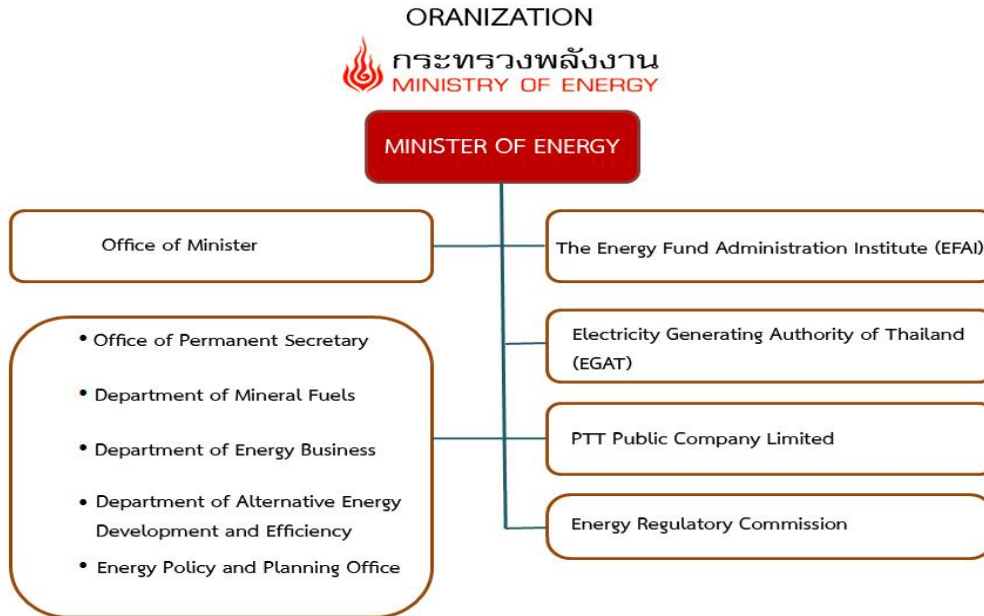
**FIGURE 3 - DOMESTIC AND IMPORTED NATURAL GAS AND LNG IN THAILAND FROM 1981 TO 2011**

Source: DEDE, 2011b, 2011c.

Ambitious targets are in place for renewable energy. The previous Power Development Plan (PDP 2010 Rev.2) (Electricity Generating Authority of Thailand, 2012b), aimed to increase the proportion of renewable energy generated in Thailand to 12.3 per cent of total generation by the end of 2030, and the subsequent PDP (PDP 2010 Rev.3 (2010–2030)) targets an increase in capacity to 19.8 per cent of total installed capacity by the end of 2030. These targets aim to improve energy security by reducing the reliance on natural gas, coal and electricity imports while at the same time reducing CO<sub>2</sub> emissions.

## 2.2 Government Institutions in the Energy Sector

The Ministry of Energy (MOE) is the main government institution responsible for energy policy in Thailand. Under the the MOE, there are six departments and four state enterprises, as shown in Figure 4. The Department of Alternative Energy Development and Efficiency (DEDE) is the main department responsible for development of renewable energy.



**FIGURE 4 - ENERGY SECTOR INSTITUTIONAL STRUCTURE OF THAILAND**

Source: Ministry of Energy of Thailand, 2002.

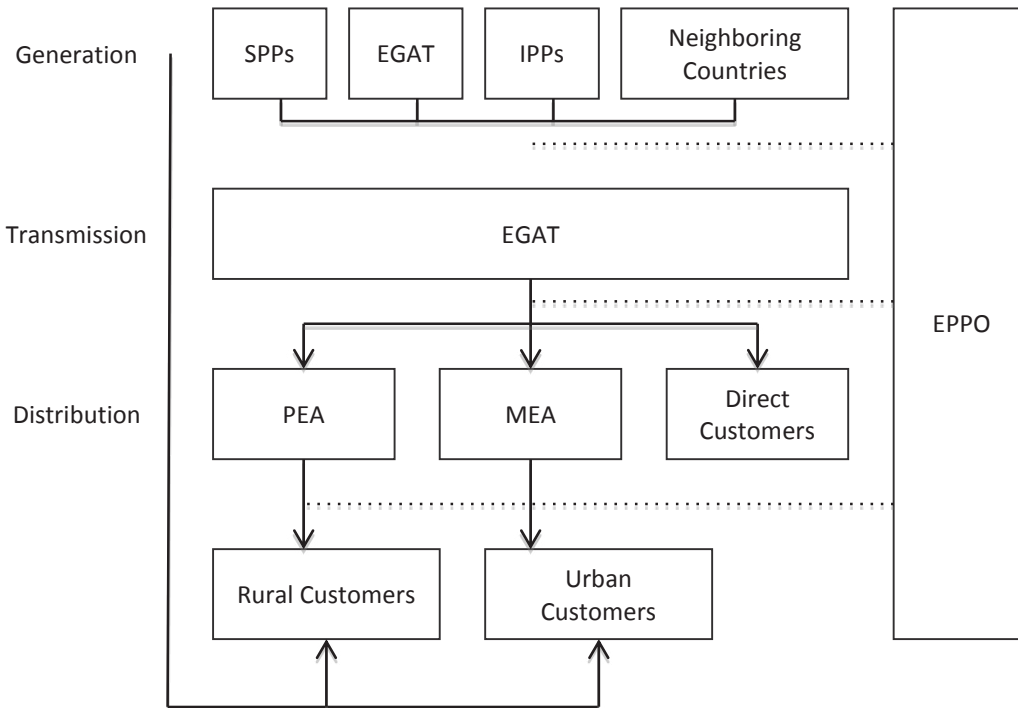
The Energy Industry Act B.E. 2007 (Energy Policy and Planning Office [EPPO], 2007), established the Energy Regulatory Commission (ERC) and separated the roles of policy-making and regulation in the electricity and natural gas sector. The ERC's primary function is to oversee the regulations that deal with systems of electricity generation, transmission, distribution, and operation.

### 2.3 The Role of the Private Sector

Thailand's electricity demand has increased over the past decades, in line with economic development. In the past, Thailand had been confronted with an insufficient supply of electricity and an inefficient electricity sector. A lack of investment saw the reserve margin fall from 43 per cent in 1985 to 13 per cent in 1989. Due to concerns over public debt and limited public sources of finance available for investment, in 1992 the Thai government decided to encourage private sector participation in the electricity sector, in order to promote competition, reduce public debt and increase the efficiency of electricity generation and distribution (EPPO, 1992). Private sector participants were allowed access to the electricity market in form of Independent Power Producers (IPPs), Small Power Producers (SPPs) in 1992 and Very Small Power Producers (VSPPs) in 2002. The definition of IPPs, SPPs and VSPPs is that installed capacity must be more than 90 MW, from 10 to 90 MW, and less than 10 MW, respectively.

The Thai Electricity Supply Industry (ESI) is based on a state-owned single-buyer scheme. The Electricity Generating Authority of Thailand (EGAT) is a major power generator and distributor. The Metropolitan Electricity Authority (MEA) is responsible for distribution in the Bangkok metropolitan area and the provinces of Nonthaburi and Samutprakan, and the Provincial Electricity Authority (PEA) is in charge of power distribution for the remaining provinces. EGAT is a single buyer who sells electricity to the PEA and MEA, and also to some large industrial electricity users who are connected directly to the transmission network.





**FIGURE 5 - ELECTRICITY SUPPLY INDUSTRY STRUCTURE IN THAILAND**

Source: Surapong & Supattana, 2006.

Most IPPs are incorporated as subsidiaries of EGAT to operate power-generation businesses. As of 2011, the installed capacity of the IPPs, SPPs and VSPPs was 12,152 MW, 10,290 MW and 5,734 MW, respectively (EPPO, 2012). Under the single-buyer system, IPPs and SPPs are required to sell electricity to EGAT, which subsequently sells the power to the distribution companies. VSPPs must sell electricity to their local distribution company. The system effectively means that the purchase of power from independent generators is not subject to competition. However, the ERC is responsible for regulating electricity procurement as well as monitoring the selection procedures to ensure fairness for all parties.

Private sector actors, SPPs and VSPPs can develop renewable energy projects. However, some renewable energy projects require government support to ensure feasibility, especially for wind power. Wind resources for power generation are very limited in Thailand, and most of the suitable areas are located in protected forest, military and agricultural areas. Consequently, the MOE is required to own any projects in these restricted areas.

A number of wind power pilot projects have been implemented by the government. These include: Hua Sai power plant (1.5 MW), Lamtakong power plant (2.5 MW) and an ongoing project in the province of Narathiwat (30–35 MW). Although only the MOE is eligible to own wind power in restricted areas, private businesses can participate in the construction of power plants.

## 2.4 Key Legislation and Regulations

A key piece of legislation is the National Energy Policy Act B.E. of 1992 (EPPO, 1992a). This act established the National Energy Policy Council (NEPC) with the National Energy Policy Office (NEPO) acting as its Secretariat. NEPO is the most influential energy authority and reports directly to the prime minister.

A significant achievement of NEPO was the creation of the Energy Conservation (ENCON) fund, which was established under the Energy Conservation Promotion Act B.E. 1992 (EPPO, 1992b). This fund receives money from the oil fund under the laws governing correction and prevention of oil shortages. The fund can be used to support other agencies that are interested in energy conservation, including promoting renewable energy projects, energy-related research and development, human resources development and training, and public awareness campaigns. However, the remit of NEPO was curtailed by the Organization of State Administration Act B.E. 2002, under which the MOE was given power over NEPO. The NEPA was re-named the Energy Policy and Planning Office (EPPO).

Recent renewable energy plans include the Renewable Energy Development Plan (REDP 2008-2022) (DEDE, 2008), which set a target to increase renewable energy by 5,608 MW (20.3 per cent) of energy consumption by the end of 2021. This was later superseded by the Renewable Alternative Energy Development Plan 2012-2021 (AEDP), which has ambitious goals to increase the share of renewable energy in the system from 7,413 kilotonne of oil equivalent (ktoe) in 2012 to 25,000 ktoe in 2021 (DEDE, 2012a). This is equivalent to a 25 per cent increase in current energy consumption.

However, in 2011 it was determined that Thailand could not reach the short-term target set out in the REDP. The total installed capacity of renewable energy was approximately 66 per cent of REDP's target in 2011. Only the deployment of solar power and biogas succeeded in meeting the targets for 2011, as shown in Table 1.

**TABLE 1 - COMPARISON OF THE CURRENT STATUS OF RE INSTALLED CAPACITY AND TARGETS OF REDP,<sup>1</sup> AEDP<sup>2</sup> AND PDP 2010 REV. 3<sup>3</sup>**

| DETAIL/PLAN      | CURRENT STATUS OF RE INSTALLED CAPACITY IN 2011 | THE 15-YEAR REDP 2008-2017 (OLD PLAN) |              | THE 10-YEAR AEDP (2012-2021) | THE PDP 2010 (REV. 3) (2012-2030) |               |
|------------------|-------------------------------------------------|---------------------------------------|--------------|------------------------------|-----------------------------------|---------------|
|                  |                                                 | 2011                                  | 2017         |                              | 2021                              | 2030          |
| Solar (MW)       | 79                                              | 55                                    | 500          | 2,000                        | 1,944                             | 3,940         |
| Wind (MW)        | 7                                               | 115                                   | 800          | 1,200                        | 1,777                             | 1,977         |
| Biomass (MW)     | 1,790                                           | 2,800                                 | 3,700        | 3,630                        | 3,126                             | 3,350         |
| Biogas (MW)      | 159                                             | 60                                    | 120          | 600                          | 128                               | 152           |
| Small hydro (MW) | 96                                              | 165                                   | 324          | 1,608                        | 176                               | 345           |
| MSW (MW)         | 26                                              | 78                                    | 1,601        | 160                          | 356                               | 374           |
| Geothermal (MW)  | -                                               | -                                     | -            | 1                            | 1                                 | 1             |
| Tidal wave (MW)  | -                                               | -                                     | -            | 2                            | 2                                 | 2             |
| Hydrogen (MW)    | -                                               | -                                     | 4            | -                            | -                                 | -             |
| <b>Total</b>     | <b>2,157</b>                                    | <b>3,273</b>                          | <b>7,049</b> | <b>9,201</b>                 | <b>7,510</b>                      | <b>10,141</b> |

<sup>1</sup> DEDE, 2008

<sup>2</sup> DEDE, 2012a

<sup>3</sup> EGAT, 2012

### 3.0 Investment Incentives for Renewable Energy

This section describes various policy schemes that have been introduced by the government of Thailand to incentivize investment in renewable energy.

As mentioned earlier, this paper adopts a broad definition of investment incentives based on UNCTAD (2004), which classifies investment incentives in three categories:

- Financial incentives, such as outright grants and loans at concessionary rates.
- Fiscal incentives such as tax holidays and reduced tax rates.
- Other incentives, including subsidized infrastructure or services, market preferences and regulatory concessions, including exemptions from labour or environmental standards.

Table 2 provides an overview of the identified investment incentives.

**TABLE 2 - SUMMARY OF INVESTMENT INCENTIVES**

| INCENTIVE TYPE       | REGULATION                       | SCHEME                                          | DESCRIPTION                                                                                                                                                                                    | TYPE OF SUBSIDY                                                              |
|----------------------|----------------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Financial incentives | Feed-in premium (Adder)          | Feed-in tariff (FIT)                            | Additional payments to RE generators                                                                                                                                                           | Direct transfer of funds, market price support                               |
|                      | The ENCON Fund                   | Compulsory, voluntary and complementary program | Government Building Project; Project on Existing Designated Factories and Building; Project on Factories and Buildings under Designing or Construction; and Promotion of Small power producers | Direct transfer of funds                                                     |
|                      |                                  | Revolving fund                                  | A fund used to provide low-interest loans to RE and energy businesses                                                                                                                          | Direct transfer of funds, provision of goods or services below market value  |
|                      |                                  | Investment grant                                | Provision of investment grants for bio energy and energy from waste.                                                                                                                           | Provision of goods or services below market value                            |
|                      |                                  | Energy Service Company (ESCO) fund              | Equity investment scheme, credit guarantee scheme and technical assistance                                                                                                                     | Direct transfer of funds or liabilities Government loans and loan guarantees |
|                      | Carbon Credit guarantee facility |                                                 | Provision of support to develop CDM and provide access to carbon markets                                                                                                                       | Provision of goods or services below market rates                            |
| Fiscal Incentives    | Investment Promotion Act         | Import duty exemption                           | Exemption and reduction of import duties on machinery and raw materials for export production                                                                                                  | Exemptions from excise taxes/special taxes                                   |
|                      |                                  | Exemption on income tax and dividends           | Up to eight years corporate income tax exemption for RE manufacture and consulting services. 50% reduction from years 9-13                                                                     | Tax expenditures                                                             |
|                      |                                  | Other tax deductions                            | Tax deductions on transport, electricity, water supply and installation or construction                                                                                                        | Tax expenditures                                                             |

|       |                                                |                                                            |                                                                                                          |                                                   |
|-------|------------------------------------------------|------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Other | Regional incentives and Special Economic Zones | Feed-in tariff                                             | Higher FIT rates in some areas                                                                           | Market price support                              |
|       | The ENCON fund                                 | Complementary program, voluntary and complementary program | Funding for human resources development, public awareness, industrial liaison, management and monitoring | Provision of goods or services below market rates |

Source: Authors' compilation.

## 3.1 Financial Incentives

### 3.1.1 Adder (Feed-In Premium) Scheme

The adder or feed-in premium program was introduced in 2007. Under the program, renewable energy investors are eligible for an additional price on top of the market price for electricity when selling to the Thai power utilities, EGAT, PEA and MEA. Solar, wind, biomass, small hydro and municipal solid waste are eligible to participate in the program. As of December 2012, adder rates for renewable energy are differentiated by technology and installed capacity.

In June 2010, the NEPC reviewed the adder policy for solar energy. Due to over-subscription and the overall impact on the end user, the adder rate for solar energy was reduced from THB 8/kWh to THB 6.5/kWh (US\$0.27/kWh to US\$0.22/kWh). Under the scheme, projects are eligible for support for 10 years.

Unfortunately, the absence of regular reviews of the adder has prevented its rates from keeping pace with developments in the renewable energy sector. The Thai government suspended the purchase of solar energy through the adder program while the purchasing scheme rate and regulations were revised, due to cost and a greater than expected uptake in the scheme. This has led to a vacuum in solar power investment in Thailand since June, 2010. The adder rates and programs for other technologies are still in place.

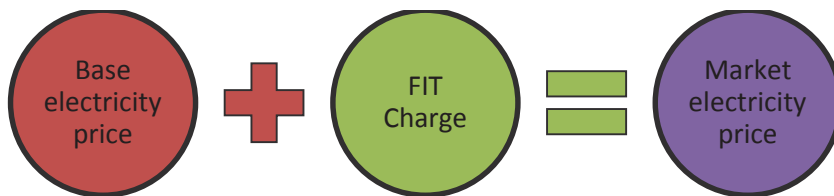
**TABLE 3 - THAILAND'S ADDER RATES AS ANNOUNCED, 2010 TO 2012**

| TYPE OF RE                | 2007 ADDER RATE (BAHT/KWH) | 2010 ADDER RATE(BAHT/KWH) | SPECIAL ADDER FOR DIESEL REPLACEMENT (BAHT/KWH) | SPECIAL ADDER FOR THREE SOUTHERNMOST PROVINCES (BAHT/KWH) | YEAR SUPPORTED |
|---------------------------|----------------------------|---------------------------|-------------------------------------------------|-----------------------------------------------------------|----------------|
| 1. Biomass                |                            |                           |                                                 |                                                           |                |
| Installed capacity ≤1 MW  | 0.30                       | 0.50                      | 1.00                                            | 1.00                                                      | 7              |
| Installed capacity >1 MW  | 0.30                       | 0.30                      | 1.00                                            | 1.00                                                      | 7              |
| 2. Biogas                 |                            |                           |                                                 |                                                           |                |
| Installed capacity ≤1 MW  | 0.30                       | 0.50                      | 1.00                                            | 1.00                                                      | 7              |
| Installed capacity >1 MW  | 0.30                       | 0.30                      | 1.00                                            | 1.00                                                      | 7              |
| 3. MSW                    |                            |                           |                                                 |                                                           |                |
| Digester Landfill         | 2.50                       | 2.50                      | 1.00                                            | 1.00                                                      | 7              |
| Thermal process           | 2.50                       | 3.50                      | 1.00                                            | 1.00                                                      | 7              |
| 4. Wind                   |                            |                           |                                                 |                                                           |                |
| Installed capacity ≤50 kW | 3.50                       | 4.50                      | 1.50                                            | 1.50                                                      | 10             |
| Installed capacity >50 kW | 3.50                       | 3.50                      | 1.50                                            | 1.50                                                      | 10             |

|                                     |      |      |      |      |    |
|-------------------------------------|------|------|------|------|----|
| 5. Small/Micro Hydro                |      |      |      |      |    |
| 50 kW > Installed capacity < 200 kW | 0.40 | 0.80 | 1.00 | 1.00 | 7  |
| Installed capacity ≤ 50 kW          | 0.80 | 1.50 | 1.00 | 1.00 | 7  |
| 6. Solar                            |      |      |      |      |    |
|                                     | 8.00 | 6.50 | 1.50 | 1.50 | 10 |

Source: ERC, 2012. (Exchange Rate: US\$1 = THB 30)

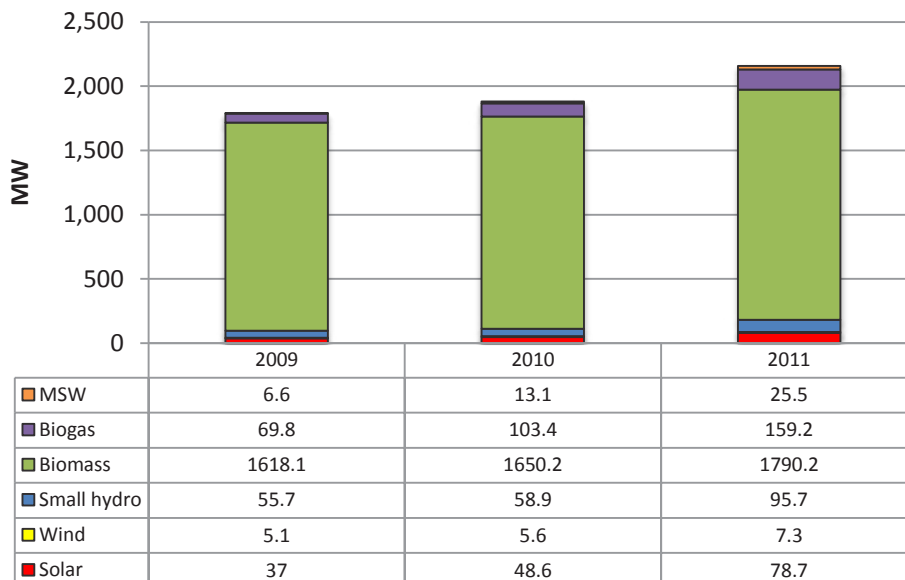
The market price of electricity is made up of two components, the base electricity price (adjusted every four years) and the feed-in-tariff (FIT) charge rate (adjusted every quarter). The FIT charge rate is an automatic fuel price volatility adjustment tariff.



**FIGURE 6 - MARKET ELECTRICITY RATE STRUCTURE IN THAILAND**

Source: Authors' diagram based on ERC, 2012.

As a result of the adder program, electricity consumers may perceive that RE investors are excessively rewarded due to the additional tariff on top of the market electricity price. Increases in fossil fuel prices are reflected in both the FIT charge and the base electricity price, leading to investors receiving benefits from each. The cost of adder payments is passed directly through to customers in the form of higher electricity bills.



**FIGURE 7 - INSTALLED CAPACITY OF RENEWABLE ENERGY PROJECTS BETWEEN 2009-2011**

Source: DEDE, 2011a.

To address criticisms of the current system, NEPC is planning to shift incentive policy to a European-style FIT in order to reduce windfall profits and limit the cost impact on consumers. The new scheme and FIT rate will consider technology, installed capacity and location in order to avoid overcapacity. This will be important in regions with cheap land prices, low electricity demand and problems developing additional transmission lines to remote areas. In addition, solar rooftop generation for the residential and building sectors will receive more attention and will get its own FIT rate.

### 3.1.2 The ENCON Fund

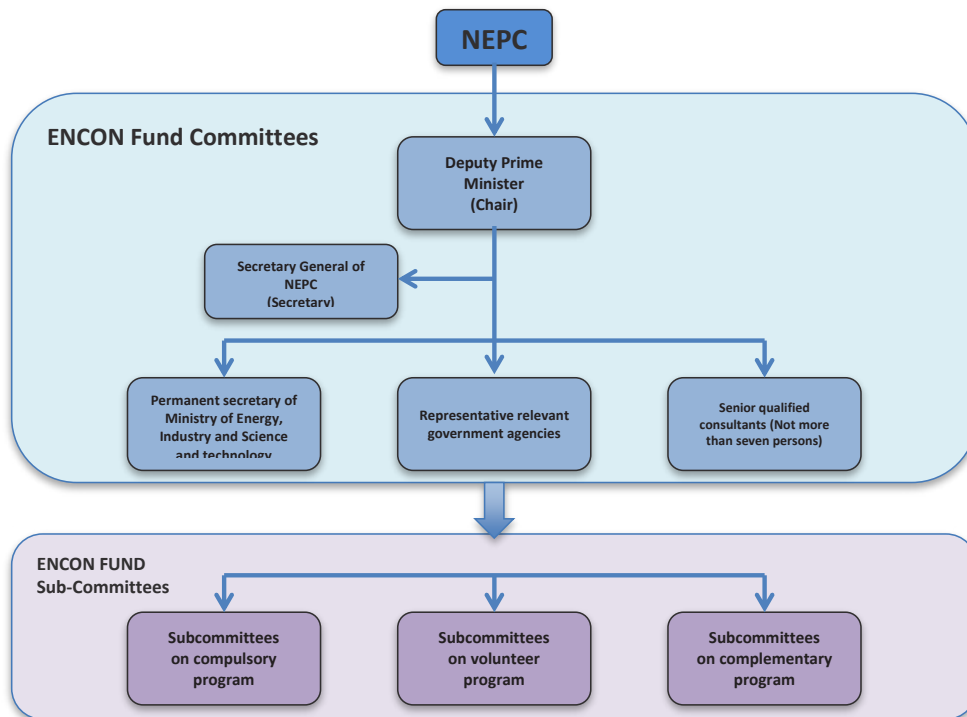
The Energy Conservation Promotion Act 1992 (ENCON Act) established the ENCON Fund, which is Thailand’s main source of public finance for renewable energy subsidies and investment incentives (EPPO, 1992b). The fund receives money transferred from the petroleum fund at an amount determined by the Prime Minister. The petroleum fund receives revenue from levies imposed on petroleum product producers and importers at a rate determined by the NEPC. Further funding comes from surcharges on power consumption and interest incurred from the ENCON fund.

The fund provides working capital and grants for investment in energy efficiency and renewable energy for both the public and private sector. The ENCON Fund is managed by the ENCON Fund Committee and subcommittees with guidance from the NEPC. Three subcommittees act to screen projects prior to submission to the ENCON Fund. Projects with budgets that do not exceed THB10 million may be approved. The categories of eligible projects are shown in Table 4.

**TABLE 4 - SUBPROGRAMS UNDER ENCON FUND**

| PROGRAM               | MAIN PROJECTS                                                                                                                                                                                                                                                                                                                                         | ORGANIZATION RESPONSIBILITY                              |
|-----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|
| Compulsory Program    | <ul style="list-style-type: none"> <li>▪ Government Building Project</li> <li>▪ Project on Existing Designated Factories and Building</li> <li>▪ Project on Factories and Buildings under Designing or Construction</li> <li>▪ Public Awareness Campaign Project, under the DEDP’s responsibility</li> </ul>                                          | <ul style="list-style-type: none"> <li>▪ DEDE</li> </ul> |
| Voluntary Program     | <ul style="list-style-type: none"> <li>▪ Promotion of Renewable Energy Utilization Project</li> <li>▪ Industrial Liaison Project</li> <li>▪ Research and Development Project</li> <li>▪ Energy Conservation in Non-Designated Factories and Buildings Project</li> <li>▪ Promotion of Small Power Producers Using Renewable Energy Project</li> </ul> | <ul style="list-style-type: none"> <li>▪ EPPO</li> </ul> |
| Complementary Program | <ul style="list-style-type: none"> <li>▪ Human resource development</li> <li>▪ Public awareness campaign</li> <li>▪ Management and monitoring</li> </ul>                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>▪ EPPO</li> </ul> |

Source: Authors’ diagram.



**FIGURE 8 - ENCON FUND COMMITTEES ORGANIZATION**

Source: Authors' diagram.

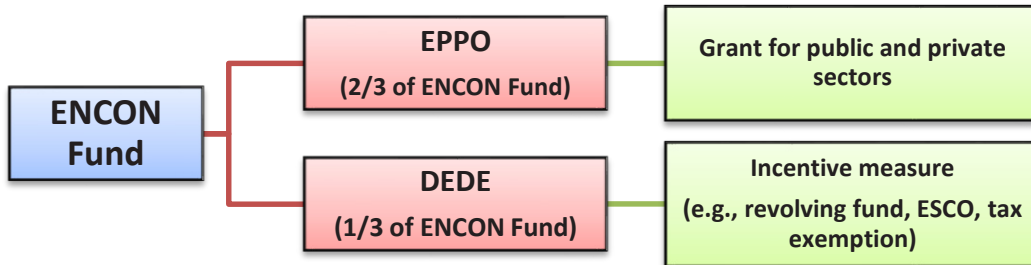
When the fund was established, an initial amount of THB 1,500 million was transferred from the Petroleum Fund. Since then, additional funds have been added, including THB 29,110 million from the Energy Conservation Promotion Fund for Phase 2 and a total of THB 32,000 million under Phase 3. A summary of the ENCON budget is shown in Table 5.

**TABLE 5 - BUDGET UNDER ENCON FUND, BY IMPLEMENTATION PHASE**

| YEAR                         | INITIAL<br>1992 | PHASE I<br>1995-1999 | PHASE 2<br>2000-2004 | PHASE 3<br>2005-2012 |
|------------------------------|-----------------|----------------------|----------------------|----------------------|
| Amount of fund (THB million) | 1,500           | 19,286               | 29,110               | 32,000               |

Source: Energy Efficiency Regulatory Office, 2012b.

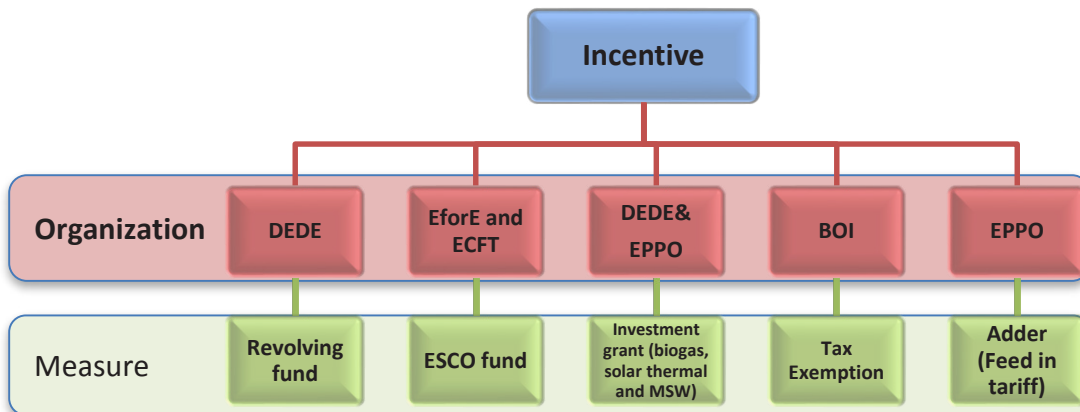
There are two departments under the MOE that are responsible for monitoring the ENCON fund: The DEDE and EPPO. Around two thirds of the total revenue of the ENCON fund is managed by EPPO, while DEDE is responsible for the remaining one third of the total revenue. EPPO provides this fund for renewable energy and energy conservation programs as investment grants to government agencies, universities, NGOs and private businesses. DEDE uses the ENCON fund to finance renewable energy and energy conservation projects, such as the revolving fund and the Energy Service Company (ESCO).



**FIGURE 9 - ENCON FUND MANAGEMENT**

Source: Authors' diagram.

For each of these incentives, DEDE and EPPO collaborate with other organizations for the actual implementation: The Thai Board of Investment (BOI), the Energy for Environment Foundation (EforE), and the Energy Conservation Foundation of Thailand (ECFT) as shown in Figure 10.



**FIGURE 10 - ORGANIZATION FOR RENEWABLE ENERGY INVESTMENT INCENTIVES**

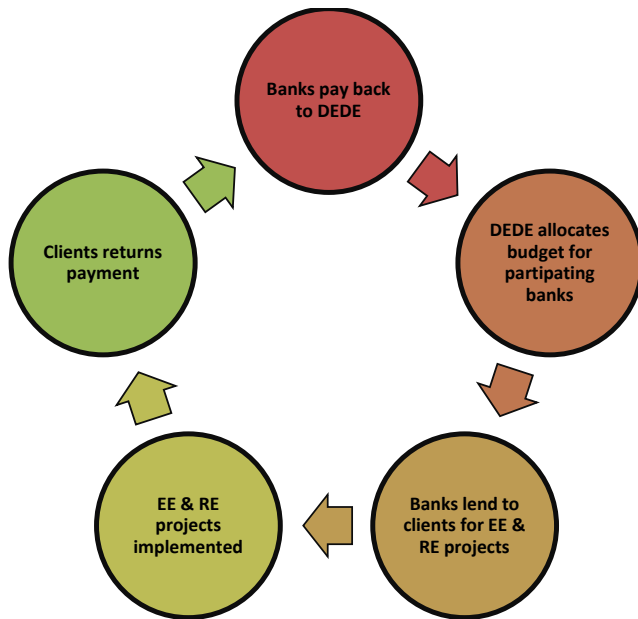
Source: Authors' diagram.

DEDE has appointed ESCO managers to two non-profit organizations: The ECFT and EforE. The BOI is in charge of income tax exemptions for energy conservation and for renewable energy equipment and machinery. All incentives are funded by the ENCON fund except the adder measure, which is covered by a surcharge on electricity bills to consumers.

### 3.1.3 Revolving Fund

The revolving fund is a low-interest loan scheme for energy conservation and renewable energy projects. The fund allocated money from the ENCON fund through financial institutions to entrepreneurs who are willing to invest in energy conservation and renewable energy. The scheme is monitored by DEDE and aims to stimulate financial institutions to provide finance to energy conservation and renewable energy. The fund provides loans to banks at a 0 per cent interest rate. The banks lend this money to renewable energy projects according to their bank financial history, with a maximum interest rate of 4 per cent for a maximum loan period of seven years. So far, 11 commercial banks have participated as the implementing partners of the revolving fund scheme.





**FIGURE 11 - REVOLVING FUND**

Source: Grüning, Menzel, Panofen, & Shuford, 2012.

The maximum loan under the revolving fund is THB 50 million (US\$1.25 million) per project, which is set to provide financing to a large number of small and medium size projects rather than to only a few large projects. However, this fund is not enough for some projects that need additional commercial finance. As of September 2012, over nine years, it has managed a total fund of THB 6,982.5 million (DEDE, 2012b) under five phases, as shown in Table 4. As a result, the total oil-equivalent saving of both energy efficiency and renewable energy projects is approximately THB 500 million (or the equivalent of 31 ktoe) per year per year. Table 6 shows that the budget for the revolving fund from the government is decreasing as the banks have gained experience in investing in energy projects and are able to finance investments with their own capital. Therefore, the banks no longer have as much need for the revolving fund as in the past.

**TABLE 6 - PERFORMANCE OF REVOLVING FUND SCHEME**

| DETAIL                     | UNIT              | 1ST PHASE FOR EE    | 2ND PHASE FOR EE    | 3RD PHASE FOR EE<br>1ST PHASE FOR RE* | 3RD PHASE FOR EE<br>(ADDITIONAL) | 4TH PHASE FOR EE  | 5TH PHASE FOR EE   | TOTAL  |
|----------------------------|-------------------|---------------------|---------------------|---------------------------------------|----------------------------------|-------------------|--------------------|--------|
| Period                     |                   | 30/1/2003-29/1/2006 | 17/3/2006-16/3/2009 | 2/8/2007-1/8/2010                     | 2/8/2007-1/8/2010                | 2/9/2009-1/9/2012 | 1/6/2010-21/5/2013 |        |
| Total project              | Projects          | 78                  | 85                  | 3,812                                 | 23                               | 11                | 2                  | 4,011  |
| Total fund                 | THB million       | 3,427               | 3,536               | 2,000                                 | 2,576                            | 1,272             | 20                 | 12,831 |
| Fund from ENCON fund       | THB million       | 2,000               | 2,000               | 1,988                                 | 942.5                            | 400               | 500                | 7,831  |
| Loan approved by DEDE      | THB million       | 1,902               | 1,805               | 1,824                                 | 865                              | 383               | 20                 | 6,799  |
| Financial amount from bank | THB million       | 1,525               | 1,731               | 1,765                                 | 1,711                            | 889               | -                  | 7,621  |
| Electricity saving         | GWh/year          | 251                 | 232                 | 36                                    | 219                              | 103               | 2                  | 843    |
| Total energy saving        | THB million /year | 1,394               | 1,415               | 1,092                                 | 751                              | 302               | 7                  | 4,961  |
| Oil equivalent saving      | ktoe/year         | 97.60               | 102.45              | 59.27                                 | 38.4                             | 13.21             | 0.37               | 311.3  |

\*Fund for renewable energy project is THB 1,000 million (DEDE, 2012b).

Source: DEDE, 2012b; EPPO, 2012.

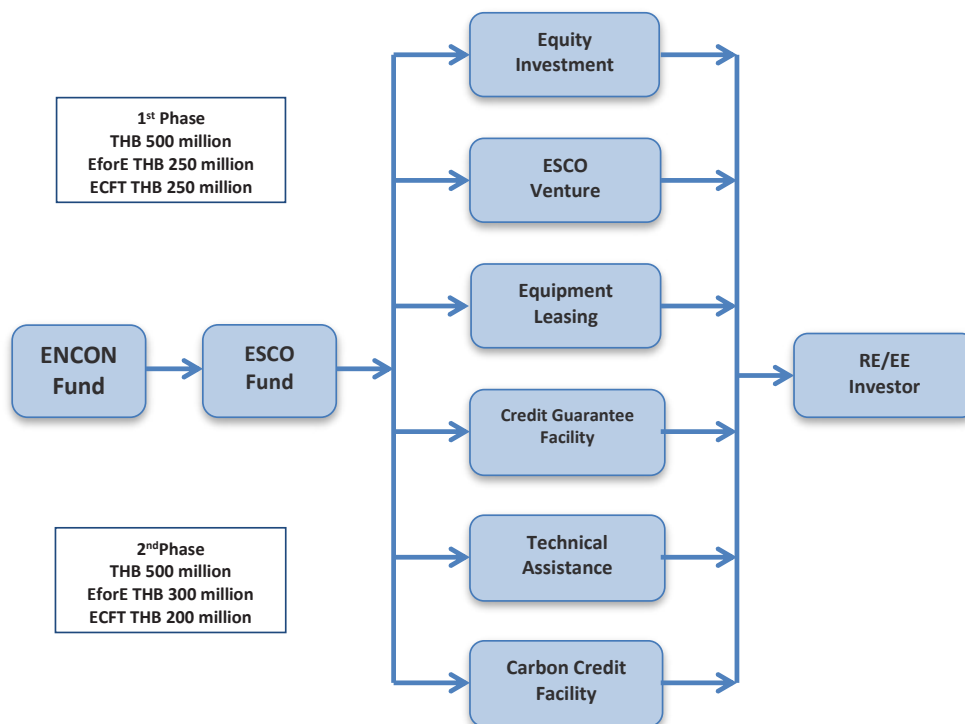
### 3.1.4 Investment Grants

The MOE has been promoting and supporting the use of biogas, municipal solid waste (MSW) and solar thermal by means of investment grants, especially the use of biogas in combination with waste management. The use of energy from waste is attractive, as it can potentially address energy security and environmental problems at the same time.

The ENCON fund committee approved approximately THB 4,000 million to the EPPO to support the use of biogas technology for five years from year 2008 to 2013. It has focused on the use of biogas derived from tapioca starch; wastewater from palm oil processing; and pig manure in factories, hotels, the livestock industry and the public sector. Investors can apply to get an investment grant for design, consultants and partial investment under this scheme as well. The maximum investment grant is about 20–50 per cent for capital investment, 25–100 per cent for MSW and 30 per cent for solar hot water, with a maximum capital grant of THB 50 million per project. As of December 2011, there have been 131 projects supported, with a total of THB 1,284 million in funding. The resulting energy saving is estimated at 302 ktce (EPPO, 2012; DEDE, 2012b).

### 3.1.5 ESCO Fund

The DEDE has established the ESCO fund to encourage investment in energy efficiency (EE) and renewable-energy (RE) projects and to promote greater use of energy management services provided by ESCOs. The scheme was specifically created to target small and medium enterprises that demonstrate potential in energy saving and renewable energy but face problems with project financing for investment. Two fund managers from non-profit organizations were assigned to implement the program, namely the EforE Foundation and the ECFT.



**FIGURE 12 - ESCO FUND MANAGEMENT**

Source: Energy for Environment Foundation, 2012.

DEDE has appointed EforE and ECFT to consider proposals received from entrepreneurs who are interested in investing in renewable energy projects. For the implementation of the first phase (October, 2008–September, 2010), EforE and ECFT were both allocated THB 250 million. For the second phase (October, 2010– September, 2012), EforE was again appointed as ESCO fund manager to manage project implementation, with an allocated management budget of THB 300 million, while ECFT received a budget of THB 200 million.

While the fund manager allows the investor to choose between the equity investment scheme and the credit guarantee facility scheme, all investors chose equity investment, since it has proved more beneficial. Under the first phase, nine projects were awarded financial support amounting to THB 235.2 million. This has stimulated more than THB 3,388 million in renewable energy investment. As a result, the total energy saving from these nine projects is estimated to be approximately 16.67 ktoe. As of June 2012, under the second phase of implementation, seven projects were awarded financial support totaling THB 192.9 million (ECFT, 2012; EforE Foundation, 2012).

## 3.2 Fiscal Incentives

### 3.2.1 Investment Promotion Act

The BOI provides incentives and services to investors in a wide range of sectors. Under the Investment Promotion Act B.E. 2520, the BOI is authorized to grant tax incentives and provide services. In addition, no restrictions are made on foreign equity in manufacturing or designated services, and exemption from land ownership restrictions and a series of guarantees and protections are provided to mitigate risks to investors. Investment services include provision of information, contacts and coordination with other public agencies (BOI, 2013).

Tax incentives included in the Investment Promotion Act include (BOI, 2011):

- Exemption/reduction of import duties on machinery. (Section 28/29)
- Reduction of import duties for raw or essential materials. (Section 30)
- Exemption of juristic person's income tax and dividends. (Section 31 and 34)
- A 50 percent reduction of the juristic person's income tax. (Section 35 (1))
- Deductions from the costs of transportation, electricity and water supply. (Section 35 (2))
- Additional 25 percent deduction of the cost of installation or construction of facilities. (Section 35 (3))
- Exemption from import duty on raw or essential materials for use in production for export. (Section 36)

Beyond the standard incentives, up until the end of 2012, the BOI provided a special tax incentive under the Investment Policy for Sustainable Development campaign for activities related to conservation or alternative energy (BOI Announcement No. 2/2553, April 23, 2010). These incentives included a corporate income tax exemption, an import duty exemption and tax deductions for costs of installation or construction (BOI, 2011).

### 3.2.2 Renewable Energy Sector Tax Incentives

The Thai government introduced tax incentives via the BOI to encourage energy-efficiency improvements and renewable energy investment by the private sector. They provide corporate income tax exemptions for eight years for the manufacture of solar cells, the generation of RE, the manufacturing of energy-saving or RE equipment and machinery, as well as for the provision of energy-related consulting services on the use or installation of energy-saving machinery and equipment. Additionally, for another five years (the 9th through 13th), the BOI will also provide a 50 per cent reduction of corporate income tax depending on the location and character of the project.

As of August, 2010, 14 renewable energy projects received support from the BOI with a total investment of THB 381.23 million, representing a total energy saving of approximately THB 120 million per year. Moreover, as of October 2012, there are 239 renewable energy and energy conservation projects proposed to receive the tax exemption with a total investment of THB 429.65 million (Energy Efficiency Regulatory Office, 2012b).

### 3.3 Other Incentives

#### 3.3.1 Regional Incentives and Special Economic Zones (SEZ)

Under the feed-in premium scheme, the Thai government has provided additional rates to RE projects in three provinces that have political unrest issues, and also in remote areas with PEA-supplied diesel replacement. This is to help investors operate RE projects in those areas.

**TABLE 7 - CATALOGUE OF RENEWABLE ENERGY INVESTMENT INCENTIVES IN THAILAND**

| PROGRAM                          | OBJECTIVE                                                                                                                              | SIZE OF INVESTMENT AND INTEREST                                                                                                                                                                                                          | PERIOD                                                                                                                                      | ORGANIZATION   | REMARK                                                                                                                                                                                                                       |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Revolving Fund                | To promote and push investment in EE & RE projects to increase the confidence of financial institutes in lending for EE & RE projects. | <ul style="list-style-type: none"> <li>Limited to THB 50 million per project</li> <li>Interest rate 4% per annum</li> </ul>                                                                                                              | Seven years                                                                                                                                 | DEDE           | -                                                                                                                                                                                                                            |
| 2. Investment Grant              | To enhance biogas, MSW and solar thermal investment.                                                                                   | <ul style="list-style-type: none"> <li>Limited to THB 50 million per project</li> <li>20-50% for biogas</li> <li>25-100% for MSW</li> <li>30% for solar thermal</li> </ul>                                                               | -                                                                                                                                           | EPPO/DEDE      | -                                                                                                                                                                                                                            |
| 3. Tax Privilege                 | To encourage operators to invest in energy efficient equipment/machinery and renewable energy projects.                                | <ul style="list-style-type: none"> <li>Eight-year income tax holiday</li> <li>50% tax reduction for year 9-13</li> </ul>                                                                                                                 | <ul style="list-style-type: none"> <li>Min. eight years</li> <li>Max. 13 years</li> </ul>                                                   | BOI            | -                                                                                                                                                                                                                            |
| 4. Adder (Feed-In Premium)       | To encourage the adoption of renewable energy investment with guaranteed electricity purchasing price.                                 | <ul style="list-style-type: none"> <li>VSPP (less than 10 MW)</li> <li>SPP (10MW-90MW)</li> </ul>                                                                                                                                        | <ul style="list-style-type: none"> <li>10 years for solar and wind</li> <li>Seven years for biogas, biomass, MSW and small hydro</li> </ul> | EPPO           | <ul style="list-style-type: none"> <li>Stopped buying electricity from solar since June 2010. It is revising for the new scheme of FIT rate and regulation. The announcement of a new scheme is expected in 2013.</li> </ul> |
| 5. ESCO<br>5.1 Equity Investment | Investments in energy efficiency or renewable energy projects.                                                                         | <ul style="list-style-type: none"> <li>10-50% of total investment cost</li> <li>Not as a majority shareholder</li> <li>Limited to THB 50 million per project</li> <li>Return: Annual dividend in the proportion of investment</li> </ul> | Five to seven years                                                                                                                         | EforE and ECFT | <ul style="list-style-type: none"> <li>Exit method of selling back the shares to the entrepreneur, or find new strategic partners.</li> <li>Board seat is required in the company.</li> </ul>                                |
| 5.2 ESCO Venture Capital         | Partner with Energy Service Companies (ESCOs) to raise capital for investments in energy saving projects of the ESCO.                  | <ul style="list-style-type: none"> <li>10-30% of registered capital</li> <li>Not as a Majority Shareholder</li> <li>Limited to THB 50 million per project</li> <li>Return: Annual dividend in the proportion of investment</li> </ul>    | Five to seven years                                                                                                                         | EforE and ECFT | <ul style="list-style-type: none"> <li>Exit method of selling back the shares to the entrepreneur, or find new strategic partners and;</li> <li>Board seat is required in the company.</li> </ul>                            |
| 5.3 Equipment Leasing            | Long-term leasing service in purchasing equipment for RE and EE.                                                                       | <ul style="list-style-type: none"> <li>Support for 100% of equipment cost</li> <li>Limited to THB 10 million per project</li> <li>Interest rate of 4% per annum</li> </ul>                                                               | Five years                                                                                                                                  | EforE and ECFT | -                                                                                                                                                                                                                            |

| PROGRAM                       | OBJECTIVE                                                                                                                                                                                                                                                                                                                                 | SIZE OF INVESTMENT AND INTEREST                                                                                                                                                                  | PERIOD                                  | ORGANIZATION   | REMARK                                                                                                                                               |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5.4 Carbon Credit Facility    | <ul style="list-style-type: none"> <li>Large project: Facilitate project owner in developing CDM and accessing to CER buyer at lower service rate.</li> <li>Small project: Act as coordinating/ managing entity and help to bundle small projects so that buyers are willing to purchase the carbon credits from the projects.</li> </ul> | -                                                                                                                                                                                                | -                                       | EforE and ECFT | -                                                                                                                                                    |
| 5.5 Credit Guarantee Facility | Guarantee commercial bank for project loans.                                                                                                                                                                                                                                                                                              | <ul style="list-style-type: none"> <li>Depending on the project risk</li> <li>Limited to THB 10 million</li> <li>Project owner will be charged at 1.75% per annum of guarantee amount</li> </ul> | Loan guarantee not more than five years | EforE and ECFT | -                                                                                                                                                    |
| 5.6 Technical Assistance      | Provide financial support for technical assistance, e.g., energy audit, feasibility study.                                                                                                                                                                                                                                                | <ul style="list-style-type: none"> <li>Limited to THB 100,000 per project</li> </ul>                                                                                                             | -                                       | EforE and ECFT | <ul style="list-style-type: none"> <li>Must be reimbursed to the ESCO fund unless the proposed technical solutions have been implemented.</li> </ul> |

Source: Authors' compilation.

## 4.0 Discussion and Analysis

### 4.1 Stakeholder Impressions

To gather views on the effectiveness of Thailand's renewable energy incentives, 10 interviews were conducted with government officials, electricity system experts and representatives of commercial companies. A list of the interviewees is provided in the Appendix.

The adder measure was considered to be the most attractive incentive. With simple administrative requirements and attractive support levels on top of the market electricity price, the adder measure allows investors to estimate the return of the project and reduce risk.

The interviews also highlighted the importance of investment assistance at the beginning of projects. Under the revolving fund, capital is available at favourable interest rates for larger projects, while smaller projects can receive funding under the ESCO fund measures in the form of equity investment. For the remaining investment, investors draw loans from financial institutions with higher interest rates.

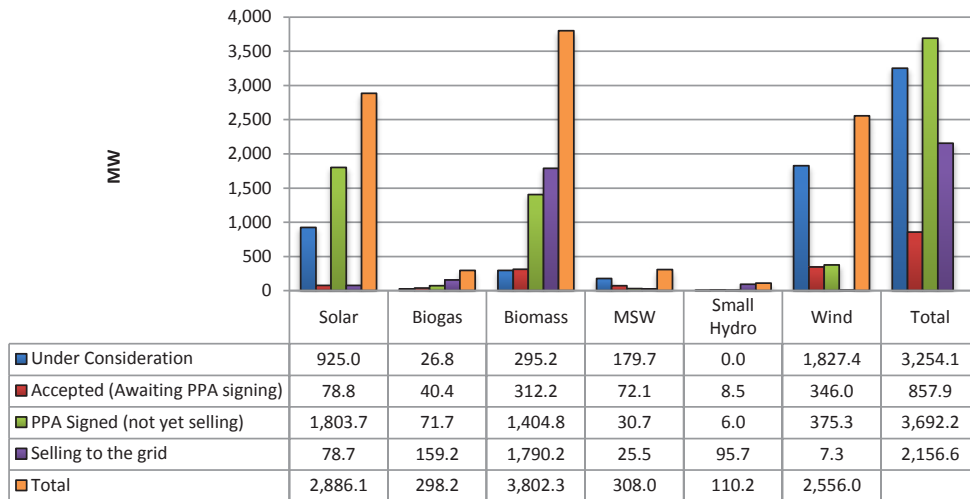
For solar and wind power projects, respondents did not report difficulties in accessing finance, as most banks are considered to be quite familiar with these technologies. The interviewees indicated that commercial finance was often difficult to access for biogas and waste projects. Respondents attributed this to a lack of knowledge of these technologies compared to solar and wind projects. Biomass projects were reported to be particularly difficult to finance due to fuel risk. Many banks will only consider biomass projects that have their own raw material. To improve the availability of finance for projects, the Thai government has established an ENCON fund investment grant campaign for biogas projects. Under this scheme, investors will receive upfront funding for projects.

Domestic capacity to produce renewable energy technologies was perceived to be a barrier to deployment. As a result, investors need to import equipment and machinery from abroad. The high import duty levied on imported equipment impacts generation cost. For example, the rate of import duty for solar panels and inverters is 35 per cent of total value (Customs Department of Thailand, 2012). However, the effect of import duty is partially offset by other tax advantages allocated to RE projects (see Table 6). Domestic production of RE technologies would reduce the trade deficit from importing machinery and equipment from abroad and reduce the cost per unit of production as well. It would also encourage the development of RE in Thailand in the longer term.

Investors also cited non-economic barriers to investment. One particular concern was that Thai utilities do not publish their expansion plans for the electricity transmission system, creating uncertainty in the assessment of potential project sites. The process of planning and permitting was also considered to be too slow, due to the myriad government departments involved. It was proposed that government action is required to streamline the process and ensure that the system is transparent. This would reduce the project risks during the feasibility stage, and ensure developers compete on a level playing field.

### 4.2 Prospects and Planned Developments for Investment Incentives

While investors noted that the adder measure had been the most effective incentive, it was not without its problems. The scheme began accepting proposals in 2007 and had a deadline for submitting applications for the end of 2008. Initially, the solar power tariff (THB 8/kWh) was not too attractive to investors. Subsequently, the solar panel price decreased dramatically, especially in the third quarter of 2008. As a result, there was a greater-than-expected number of applications to participate under the adder program.



**FIGURE 13 - STATUS OF RE PROJECTS BY TYPE AND STAGE OF APPLICATION PROCESS, AS OF DECEMBER, 2011**

Source: EPPO, 2012.

Figure 13 shows that, as of December 2011, there were 2,886.1 MW of solar applications, from which only 78.7 MW have been connected to the grid. Of the remaining applications, approximately 1,000 MW are still under consideration without a power purchase agreement (PPA); approximately 79 MW are waiting for the PPA to be signed; and a further 1,800 MW have signed a PPA but have yet to start generating.

The cost of purchasing the output for the requested 2,886.1 MW of solar photovoltaic (PV) at THB 8/kWh would result in sharp electricity bill increases for customers. Consequently, the Thai government announced in 2010 there would be a reduction in the purchase price of electricity from solar power applications that have not signed a PPA from THB 8/kWh to THB 6.5/kWh.

Due to the greater-than-expected rise in solar power development, in 2010 the government temporarily stopped buying solar energy under the adder program. This has resulted in a lack of new investment, not just for solar energy development but also for other renewable energy technologies in Thailand because of a perceived political risk.

In this regard, interviewees from the private sector stated that a weakness of the adder program was the lack of regular review/monitoring of the investment costs for renewable energy projects. The interviewees from the government mentioned that the purchase rate under the adder program was at times significantly higher than the real investment cost, which was unfair to customers who must pay the additional electricity cost to renewable energy investors.

In response to concerns about the investment vacuum and grid bottlenecks, the adder program was reviewed. The government decided to move from a feed-in premium to a fixed-price, feed-in tariff (FIT). As such, FIT rates will be reviewed periodically. However, the fixed-price FIT measures may have a negative impact on renewable energy projects that have variable fuel costs, such as biomass. When demand increases, the price of raw materials will increase as well. This will result in higher production costs per unit of electricity. Some stakeholders recommended that the potential change in biomass cost should be taken into account when setting the purchasing price under the FIT program. The possibility of indexing biomass prices to coal prices was raised.

Interviewees from the public sector were generally satisfied with the functioning of the other incentives schemes. Also, interviewees from the Thai government stated that other energy incentive measures will continue to be implemented as in the past, with the exception of the revolving fund for the energy sector. This will be phased out as the capacity for banks to invest their own money increases. Investors in the sector also mentioned the need for special financial support and simple regulation for small-scale renewable energy development.

### 4.3 Positive or Negative Examples of Projects Where Investment Incentives Have Played a Role

Solar energy investors that have managed to install projects under the original adder program are generally quite satisfied because they were able to achieve very high rates of return with a tariff of THB 8/kWh. During public hearings on the new tariffs for solar energy, many solar investors seemed not to be satisfied with the revised FIT program because the rates were considerably lower than the adder program. The government will consider the tariffs and regulations again and will announce revised plans in 2013.

The deployment of small-scale renewable energy projects such as biogas and biomass have been successful as a result of the high priority given to the sector and the funding available. Investors suggest that incentives aimed at promoting community investment in renewable energy could be particularly beneficial.

One such project that has been receiving financial support is the SPM pig farm. In the past, the SPM farm encountered waste water management problems related to odour and pollutants. A waste water management system and incubator system were installed that improved energy access for the company, powered by energy from a biogas and solar power system. SPM further increased system resilience with a biogas storage and the use of buffer tanks capable of storing the equivalent of two days of hot water use in case there is no solar power available during cloudy days or in the event of unplanned outages.

SPM has reportedly saved approximately 12,902,400 kWh per year and avoided approximately 69,130 tonnes of carbon dioxide per year. The total investment cost of the biogas system, including construction and equipment, was about THB 222 million. The total cost to SPM was THB 172 million (as shown in Table 8). SPM has received funds from many sources that support clean energy, including the Energy Conservation Fund, Energy Policy and Planning Office, Office of the Prime Minister and the DEDE. The details of the project financing are described in Table 7 (SPM Biogas, 2012).

SPM also receives benefits from selling organic fertilizer and Clean Development Mechanism (CDM) credits of approximately THB 1,277,500 and THB 12,000,000/year, respectively. This investment reduces energy costs and the infant pig mortality rate, saving nearly THB 65 million per year, with a payback period of less than four years.

The farm uses waste products and solar power to generate electricity for use on the farm instead of purchasing electricity from the utility company. SPM developed a model system for investment of biogas systems on pig farms which has since resulted in investments at many other farms.



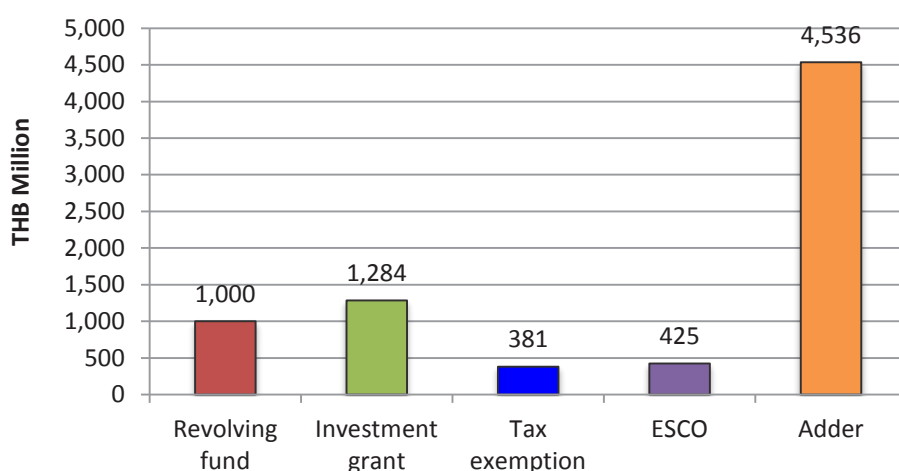
**TABLE 8 - TOTAL INVESTMENT COST OF COGENERATION SYSTEM AT SPM FARM**

| DETAIL                                                                             | FIXED INVESTMENT (THB MILLION) | SUPPORTED FUND (THB MILLION) | SELF-INVESTMENT (THB MILLION) |
|------------------------------------------------------------------------------------|--------------------------------|------------------------------|-------------------------------|
| Biogas digester system                                                             | 158                            | 43                           | 115                           |
| Electricity generation system and heat exchange with temperature controlled system | 37                             | -                            | 37                            |
| Vacuum tube system                                                                 | 18                             | 6.8                          | 11                            |
| Incubator system for newborn baby pigs                                             | 9                              | -                            | 9                             |
| Total                                                                              | 222                            | 50                           | 172                           |

Source: DEDE, 2012c.

#### 4.4 Estimates of the Costs and Benefits of Renewable Energy Investment Incentives

Between 2002 and 2012, the Thai government supported four incentives to RE projects by allocating approximately THB 3,014 million from the ENCON fund. Under the adder measure, an additional THB 4,536 million has been spent in the same period, funded through a surcharge on consumer electricity prices. The adder mechanism receives the highest support, followed by the investment grant, the revolving fund, the ESCO fund and the tax exemption respectively, as shown in Figure 14.



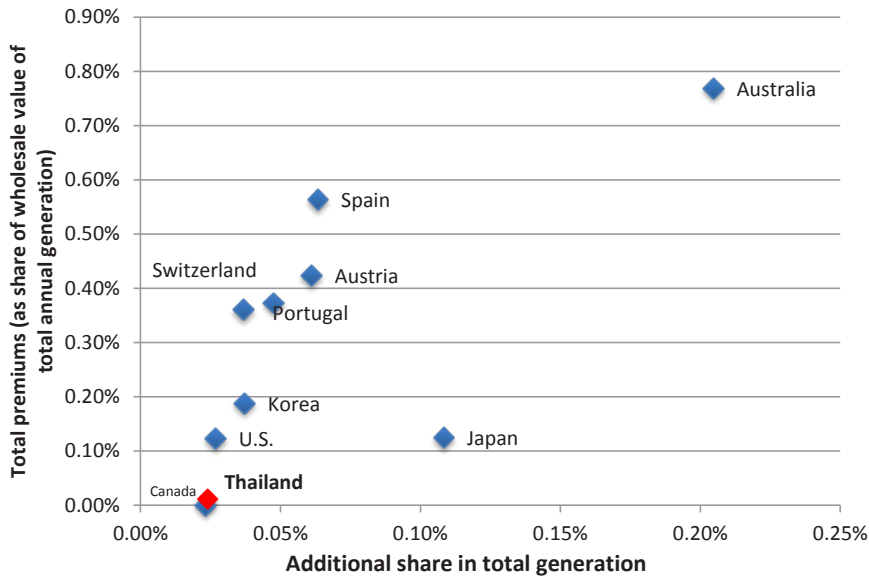
**FIGURE 14 - TOTAL RENEWABLE ENERGY INCENTIVES BY MEASURE, 2002-2011**

Source: Energy Efficiency Regulatory Office, 2012b.

As mentioned, based on the interviews with stakeholders from the technology developers listed in the Appendix, the adder program appears to be the most positively viewed incentive. This study also uses the TCI approach to assess if the overall costs of the adder policy are in line with the contribution of renewable electricity to Thailand's electricity system.

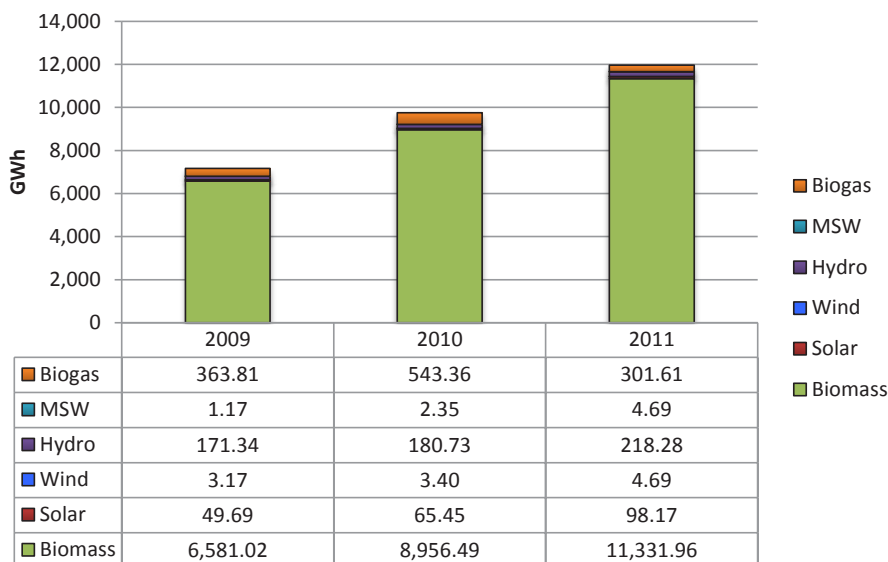
The TCI calculates the amount of the additional annual premiums paid for additional generation produced in a given year. The annual premiums are expressed as a percentage of the total wholesale value of all the electricity generated.

The TCI is plotted together with the share that the additional generation achieved in a given year compared to total generation (International Energy Agency [IEA], 2011). The TCI approach has been used by the IEA to assess the relationship between cost and additional generation of solar PV in major Organisation for Economic Co-operation and Development (OECD) markets (see Figure 18).



**FIGURE 15 - TCI FOR SOLAR PV IN MAJOR MARKETS, 2010**

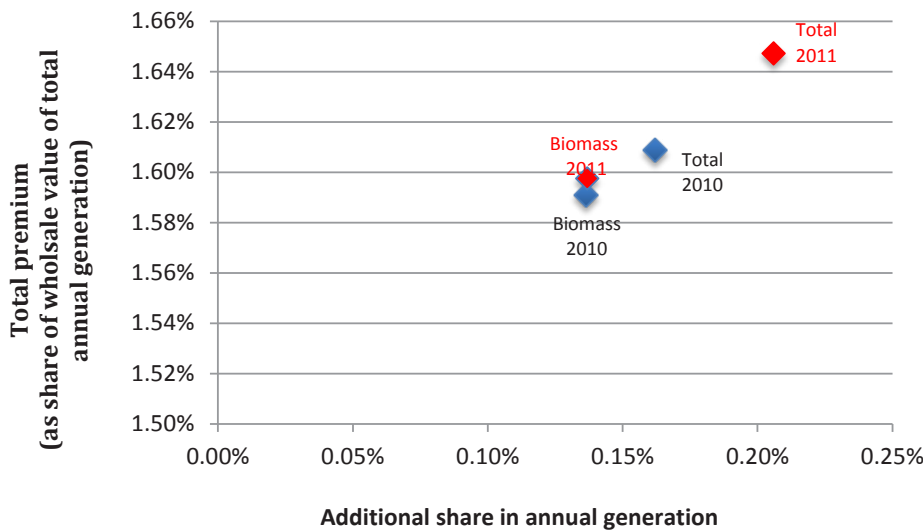
Source: International Energy Agency, 2011.



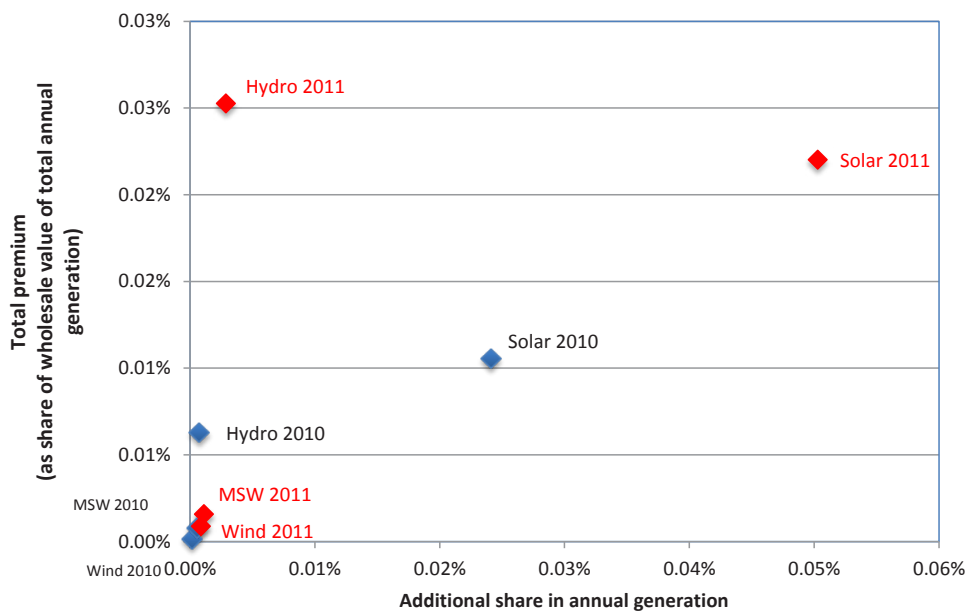
**FIGURE 16 - TOTAL ELECTRICITY GENERATION FROM RENEWABLE ENERGY 2009-2011**

Source: DEDE, 2011a.

Based on available data as shown in Figure17, Thailand generated 7,170.2 GWh electricity from renewable energy in 2009, 9,751 GWh in 2010 and 11,959 GWh in 2011. The additional generation, therefore, was 2,581.6 GWh in 2010 and 2,208 GWh in 2011. The additional electricity generation from biogas decreased from 534.3 GWh to 301.6 GWh because it was increasingly being used for heat instead of electricity, in order to reduce fuel oil consumption in the industry sector. From Figure 17, premium rates are compared to the amount of electricity by type of renewable energy that Thailand obtains through the payment of premiums (average market price per kWh is THB 3.5). The total electricity generation in Thailand was 135,209 GWh, 149,320 GWh and 148,700 GWh in 2009, 2010 and 2011, respectively.



**FIGURE 17 - TCI FOR BIOMASS IN 2010 AND 2011**



**FIGURE 18 - TCI FOR SMALL HYDRO, SOLAR, MSW AND WIND IN 2010 AND 2011**

Table 9 shows the relationship between additional renewable energy generation and the costs of incentives, shown as the total cost indicator. In 2010, it was found that to get 1.73 per cent additional electricity from renewable energy, Thailand needed to pay 0.17 per cent of the market electricity price value in premiums. In 2011, Thailand needed to pay 0.21 per cent of the market electricity price value in premiums for an additional 1.65 per cent from renewable energy. A high proportion of the increases in renewable electricity generation came from biomass (Figure 17). Despite the fact that, on a per kWh basis, the premium for solar power is higher than biomass by about 96 per cent, the additional generation from solar power was much lower (about 99 per cent).

It was further shown that doubling the additional generation from solar power in 2011 required doubling the price paid in premiums. The biomass adder seems to give better value for money, but it should be noted that the solar PV adder was already under review in 2010. The impact of policy changes and uncertainty around the solar adder may have affected this sector.

**TABLE 9 - TCI BY TYPE IN 2010 AND 2011**

| TYPE OF RE/<br>DETAIL | 2010              |                                           | 2011              |                                           |
|-----------------------|-------------------|-------------------------------------------|-------------------|-------------------------------------------|
|                       | TOTAL PREMIUM (%) | ADDITIONAL SHARE IN ANNUAL GENERATION (%) | TOTAL PREMIUM (%) | ADDITIONAL SHARE IN ANNUAL GENERATION (%) |
| Biomass               | 0.136             | 1.591                                     | 0.137             | 1.597                                     |
| Solar                 | 0.024             | 0.011                                     | 0.050             | 0.022                                     |
| Wind                  | 0.000             | 0.000                                     | 0.001             | 0.001                                     |
| Hydro                 | 0.001             | 0.006                                     | 0.003             | 0.025                                     |
| MSW                   | 0.001             | 0.001                                     | 0.001             | 0.002                                     |
| Biogas                | 0.010             | 0.120                                     | 0.014             | -0.163                                    |
| <b>Total</b>          | <b>0.172</b>      | <b>1.729</b>                              | <b>0.206</b>      | <b>1.647</b>                              |

Source: Authors' calculations.

In Thailand, small hydro power accounted for an additional share in annual generation of 0.025 per cent, and MSW accounted for an additional 0.002 per cent, while costing a premium of only 0.003 per cent and 0.001 per cent, respectively. This illustrates that these technologies are close to being cost competitive. For this reason, some countries do not have any support for these two technologies. The analysis shows that Thailand has been promoting solar power at higher costs than other types of renewable energy, a fact which reflects the global picture. Advocates for solar PV argue that high support today, as shown in Figure 18, is justifiable while PV is moving down the learning curve.

## 5.0 *Conclusions and Recommendations*

Thailand has the most developed renewable energy policy among the Association of Southeast Asian Nations, with many incentives implemented in recent years. The ENCON fund has been successful for supporting RE projects, especially on a smaller scale. Without the ENCON fund, RE deployment would probably have been lower.

Despite the success of investment incentives in Thailand, from the ENCON fund to the revolving fund and the adder program, renewable energy investment in Thailand still faces a number of economic and non-economic barriers.

The lack of interest and experience of banks in investing in new renewable technologies was one of the barriers to securing finance in the past. However, the revolving fund has demonstrated the potential of renewable energy projects to the banks. As a result, banks are now more willing to invest in renewable energy projects. The Thai government is no longer supporting the banks with zero-interest loans as in the past.

According to interviewees, the adder program is considered to be the most attractive and effective support instrument for investment in Thailand due to its high rates, especially for solar projects. Moreover, the rate structure is simple and easy for investors to integrate into investment plans. However, the adder program has also created some burdens which could directly affect consumer electricity bills in the future.

Under the adder program, renewable energy investors initially benefited from high tariffs at the expense of consumer electricity bills. After the Thai government stopped buying electricity from solar power in 2011, there was a steep drop in energy investment. It is recommended, therefore, that the Thai government review and revise tariffs and regulations, including the inclusion of a mechanism designed to automatically adjust tariffs based on installation rates, as soon as possible.

Non-economic barriers include both regulations and technical barriers. The accessibility of transmission-line information still remains a risk factor for renewable-energy investors. A coordinated approach between electricity utilities would help to address some of this uncertainty. The limited capacity of transmission lines, coupled with the high cost of investment and an increase in renewable energy projects in areas with low electricity demand, creates a challenge for the sector. Transmission constraints are a bottleneck which should be addressed by government in order to support the development of Thailand's abundant renewable energy resources in the future.

In order to encourage sustainable renewable energy investment in Thailand, both the Thai government and private sector need to work together to learn from the failures of the past and to improve implementation by tackling economic and non-economic barriers. Incentives with a clear policy, high transmission line capacity, appropriate regulations and attractive—but not excessive—prices would be the best solution to support private sector investment in RE in Thailand.

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## Appendix

### List of Interviewees

1. Twarath Sutabutr, The Deputy Director-General of the Department of Alternative Energy Development and Efficiency, Ministry of Energy
2. Samerjai Suksumek, The Deputy Director-General Energy Policy and Planning Office, Ministry of Energy
3. Kawin Thangsupanich, The Secretary General of the Office of The Energy Regulatory Commission of Thailand
4. Titiporn Sangpetch, Head, Distribution System Connection Planning Section, Transmission System Investment Planning Department, System Planning Division, Electricity Generating Authority of Thailand
5. Payomsarit Sripattananon, Manager of Distributed Generation Planning Division, Provincial Electricity Authority of Thailand
6. A.T. BiopowerCo., Ltd. (Biomass)
7. SPM Feed Mill Co., Ltd. (Biogas)
8. Wind Power Generation Co., Ltd. (Wind)
9. Solar Power Co., Ltd. (Solar)
10. Energy for Environment Foundation (ESCO Fund Manager)



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