A Review of Energy Efficiency Policy Development and Challenges for Implementation in Thailand

Suttikorn Chemhengcharoen[1,2], Sebastien Bonnet[1,2,*] and Ingo Puhl[3]

[1]The Joint Graduate School of Energy and Environment, Center of Excellence on Energy Technology and Environment, King Mongkut's University of Technology Thonburi, Thailand
[2]Centre for Energy Technology and Environment, Ministry of Education, Thailand
[3]South Pole Carbon Asset Management Ltd, Bankgok, Thailand
*Corresponding author: sebastien@jgsee.kmutt.ac.th

Abstract: In Thailand, the demand for energy has been increasing sharply over the past few decades. Fossil energy contributes the largest fraction of the overall energy used to satisfy the energy demand and more than half depends on energy imports. Hence energy security is an issue of increasing concern and since 1992 the Thai government has come up with a series of successive energy efficiency policy plans and programs to tackle such a challenge. In this study, the development of energy efficiency policy in Thailand was reviewed and the challenges associated to its implementation in the industrial and building sectors investigated through a few case-studies. The review indicated that since the establishment of the ENCON in 1992, a series of energy efficiency policies and conservation and plans have been developed with a number of different organizations responsible for their development and implementation. The system appears to be quite complex overall and prone to changes. Regarding the implementation of energy efficiency and conservation measures, the investigations of the cases studies surveyed revealed that there is still a number of challenges and barriers that need to be overcome. It was found that conservation measures in designated factories and building cannot be effective unless experts from relevant energy organisations are made available to provide advice and technical support, as well as follow-up services. The successful implementation of energy efficiency policy and conservation measures depends strongly on providing such support as it appears organizations are aware and willing to participate in actions enabling to enhance the efficiency of their operations and conserve energy.

1. Introduction

In Thailand, over the past few decades, energy consumption has been sharply increasing as a result of economic development and is expected to continue rising to meet the demand. Fossil energy resources are limited and more than half of the national energy demand depends on energy imports [1]. As the energy demand is increasing, the dependency on fossil energy and related import is increasing, leading to energy security concerns at the national level for the future. Over the period 1990-2010, the energy consumption in Thailand has been continuously increasing. It is now over 2 times higher than the 1990 level. The industrial and commercial building sectors are important contributors to this increasing consumption [2]. This energy security challenge is also accompanied with environmental issues, notably, climate change as result of increasing fossil based emissions of greenhouse gases.

Related to the above challenges, the set up of energy efficiency and conservation policies and measures is of utmost importance. If energy conservation and energy efficiency improvements are not adequately designed to support energy consumption in Thailand, the energy demand under the business-as-usual (BAU) scenario is predicted to reach 99,838 ktoe in 2021 and 151,000 ktoe in 2030; this last figure is a twofold increase as compared to 2011 (71,728 ktoe was csonumed in 2011) [1-2].

Over the past 2 decades, since 1992, the Thai government has been working on addressing these energy security challenges and has developed a series of energy efficiency policy plans and programs. In this paper, these plans and programs are reviewed, and potential challenges of implementation investigated based on specific case-studies in the industrial and building sector.

2. Review of Energy Efficiency Policy Development in Thailand

2.1 Energy efficiency policy

In 1992, the National Energy Policy Office (NEPO) under the Office of the Prime Minister, Thailand, initiated the development of energy efficiency policy by establishing the Energy Conservation Act (ENCON Act). The Energy Conservation Fund (ENCON Fund) was set up by the ENCON Act to support energy efficiency projects or programs in terms of finance. In 1993, the Energy Conservation Program (ENCON Program) was established to operate the development of energy efficiency programs. The ENCON Act also announced Royal Decrees for "Designated Building" and "Designated Factory" as detailed below [3].

The royal decree on "Designated Building" was issued in 1995 under the ENCON Act. A building can be defined as Designated Building based on the type, quantity of energy used and methods of energy utilization in such a building, and shall be made into a royal decree. The criteria include:

- Buildings with energy consumption of more than 1,000 kW or those authorized to install one or more transformers with a total capacity of 1,175 kVA or buildings with electricity and/or commercial energy consumption and/or consumption of steam thermal in the past year in a total volume of 20 million MJ or more of electrical energy equivalent.
- The specifications of energy consumption volumes for designated buildings exclude energy generated from renewable energy sources (e.g. firewood, rice husks, bagasse, biomass, hydro, solar and wind) so as to promote more utilization of renewable energy.

The target groups are industrial factories, buildings, and the producers or vendors of energy efficiency equipment for energy conservation.

The royal decree on "Designated Factory" was issued in 1997 under the ENCON Act. A factory can be defined as "Designated Factory" based on the type, quantity of energy used and methods of energy utilization in such a factory, and shall be made into a royal decree. The criteria include:

- A single factory or factories under the same address which are allowed by any energy distributor to install electricity metering device, or to install one or more transformers of which combined capacity is 1,000 kW or 1,175 kVA or more or;

- A single factory or factories under the same address which consume, either one or a combination of the following, electricity from an energy distributor's system, steam thermal from an energy distributor, or commercial energy from an energy distributor or from self-generation, as from 1st January to 31st December of the past year at a total volume of 200 million mega joules or more of electrical energy equivalent.

To promote energy efficiency, the Thailand Energy Award was also created so as to encourage entrepreneurs to implement energy conservation measures and push forward high-energy efficiency development.

In 2003, the Department of Alternative Energy Development and Efficiency (DEDE) was established under the Ministry of Energy and made responsible for the development of energy efficiency programs in Thailand. The Energy Efficiency Revolving Fund (EERF), Tax Incentive, and ESCO Fund were set up in 2003, 2006, and 2008 respectively to support budget management. The latest energy efficiency policy programs were set up in 2011, including, the Energy Efficiency Revolving Standard (EERS) and the 20-year Energy Efficiency Development Plan (20-year EEDP) with the Building Energy Code (BEC), Energy Resources Standard (EERS), and Demand Side Management (DSM) bidding program as related schemes [3-5].

The ongoing energy efficiency related programs are illustrated in Fig. 1. To improve and promote energy efficiency, external agencies such as the Electricity Generating Authority of Thailand (EGAT) and the Board of Investment (BOI) are also involved.

2.2 Major Ongoing Programs

2.2.1 The 20-year Energy Efficiency Development Plan

The 20-year EEDP is currently in its first phase (2011-2016) with a short-term target of accumulated energy saving of 7,980 ktoe. The following sectors are involved in this target: buildings and houses, low energy efficiency factories, transportation (efficiency), public services (street lights, advertising boards, etc.). The main strategy of EEDP is to continue with the implementation of a successful number of measures, including, ESCO and DSM bidding, promoting incentive schemes on technologies, enforcement of mandatory programs for designated buildings and factories, promotion of voluntary agreement programs, development and promotion of energy efficiency management systems, promotion of energy efficiency logistics, and increase of awareness for energy consumers [6].

2.2.2 The Building Energy Code

The BEC was established in 1995 by DEDE to control building design, construction and operation in order to contribute optimising energy conservation. The BEC is ongoing and focuses on new building designs covering the system performance and whole building energy compliance approvals rather than on retrofitting buildings. Buildings that are under the BEC are new buildings and retrofitted ones with more than 2,000 m^2 of total area. The BEC covers building envelopment, lighting system, air conditioning system, hot water generator system, renewable energy utilization and whole building performance [7].

2.3 Incentive Funds

2.3.1 The ENCON Fund

The ENCON Fund framework has been designed to operate over the period 2012-2016 (Phase 3) following 3 plans that are:

- The 20-year EEDP under Ministry of Energy
- The Alternative Energy Development Plan (AEDP 2012-2021)
- Other policies relating to the ENCON Act

The objective of this fund is to increase energy efficiency via the ENCON program and the 20-year EEDP, following a number of strategies, including [8]:

- Strategies on regulations and standard enforcement
- Strategies on promotions and supports of energy efficiency
- Strategies for creating public awareness and behavioral changes
- Strategies for promoting technology and innovative development
- Strategies for human and institutional capacity development

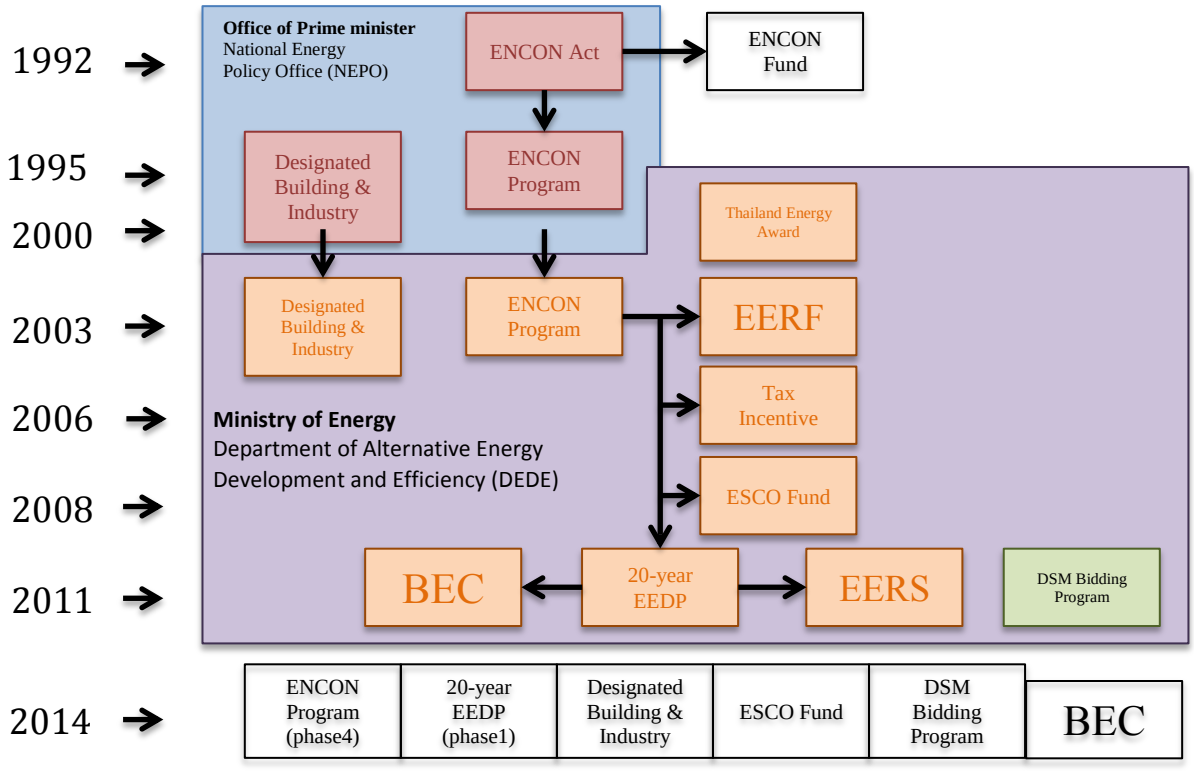

Figure1. Development of Thailand's energy efficiency and conservation policy (1992-2014).

2.3.2 The ESCO Fund

At present, there are 5 ESCO programs running under the Energy for Environment Foundation and the Energy Conservation Foundation of Thailand (ECFT). These are as briefly detailed below [9].

Equity Investment: This program focuses on investments in energy efficiency or renewable energy projects with the following size and interest: 10-50% of total investment cost (not as a majority sharer) but not more than 50 million THB per project; annual dividend is returned in the balance of investment.

ESCO Venture Capital: This program works on a partnership basis with ESCO to raise the investment capital for energy conservation projects of ESCO. This program increases the registered capital by 10-30% but not more than 50 million THB per project; annual dividend is returned in proportion of the investment.

Carbon Credit Facility: This program is divided into 2 projects, i.e. large projects and small projects. In large projects, the Clean Development Mechanism (CDM) and Certified Emission Reductions (CER) assessment of an owner are facilitated at lower service rates. For small projects, ESCO plays a role in facilitating the bundling of small-scale projects and/or project activities into a single emissions reduction project.

Credit Guarantee Facility: This program guarantees project loans from commercial banks; the maximum amount is 10 million THB and 1.75% per annum of guarantee amount is charged to the project owner.

Technical Assistance: This program provides financial support for technical assistance not exceeding 100,000 THB per project, including, energy audits and feasibility studies.

2.3.4 Demand Side Management (DSM) Bidding Program

The DSM bidding program or DSM by bidding mechanism, which is operated under EPPO and EGAT, was established to be an alternative for inducing factory owners to improve the energy efficiency of their operations or change machines to higher energy efficient ones. The supporting fund for such projects for private companies, e.g. industrial factories, commercial buildings, department stores, hospitals, hotels, resorts, etc., is the ENCON Fund. It is a competitive program as the fund is given in priority to the competing organization that saves the most energy on an annual basis [10].

3. Assessment of energy efficiency implementation and challenges in selected case-studies

As observed from the previous section, Thailand has been active in setting up energy efficiency policy programs since the establishment of the ENCON Act in 1992. A large number of schemes have been developed in order notably to promote, stimulate and support the implementation of energy efficiency and conservation measures. To assess the challenges, limitations and opportunities associated to such implementation, a couple of designated factories and a school were surveyed. The findings of these investigations are reported below.

3.1 Designated factories

3.1.1 Steel wheel manufacturer

The steel wheel factory investigated in this case is located in Chachoengsao. This designated factory has a capital of 492 million THB and manpower of 370 persons. To comply with energy efficiency and conservation requirements, this company has to submit an annual energy report and energy conservation plan to DEDE each year. In terms of energy efficient equipment, the factory indicated that it prioritises the maintenance of damaged machines over investment in buying new ones to avoid spending large amount of money (short term consideration). The company indicated that it provides information about energy conservation to its staff. However, the implementation of energy conservation measures is difficult as there is only one person in charge of this duty in the factory (in designated factories only one person is required to be in charge of energy). Also, as people in the factory work separately in each division and without any particular concern regarding energy conservation, the energy conservation plan that has been elaborated by the company for submission to DEDE is not being operated efficiently. This is also partly so because there is no follow-up and therefore no punishment when the amount of energy consumed in the factory is increasing as compared to the previous year; only the main causes of energy use are identified. The factory informed that they did not go for any of the funding schemes detailed previously as they do not match the company's need.

3.1.2 Enamel wire manufacturer

This large factory is also located in Chachoengsao. It is a designated factory and as for the previous case is required to submit an annual energy report and energy conservation plan to DEDE as well. This factory produces enameled wire. During the production process, the wires are to be tested, which is an energy intensive activity. The company indicated that it has been proactive in trying to reduce its overall energy consumption via an array of options. It notably joined the tax incentive program to purchase air conditioning systems, LED light bulbs, and invertors. However, the company did not join ESCO as the ESCO's list does not include equipment of interest for the factory. To conserve energy, the factory adjusted the size of the copper wires it produces (product) to a smaller size in order to reduce the electricity required in the testing process. This adjustment enabled the factory to save about 40% of the energy it initially required to produce the larger copper wires. However, the consumers did not wish to purchase the new products made of thinner wires as they had to pay the same price as before and this even though these products were approved by international standards. This was an important challenge faced by the company highlighting the importance in awareness raising to consumers as well. In terms of energy efficiency, the company reported that the support that can be obtained for improvement is not attractive enough unlike it is the case for larger industries like PTT or SCG. Also, the energy manager of the factory indicated that the implementation of energy efficiency and conservation measures should be the subject of a follow-up by DEDE experts as a precautionary measure. At present, there is no strategy to encourage energy conservation operations in the company since only the submission a report to DEDE is required without any follow-up.

3.2 Non-designated building

The non-designated building investigated in this case is an international school of 350 students in Samutprakarn. To conserve energy, the school was offered an air conditioner controller by the Smart Energy Company (Satec). The school reported it can conserve about 20-30% of its energy consumption by using this instrument. The school also uses fluorescent light bulbs in every buildings and rooms. However, LED (Light Emitted Diode) light bulbs are not used as the main ones because they are too expensive; only broken bulbs are replaced by LEDs. All pieces of equipment that are purchased by the school are in the ESCO's list. Before joining ESCO, the school reported that it had to sign an energy agreement. In the agreement, there was a section to inform about targets of energy conservation

(how much energy is saved for each of the equipment used), and ESCO should pay for the difference in energy i.e. excess energy. In the future, the school plans to change the invertor and install solar cells. At the moment, the school feels solar cells are too expensive to invest in and have a too long break-even point. The person overseeing energy matters for the school suggested that experts in energy or persons who contribute to energy agencies (e.g. EGAT) should be involved. Technical guidance is wanted to support the implementation of adequate energy efficiency measures and improve energy conservation in the school. However, at present, it seems that such resources are not available and most of the people who are involved in dealing with energy efficiency issues are from the private sector. This is because energy efficiency matters are mainly run as a business making it difficult for some organizations to get started and for this school to go ahead with more options for improvement.

3.3 Discussion

Based on the above case-studies surveyed, a number of challenges associated to the implementation of energy efficiency and conservation measures were identified. First, it was found that for factories focus is mainly on maximizing production rather than on producing more safely and more efficiently. This renders the assessment and implementation of energy efficiency and conservation measures difficult. Another issue is related to the hierarchical structure of organizations in general which tends to hinder bottom-up communication and suggestions for improvement to the executive body. Another limitation is related to the lack of energy monitoring systems, e.g. some companies have only one electricity meter and water meter for an entire plant. This is because energy is seen as a fixed cost and so not adequately monitored or managed. Also, as revealed in one of the factories surveyed, people working in different units of a company may have access to different information and there is no system or even in some cases person responsible for centralizing the information related to energy consumption. This combined with a lack of technical knowledge, and external information and expertise makes it difficult to address and implement adequate energy efficiency and conservation measures. Support from energy agencies needs to be improved to overcome this particular challenge as indicated by the last case-study. One last important barrier is related to the lack of financial resources for investment. This is one important limitation that was raised by all the organization surveyed. In some cases, the payback period requires a few years following investment which some organisations do not find attractive as immediate benefit is expected. In some other cases, a large saving could be obtained with a short payback period but a high initial investment would be required which some companies cannot afford and which the incentive funds detailed previously do not cover.

4. Conclusion

In Thailand, in 1992, the National Energy Policy Office (NEPO) under the Office of the Prime Minister initiated the development of Energy Efficiency policy by establishing the Energy Conservation Act (ENCON Act). The Energy Conservation Fund (ENCON Fund) was set up by the ENCON Act to support Energy Efficiency projects or programs in terms of finance. Since then a succession of Energy Efficiency programs have been developed. The main ongoing programs include the ENCON Program (phase 4), the ENCON Fund (Phase 3), the Designated Industry and Building, the 20-year EEDP (phase 1), the ESCO Fund, and the DSM Bidding Program.

Regarding the implementation of energy efficiency measures at an organizational level, based on the case-studies investigated, it was found that those that are either under the category of designated industry or designated building are only required to submit an annual energy report and energy conservation plan to DEDE. However, there is no follow-up from DEDE following the submission of this report. This can be a problem, notably, when energy data reported show no improvement or even a worse performance as compared to the previous year. The organizations surveyed indicated that although there is an energy conservation plan set out, only some people follow the plan. Some organisations also mentioned that the replacement of certain equipment by more efficient ones is usually not done since the prices of equipment are usually too high with too long payback period; also there is usually no support from contributing agencies (for self-entrepreneurs). Some of the organizations surveyed indicated that expert advice from energy agencies such as DEDE or EGAT and follow-up of operations with technical suggestions for improvement would be very useful.

Acknowledgement:

The authors would like to acknowledge South Pole Carbon Asset Management Ltd for providing the support and facilities necessary to perform this study.

References

[1] Sutabutr T, Alternative Energy Development Plan: AEDP 2012-2021, *International Journal of Renewable Energy* 7/1 (2012) 1-10.

[2] EPPO, *20-year Energy Efficiency Development Plan (2011-2030)* (2011) Energy Policy and Planning Office, Ministry of Energy, Thailand, Available online: http://www.enconfund.go.th/pdf/index/EEDP_Eng.pdf [Accessed on: 28 September 2014].

[3] IIP, *Industrial Efficiency Policy Database. Institute for Industrial Productivity* (2014) Available online: http://iepd.iipnetwork.org/country/thailand [Accessed on: 17 October 2014].

[4] Pichalai C, Thailand's Energy Conservation Program and the Role of New and Renewable Energy in Energy Conservation, *The Royal Institute* 1 (2007) 125-133 (in Thai).

[5] APERC, *Compendium of Energy Efficiency Policies of APEC Economies* (2012) A report prepared by the Asia Pacific Energy Research Centre (APERC), Available at: www.ieej.or.jp/aperc [Accessed on: 25 Oct 2014].

[6] Egkamol D, *Development & Status of Energy Efficiency in Thailand* (2013) Department of Alternative Energy Development and Efficiency, Ministry of Energy, Thailand, Available online: www.egeec.apec.org/dmsdocument/428 [Accessed on: 20 October 2014].

[7] Sutabutr S, *Building Energy Code and Regulations* (2011) Ministry of Energy, Thailand, Available online: http://www.creativepartnership.org/wp-content/uploads/2011/10/BEC-Presentation-for-Thai-US-Seminar-Sep-26.pdf [Accessed on: 17 October 2014].

[8] EPPO, *ENCON Fund Guidelines (2012-2016)* (2014) Energy Policy and Plan Office, Ministry of Energy, Thailand, Available online: http://www.enconfund.go.th/index.php [Accessed on: 31 September 2014] (in Thai).

[9] JGSEE-CEE, *Thailand contribution to Analysis of Energy intensity, Energy Efficiency Targets and Policies* (2014) Report by The Joint Graduate School of Energy and Environment - Centre of Excellence on Energy Technology and Environment at King Mongkut's University Technology Thonburi (in process).

[10] EGAT, *Demand-Side Management by bidding mechanism* (2014) Electricity Generating Authority of Thailand, Available online: http://www.egat.co.th [Accessed on: 20 October 2014].

