

## Management of Energy Demand in Thailand

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### Abstract

Given increasing world energy demand, instabilities of supply and the adverse environmental impacts of the typical fossil fuels, there is an urgent need to establish an efficient and environmentally friendly energy industry in order to move on a sustainable economic development path. This paper reviews the current energy situation in Thailand and highlights her efforts using a range of economic and financial measures to encourage investment in energy efficiency technologies and equipment, together with the promotion of conservation measures. Even though efforts may not be at all times successful as there are many factors contributing to the success in using these instruments, we need to learn and plan to overcome possible failures. Policy measures to change behaviors of energy users towards more efficient uses of energy and also reduction in energy demand would be the cost effectiveness approach and will continue to hold an important role in energy management and planning on the global scale.

*Key words:* energy demand management / economic instruments / Thailand

### 1. Introduction

Energy has generated major concern to the global community not only because of its major role in driving economic development and industrialization but also its associated environmental impacts especially the emissions of greenhouse gases (GHGs) from fossil fuels. The environmental degradation caused by GHGs emission has become a major threat to human health and has affected the ecological balance and biodiversity. Increasing climate-related disaster worldwide such as drought, floods, storm surges, heat waves and forest fires have been frequently experienced by many countries during the past decade. As reported by the Greenpeace, these events may be largely attributed to climate change and could possibly lead to irreversible changes in ecosystems. As three-fourth of world energy consumption still mainly relies on fossil fuels, one of the main GHGs polluters; global actions to, for example, improved energy efficiency, energy conservation and

development of alternative energy sources are desperately needed to help stabilize climate change.

With the threat of great fluctuation in oil prices and sharp increase in greenhouse gas emissions, this paper provides the efforts of Thailand in increasing efficient use of energy and conservation as this will prove to be the most cost effective measure in energy management. Some relevant economic and social instruments have been employed to change individual behaviors and practices in energy consumption and/or shift toward alternative energies with more favorable economic and environmental conditions. The main objective of this study is to conduct a comprehensive review of the current situation of energy, measures and instruments employed in energy conservation and management in Thailand, with special interest to the demand side management program.

## 2. Overview of energy consumption in Thailand

After the financial crisis hit Thailand and Asia in mid of 1997 causing an approximately 10% reduction in GDP, the economic has rebounded relatively quickly with an annual average economic growth around 5% during the past decade. Growth on energy consumption has been closely related to economic development with the annual average of about 4% growth of final energy consumption following the rebound of the economy.

Energy consumption in Thailand has grown rapidly, fueled largely by rapid industrialization, urbanization and increasing economic activities. The nation's energy consumption has risen almost three folds during 1990 to 2007, from about 30 MTOE in 1990 to 80 MTOE in 2007, of which sixty three percent was imported. Import of energy in 2007 was approximately 18% of the country's total imports.

In terms of current primary energy consumption, petroleum and natural gas are the major sources, each sharing similar weight of about 40% of the total. The share of imported coal has significantly increased from less than 1% in 1990 to currently 12.5% while the locally produced lignite is currently supplied only 6% of the total primary energy consumption. This suggests that the overwhelming majority of energy supply in Thailand still come from traditional non-renewable sources such as coal, natural gas and oil. Nuclear power is still far from realization, however, it is currently proposed in the national's energy development plan.

In terms of final demand, petroleum products accounts for about half of national energy consumption, with diesel takes the highest proportion, following by gasoline and fuel oil. Next are electricity and renewable energy. Even though the proportion of renewable energy

consumption has remained unchanged during the past decade but the quantity consumed has been on an upward trend. The main renewable energy in Thailand is biomass which is normally used in the residential sector in the rural areas and small and medium enterprises in the commercial sector. Similar to many developing countries, the Thai government has put effort in promoting utilization of more diversified renewable energies as they are favorable in terms of environmental quality and sustainability.

## 3. Economic and social instrument employed in energy conservation in Thailand

The energy conservation movement in Thailand began in 1992 when the Royal Thai Government passed the Energy Conservation Promotion Act (ENCON Act) to promote energy conservation. The ENCON Act has been the major instrument for the government in setting regulatory measures and other instruments to promote conservation and efficient uses of energy and renewable energy. Under the ENCON Act, the Energy Conservation Fund (ENCON Fund) was established as a working capital to provide financial support to activities related to energy efficiency and renewable energy development. Beside the ENCON Act, the Thai government established the demand side management (DSM) unit as a new department in the Electricity Generating Authority of Thailand (EGAT) to act as an executing agency for DSM programs in order to promote efficient use of electricity. This made Thailand the first Asian country in officially adopting the DSM approach in energy planning and management. Later, the DSM unit at EGAT was shifted to the DSMO (demand side management office) under the Ministry of Energy. The demand side management planning framework normally targets at the end use

sectors (including mainly residential, commercial and industrial), buildings, and end use equipments and technologies.

Several regulations, economic and social measures have been employed to stimulate energy conservation and efficiency in Thailand, those which are effective can be classified into the following broad categories.

### 3.1. Energy label/ energy rating

As one of the information programs that have potential impacts on consumer behavior, the voluntary energy labeling

program was first introduced in 1994 through EGAT's DSM initiatives, targeting initially at refrigerators. The Thai energy label is designed on the scale of 1 to 5, where the label no.5 promoted as the designation of the most energy efficient level. As shown in Figure 1, the Thai energy label provides a consumer-friendly information with a simple scale 1-5 rating that is clearly explained at the top with the indication of 1 (low), 2 (fair), 3 (medium), 4 (good) and 5 (very good). Normally, a scale of 3 indicates the minimum energy performance standards (MEPS).



**Figure 1** Example of energy label in Thailand

Even though most people are able to grasp the 1 to 5 efficiency rating system, many still do not understand or do not pay much attention on the detailed product information displayed below. The detailed information includes the average energy consumption (kWh/year) and the average electricity bill (baht/year). Despite the problem, the appliance labeling program has significant impact on the consumer market. The marketing surveys indicated that after three years of implementation, over 60% of Thai consumers asked about or used the energy labels and 28% reported energy efficiency among their top three purchasing priorities (Hardy et. al., 2004). In Thailand, the energy label is widely recognized through the massive nationwide advertising campaigns. Aside

from the very effective advertising campaigns, the Thai consumers also pay great attention on rating of energy efficiency of their appliances on their purchasing decisions to lower their long-term energy bill.

Even though there has been the rescaling energy scheme for some products to improve energy efficiency performance, the standard of the energy label does not seem to catch up with technological change. Besides, as the mandatory labeling program is still rather limited for only certain products, the manufacturers and distributors choose not to label their products if they are rated on scale less than 3, so we barely see any appliance in the Thai market with any rating level but 5.

In 2007, Thailand developed Ministerial Orders for 26 appliances such as refrigerator, air conditioning, ballast, electric fan, rice cooker, motor, lighting and car. The lists will be extended to 35 appliances by 2011 to stimulate most efficient energy consuming products to enter the market.

### **3.2. Equipment rebate program**

As one of the highly successful DSM options, energy rebate program has been targeted heavily in promoting the market transformation to the more efficient use of electrical appliances and equipments, with the current focus on the efficient lighting programs.

Energy saving light bulb have been distributed free of charge by means of gift certificates with the electricity bill. A total of nearly 49 million free energy saving bulbs was distributed in 2008. If considering they consume 80% less energy than incandescent light bulbs and last between 6-8 times longer, this will lead to major energy savings. Complementary to this program, 6 million energy saving light bulbs were distributed through a 2 for 1 program for the voluntary replacement of incandescent bulbs.

In addition, to expand the market transformation to the efficient light bulbs with cost effective means, the rebate programs are given to the manufacturers and wholesalers to distribute the bulbs to the consumers at very low cost through their strong and established distribution retailers. With this program, the promoted light bulbs are sold at a 40-50% lower than the then current market price. Public advertising campaigns indicate the low price of the bulbs along with an 80% reduction in electricity bill display another marketing effort to stimulate the product transaction nationwide. This program is estimated to save energy up to 1,500 million units per year or

approximately 4,500 million baht. The final electricity demand will be reduced at the maximum of 300 megawatt per year.

Beside the promotion of the compact light bulbs, the government also greatly supports the substitution of very thin compact fluorescent bulbs with 5-inch diameters (T5) to the less efficient fat tubes (T12) in residential and office buildings. If the complete replacement of T5 succeeds, it will help Thailand to save energy up to 3,000 megawatts and reduce CO<sub>2</sub> emissions up to 4.5 million tons per year which is equivalent to CO<sub>2</sub> emissions of 1.2 million cars.

In order to transforming the lighting market to the more efficient electricity saving equipments, "the Thai People Network Against Global Warming by New Thin Tube" Project was also launched in 2008 with cooperation from over 30 targeted organizations especially large corporations. The targets to replace the less efficient existing lighting systems and light bulbs with the currently highly efficient very thin compact fluorescent lightings (T5) are set for the participating organizations, for instance, the replacement of 0.45 million tubes for the Petroleum Authority of Thailand (PTT), 0.19 million for the cement group and 0.14 million for Carrefour, Thailand. To ease and stimulate the change, the government allocates 2,000 million baht as the revolving fund to be used as the (free-interest rate) loan to those participating in the program with 24 monthly repayment period. The electricity saving for this new very thin tube will cover the replacement cost and lower the long-term average energy cost for the participating corporations.

### **3.3. Tax incentives**

The Thai government has employed the tax incentives for energy conservation and energy efficiency improvement projects. The main objective is to provide

tax incentives to owners of facilities in the private sector that have efficiently implemented energy conservation and/ or energy efficiency measures. The tax incentives are roughly classified into three types.

### *3.3.1. Cost-based tax incentive*

Under this program, business operators can deduct 1.25 times the value of the replacement of energy efficiency equipments as part of corporate expenses, making this a cost-based incentive. In other words, 125% of energy efficiency investment will be eligible for deductible taxable income. This tax scheme is applied to the first 50 million baht investment with its tax incentives spread over 5 years. In addition, 25% tax break is provided for the investment in energy efficiency projects resulting in efficiency improvement.

### *3.3.2. Performance-based tax incentive*

The amount of performance –based tax incentive is based on the actual energy savings, i.e., 100% of achieved energy savings will become tax deduction with maximum incentive of 2 million baht per facility. Pre and post audit are required with the reliability of measurement, however, verification has still been a major problem encountering.

### *3.3.3. Board of Investment 's tax incentive*

To promote energy efficiency and energy savings from reduction in oil imports, Thailand's Board of Investment (BOI) implements the program on exemption of corporate income tax and import duties for new investment in energy conservation business and the investment in activities concerning alternative energy production are given for the maximum period of 8 years. Examples of energy conservation business include high efficiency machine or equipment and renewable energy equipment manufacturing, solar PV

manufacturing, and Energy Service Companies (ESCOs). Alternative energy production business includes, for instance, alcohol or fuels from agricultural products including waste and residues, fuel cells, and business involving electricity or stream generation.

Taxes are normally considered as one of the most common economic tools employed in environmental management; however, they may also be subject to criticism on potential uncertain environmental effects. Thailand has experienced some perverse effects of using fuel taxes and subsidies on energy consumption to encourage fuel switching during the 2008 energy crisis. The case is briefly illustrated as below.

### *3.3.4. Encourage fuel switching by taxes and subsidies*

As the key component of Thailand's national energy policy and development plan is to promote alternative energy in order to diversify fuel types and reduce dependency on energy import, several instruments have been heavily used especially in 2008 when the economy was hit heavily by the soaring oil prices. Natural gas is aimed to replace diesel and benzene as vehicle fuel. Gasohol and biodiesel are introduced to substitute for benzene and diesel mainly in the transportation sector. To achieve the goal of fuel switching, the energy price structure was heavily distorted especially during the 2008 energy crisis.

Prices of natural gas are subsidized at 50% of the price of diesel in order to make it more commercially viable even though these prices are much lower than the actual market prices. Moreover, it is subject to only value added tax (VAT) while all other taxes are exempted. Special low interest loans (0.5%) are arranged for taxis and buses to convert to natural gas. Free subsidy for installing compressed natural gas is given to 20,000 taxis. Grants are made for the bus system

to purchase natural gas vehicle (NGV) engines. In addition, the government lowered the excise tax and duty on all imported NGV engines and parts, relax regulations involved in reimbursement for expenses incurred when installing NGV equipment in state vehicles, and devise incentives such as the reduction of the registration tax on NGV vehicles to encourage taxis, trucks, buses and other vehicles to switch. These incentives, along with the soaring oil prices led to explosive growth of demand of natural gas during the first half of 2008.

Aside from natural gas, LPG prices are also heavily subsidized mainly for household uses. LPG price was set at 330 USD per ton much lower than the world market price of 900 USD per ton in June, 2008. In response to increase in oil prices as compared to subsidized LPG, a large proportion of taxis, trucks, and other heavy fuel using vehicles have switched to LPG. During the first five months of 2008, 600,000 vehicles were fitted with LPG engines. This brought the total of LPG-fuelled vehicles to 1.2 million. Thailand has shifted from a net LPG exporter, to become an importer in April, 2008. The wrong price signals have inevitably led to serious market distortion.

These recent experiences suggest that inappropriate structure of price could lead to excessive uses of fuels in this case both NGV and LPG in transportation and industries. Such subsidies would also create a rebound effect, i.e., encourage to use more or reduce incentives to conserve energy. The estimate of the BP oil company indicates that countries with fuel subsidies accounted for 96% of the world increase in energy use in 2007 (Bradsher, 2008).

### **3.4. Financial incentives**

The Energy Conservation Fund (ENCON Fund) was established to provide financial support for projects

ranging from investment in energy efficiency improvement project, demonstration and dissemination of renewable energy technologies, research and development (R&D) projects, up to capacity building, policy study and promotional campaigns. As in the past the financial institutions were still unfamiliar and had less confidence in dealing with the energy efficiency projects.

Financial incentives together with technical assistance have also been directed toward the targeted industries. The Department of Alternative Energy Development and Efficiency (DEDE) attempts to introduce and demonstrate potential high and advanced energy efficiency technology to the selected industrial groups with economic significance such as food and beverage, plastic, steel, textile, petrochemicals, hospital, etc. by providing 20% subsidy on the investment costs.

To promote investment in energy efficiency projects, the ENCON Fund provides interest free funds to participating commercial banks for loaning to commercial and industrial customers at the fixed interest rate up to the maximum of 4%, 7-year loan period with grace period of 1 year. The loan is provided up to the maximum of 50 million baht (approximately 1.2 million USD/ project). The banks take responsible in managing the loans and reporting to DEDE, while the DEDE provides technical assistance, i.e., administers and monitors the overall requirements and the progress of the program.

Financial incentives through the ENCON Fund have continued to be an important government tool to promote the uptake of energy efficiency practices and development of renewable energy supplies as illustrated in the following two successful projects.

### 3.4.1. Promotion of biogas technology: converting pig wastes into domestic renewable fuel source

Pig production in Thailand has changed remarkably from small backyard family farm to specialized large scale production often with several thousand pigs. In 2008, there were about 3,000 pig farms with approximately 12 million pigs. Disposal of pig wastes without proper treatment have caused severe environmental problem not only in the form of bad smell and wastewater discharges but also emissions of methane and nitrous oxide<sup>1</sup> that causing global warming. By using biogas fermentation technology, these wastes can be transformed into biogas<sup>2</sup> and fertilizer from treated sludge. Biogas obtained from the process can be substituted for liquefied petroleum gas (LPG), and can also be converted to electricity for residential uses. Not only the biogas technology can help solve the environmental problem from wastes, it also reduces energy cost and can generate additional income to the livestock farmers if the excess biogas/ electricity produced can be sold.

Even though there are several types of biogas fermentation technologies, the investment costs have been relatively high, resulting in limited adoption. With significant positive social non-monetary benefits, the promotion of biogas technology program was implemented firstly with the pig farms since 1995. The program initially designed for medium- and large-sized pig farms with the ENCON Fund providing direct subsidy up to 35% and 18% of the investment costs

for the medium- and large-sized farms, respectively.

However, even with partial financial support, the program had only limited success at the initial stage due to high investment cost, ineffective use of the biogas and further investment needed to turn surplus biogas into electricity. The biogas adoption has been accelerated after 2002 when the Pollution Control Department (PCD) has set and enforced the effluent standard for pig farms. Several other means have been implemented to assist farmers to comply with the law. These include technical assistance in waste management in pig farms in the form of e-learning, PCD's web-based assistance center, manual and on site visit. The "Greening pig farm award" for those compliance pig farms with clean and environmentally friendly management is also introduced to help increase the compliance rate.

Aside from regulation, the success of the program has also been supported by the increase in world energy price and the decrease in investment cost due to technological development.

The biogas promotion has continued since 1995, by the end of the third phase in 2009, the total subsidy for biogas in pig farm would amount to approximately 28 million USD which can treat pig wastes up to 20% of the total pig population (Wongsapai et. al., 2007). Aside from livestock industry, the biogas promotion campaign also covers variety of potential other energy sources such as wastewater, organic waste, and food residues. In addition to livestock farm, the biogas promotion of the fourth phase during 2008-2012 covers animal slaughter houses, animal processing factory, food waste and community waste. The ENCON Fund will provide funding for consultancy costs of the system design and investment cost of the system whereby funding will not exceed 20% of the total costs and not exceeding the

<sup>1</sup> Methane and nitrous oxide has the capacity of warming the atmosphere 21 and 310 times more than carbon dioxide, respectively.

<sup>2</sup> Biogas composes of approximately 60-70% methane, 28-38% carbon dioxide, and 2% of other compounds (water vapor, hydrogen sulfide and siloxanes). One cubic metre of biogas is equivalent to 0.46 kg LPG, 1.2-1.8 kWh of electricity and 0.67 litre of gasoline.

maximum amount of funding as specified for each type of industry. The total budget would be approximately 5,000 million baht.

### *3.4.2. Promotion of agricultural biomass: integrating energy conservation and efficiency in Thailand's rural development*

The share of renewable resources mainly biomass has contributed quite significantly in Thailand. Renewable energy presently accounts for 18% of final energy supply in Thailand. The 1992 ENCON Act considers renewable energy under the heading of energy conservation; therefore, related activities and projects are consequently eligible for funding under the ENCON Fund.

Agricultural biomass has long been traditional energy source in rural Thailand but has only recently been developed on a commercial scale. There are still large amount of agricultural residues unused and have great potential as new alternative energy sources. These include rice husk, bagasse, oil palm residue, rubber wood residue, food waste and livestock manure.

In fact, the Thai government has strongly supported the development of renewable energy supplies especially as the means to agricultural modernization and rural development. Various economic incentives and legal framework have been employed to facilitate the programs. The predominant measure has been subsidies (from the ENCON Fund) in investment costs and capacity building.

To help achieve the national target for renewable energy development to substitute fossil fuel especially in generating electricity, the following economic incentives and institutional measures have been implemented.

- Establishment of legal enforcement on the Renewable Portfolio Standard (RPS) for new power plants that 5% of their generation capacity must be generated by renewable energy such as solar, wind or biomass.

- Economic incentives including provision of tax credit, privilege and subsidies to encourage purchase of power generated by renewable energy.

- Encourage participation and partnership of the local communities in renewable energy-fueled power plants.

- Guarantee prices and market for electric power generated by agricultural biomass and other renewable energy sources. The government supports small power producer (SPP) and very small power producer (VSPP) by subsidizing additional electricity prices (adder) for contract of 7-10 years, to attract private investments according to the long term national energy policy. The additional prices are differentiated to address diversification of renewable energy sources by giving higher additional prices to those with potential but produced currently at higher cost.

To promote use of agricultural biomass in substitution with imported fossil fuel for household uses, farm engines and small and medium scale enterprises, the related government agencies have organized training and demonstration project of alternative biomass energy nationwide to disseminate appropriate technology and encourage proper energy management in the rural areas. As shown in Figure 2, agricultural biomass residues such as wood chips and rice husks are used to produce energy to substitute LPG for cooking or fuel in farm machines, heating and drying process for fruits.



**Figure 2** Small biomass gasifier for household use and farm engine

### **3.5. Promotion of Energy Service Companies (ESCOs)**

As part of the ENCON Act, Energy Service Companies were established to promote and assist with the implementation of energy conservation. ESCOs are private companies that provide comprehensive energy-efficiency or load-reduction services to customers who own or operate facilities such as factories or buildings. They provide energy savings for a fee. Under the initial stage, the government provided interest-free loans to finance industrial energy conservation investments by private ESCOs.

The government has promoted the activities of ESCOs by providing various incentives as follows:

- Tax incentive by giving corporate income tax exemption for ESCO projects for a maximum of 8 years.
- Financial assistance for ESCOs to access to low-interest rate loan from revolving fund on project by project basis.
- Promotion of ESCOs' activities through seminars, workshop, website and publication. Lists of ESCOs and successful cases are also disseminated to the public.

### **3.6. Social measures: promotion of public awareness**

To influence participation and adoption of a variety of programs related to energy efficiency and conservation

measures, a very important element in the implementation process involves public awareness. Several techniques and methods can be selectively supplemented to educate and communicate knowledge and information to the public to increase perceived value of energy services and customer awareness of the programs. Advertising campaigns through various media including television, radio, newspapers have proved to be very effective in promoting public awareness and participation in the DSM programs and energy conservation movement in Thailand. The following summarizes some of the social measures which have been initiated and implemented to increase public awareness and response to the energy efficiency and conservation in Thailand.

#### **3.6.1 Curriculum development and training**

Several organizations such as EGAT and DEDE have developed courses to enhance energy conservation awareness and efficient utilization at various levels especially among the young generation. Example includes EGAT's installing green learning rooms for school across the nation.

DEDE has also designed curriculum include general courses and specialized courses in energy management, energy audit, energy efficiency in major systems such as air conditioning, lighting and

heating. Energy efficiency courses designed specifically for those heavy energy consuming industries such as textile, paper, and cement have also been developed and offered together with technical assistance. In addition, attempt is made on cooperation with vocational study department to add energy efficiency study in curriculum. Several other plans include development of curriculum for private to offer as commercialize training and also vocational school teachers' training nationwide.

### 3.6.2 Public relations media and campaigns

To provide extensive information on energy to various target groups, the Energy Policy and Planning Office (EPPO) established the Thailand Energy and Environment Network (TEENET). The network was set up as a one stop front desk providing linkages to various energy related organizations, and provides information services in energy efficiencies, technologies, energy expertise and database on research and development. The network can be visited at [www.teenet.info](http://www.teenet.info). In addition to TEENET, the DEDE has also provided the one stop service called energy clinic to advice on energy conservation measures to all interested parties. The consultancy service can be accessed by phone and email. Several other websites providing information on conservation movement in Thailand can be visited such as [www.energyfantasia.com](http://www.energyfantasia.com) and [www.thaienergynews.com](http://www.thaienergynews.com).

## 4. Conclusions

Since the first oil crisis in early 1970s, several factors including economic, social, political, technological and environmental dimensions have combined to change the energy industry's operational environment. Significant

fluctuation in demand and economic growth along with rising and fragile energy prices have inevitably worsen the economy especially during the current global recession. Demand management through increase in energy efficiency and energy conservation appears to be one of the most cost effective approaches in fighting with the energy crisis.

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