Challenges of Energy Efficiency Promoting Policy in Thailand

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Abstract. Energy efficiency enhancement is well recognized worldwide as the efficient measures to deal with energy-related challenges, which are economic growth and development, energy security, and climate change. For Thailand to accelerate energy efficiency implementation, the energy development plan is set to meet the national targets including the Energy Efficiency Plan target and to achieve the Greenhouse Gas emission reduction target. In many countries, financing energy efficiency promoting policy is critically important strategy to provide financial incentive for mitigating clean energy investment barrier. For long-term public support, there is an emerging body of evidence on the on-going practice and performance of the financial incentive programs, which offers an opportunity to improve our understanding of the energy efficiency promoting policy. This study reviewed the latest situation of three energy efficiency financial incentive programs that governed by Department of Alternative Energy Development and Energy Efficiency (DEDE), which are (1) Energy Efficiency Revolving Fund (EERF), (2) Energy Service Company Revolving Fund (ESCO Fund), (3) DEDE Demand Side Management Bidding (DSM Bidding). The study aims to examine the positive and negative challenges posed by existing policies that need to be overcome and to identify the opportunities for policy improvement to more effectively promote energy efficiency implementation. EERF and DSM Bidding are suitably designed for large company who has strong financial capacity. ESCO Fund is well-designed for low collateral capacity company. EE measures under EERF are mostly well-known technologies that are proven generating energy savings. ESCO Fund is suitable for promoting new technologies according to project-based analysing basis. DSM Bidding can be designed for wide-range EE measures from simple to complex measures. However, there are some main challenges that can be improved, i.e., technical and financial risks bearing by customers from EERF, default projects risk taken by government and insufficient to encourage EE investment of low interest rate from ESCO Fund, and expanding to support more for complex technology instead of only well-known technology for DSM Bidding.

1. Introduction
Energy efficiency (EE) is well recognized as lowest cost option to deal with energy-related challenges, which are economic growth and development, energy security, and climate change. Thailand has made the best efforts for EE enhancement by establishing law, financial support and EE development plan. Energy Efficiency Plan 2015–2036 (EEP 2015) is complementary to Energy Conservation Act that it targets to reduce energy intensity of 30% by 2036 (compared with 2010). Department of Alternative Energy Development and Energy Efficiency (DEDE), which is implementator-organization under
Ministry of Energy, has established and govern three financial incentive programs, including (1) EERF, (2) ESCO Fund and (3) DSM Bidding, for promoting EE investment to meet the EEP 2015.

The programs aim to enhance EE investment for four sectors. First sector is designed factories and buildings (DF&Bs) that are regulated based on their installed capacity over 1 MW or 1175 kVA and annual energy consumption over 20 million MJ. Second sector is factories and buildings that are not regulated (non-DF&Bs), which they are low energy consumption and low financial capacity, sometime called ‘SMEs’. Third sector is energy service companies (ESCOs) that are energy specialized consultants, which they can also finance or arrange financing for their customers. Last sector is new buildings that have Building Energy Code (BEC) certifications.

For Thailand, to ensure energy security and to cope with global warming impacts, promoting low carbon electricity generation is one of essential strategy [1]. In addition, using efficiently energy is other well-known option. However, lack of access to financing is the one of critical EE barriers [2]. Many authors [3-5] have studied about government financial incentive for EE that provided programs’ information and analysis basis. EERF was claimed that it was innovative designed and successful implementation [3]. However, it was unsuccessful from a sustainability perspective, which the participating banks discontinued EE loan without government initial funding support [6]. ESCO Fund was also claimed that it was successful implementation for enhancing RE/EE [4], however, all lesson learned was mainly on RE supporting practices. DSM bidding program, which was implemented in Switzerland, was evaluated and conclude that it was successful in delivering energy savings at low cost and the openness to technologies under the program was main advantage [5]. This study shows current situation of three financial incentive programs in Thailand in regard of how programs support for large or small financial capacity company and for complex or well-known measure, which would be useful to policy makers to advance policy design for increasing EE enhancement.

For long-term public support, there is an emerging body of evidence on the on-going practice and performance of the programs, which offers an opportunity to improve our understanding of the EE promoting policy. The objective of the study is to understand existing EE promoting policies and to identify the opportunities for policy improvement to more effectively promote EE implementation. This study reviews the latest situation of above three programs. The study aims to examine the positive and negative challenges posed by existing policies that need to be overcome.

2. Current situation analysis
This section shows current situation analysis for EERF, ESCO Fund, and DSM Bidding. The program details including design, institution structure, operation, and performance are illustrated and analyzed. Short overview for three programs is shown in Table 1.

| Table 1. Overview of financial incentive programs for promoting EE investment |
|---------------------------------------------------------------|
| **Type of program** | **EERF** | **ESCO Fund** | **DSM Bidding** |
| Promoting year 2003-2019 | Credit line for low-interest rate revolving loan fund | Venture capital, equipment leasing, de-risk mechanism, and technical facilitator | Subsidy via bidding mechanism |
| Maximum support 50 MB/Project | 2008-2017 | 20 MB/Company* | 2016-2017 |
| Targets | DF&Bs, non-DF&Bs, ESCOs, new building | DF&Bs, non-DF&Bs, ESCOs | 100 MB/Company |
| Project eligible EE/RE | EE/RE | ESCOs, new building | LED/VSD Air |

*Maximum support for EE equipment leasing instrument

2.1. Energy Efficiency Revolving Fund (EERF)
EERF is a ‘credit line’ that supports for EE/RE investments, which public provides a principal with zero or low-interest rate to commercial banks for providing a ‘soft loan’ to energy end-user. EERF was allocated the total initial fund from ENCON Fund which was 12,332 million baht (MB) [7].

Target was designed for only DF&Bs at the early of first phase [3] and then were expanded for non-DF&Bs, ESCOs, and new buildings [7]. Government established EERF, for enhance EE implementation
by enabling energy end-user to access funding with low-interest rate for being upfront cost. Low-interest rate instrument helps to reduce the friction of investment decision of energy end-users. In addition, commercial banks are also aimed to receive capacity building on EE lending experiences [3].

Maximum loan is 50 MB per project that was initial designed for medium-sized investments [3]. Eligible measures are EE/RE that payback period is no longer than seven years. Interest rate was initial designed not more than 4% flat rate for banks’ management fee and risk associated cost, [3]. In phase 6, DEDE has assigned the interest rate as not more than 3.5% to encourage more EE investment. In practice, banks have provided interest rate with not more than 3.5% effective rate for five years loan [8]. Government has provided the principal fund with 0.5% interest rate since phase 3. Banks assess financial potential by using ‘assets-based’ practice that requires strong balance sheets and collaterals [3]. Program contractor, hired by DEDE, assess technical potential of projects, conducts the measurement and verification (M&V) for selected measures, and manages administration tasks. Approval process requires duration of two months, which banks and DEDE need one month each [7]. Loan fund is released from ENCON Fund through DEDE to banks within one month. Banks provide loan to borrowers, with grace period up to one year. Borrowers repay principal with interest to banks. Banks repay principal and interest to DEDE within seven days after receiving from customer. For risk management, DEDE allows bank to terminate contract for defaulted project and start a new contract with commercial interest rate. DEDE will fine banks with 14% when late repayment occurring [3].

Performance from phase 1-5 shown that EERF enhanced EE/RE investment for 295 projects. Total stimulated investment was 15,959 MB, which EERF allocated 7,205 MB. EERF supported to generate energy cost savings of 6,806 MB and energy consumption reduction of 320 ktoe/year. In phase 6, EERF has supported for 162 projects by the allocated fund around 2,909 MB.

### Table 2. EERF performance

| Promoting year | Unit | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Total | Phase 6 |
|----------------|------|---------|---------|---------|---------|---------|-------|--------|
|                |      | 2003-   | 2006-   | 2007-   | 2009-   | 2010-   |       | 2015-  |
| No. of projects| Projects | 78      | 85      | 104     | 11      | 17      | 295   | 162    |
| EERF budget    | MB    | 2,000   | 2,000   | 2,942.5 | 400     | 500     | 7,842.5 | 4,489  |
| EERF allocation| MB    | 1,902   | 1,805   | 2,853   | 383     | 262     | 7,205 | 2,909  |
| Total investment| MB   | 3,427   | 3,536   | 6,388   | 1,272   | 1,336   | 15,959 | n/a    |
| Energy cost savings| MB  | 1,394   | 1,415   | 1,092   | 1,053   | 1,852   | 6,806 | n/a    |
| Energy savings| ktoe/y | 97.6    | 102.45  | 98.01   | 13.21   | 8.73    | 120   | n/a    |
| No. of banks | Banks | 6       | n/a     | n/a     | n/a     | 13      | 8     | 8      |
| Interest rate to banks | % p.a. | 0%     | 0%     | 0.5%   | 0.5%   | 0.5%   | - 0.5% | 0.5% |
| Interest rate to borrowers | % p.a. | 4%     | 4%     | 4%     | 4%     | 4%     | - 3.5% | 3.5% |

* for phase 1-5

b as of September, 2018

2.2. Energy Service Company Revolving Fund (ESCO Fund)

ESCO Fund was designed for providing various financial instruments for mitigating EE/RE financial barriers. ESCO Fund was allocated the total initial fund of 2,000 MB from ENCON Fund. There are six instruments which two main instruments are equity investment for RE and equipment leasing for EE/RE, with further venture capital forESCOs, carbon credit facility, credit guarantee facility and technical assistance. EE projects are supported via equipment leasing instrument, which is analyzed in this paper.

Equipment leasing for EE/RE measures was designed to be ‘soft loan’ by using associated EE/RE equipment as collateral and company’s authorized director as guarantor [9]. Public provides initial fund for being upfront cost and allows using savings as repayments. DEDE has developed ESCO Fund to encourage low collateral proponents’ opportunity by transforming from ‘assets-based’ to ‘project-based’ assessment, which public takes risk on defaults. The maximum loan size is 20 MB per company and interest rate is 3.5% flat rate for five years loan, at the final phase. Both equipment cost and associated cost, which is not higher than 20% of total cost including such as engineering fee, installation cost, O&M cost, M&V cost, and insurance fee, are eligible [9]. Grace period for both principal and interest
delayed-repayment is up to six months [9]. Eligible projects must be implemented with EPC guarantee by ESCOs, which ESCOs will be charged when shortfall of energy savings occurring.

In addition, ESCO Fund also aims to promote ESCOs’ services to be high quality and acceptable by energy end-users [9]. ESCOs are one of beneficiaries which they are supported initial fund for implementing shared-saving projects or arranging finance for guaranteed-saving projects. Fund managers are responsible for both financial and technical assessments, complementing with marketing, project coordination, legal, accounting, and database tasks. According to ‘project-based’ basis, strict technical assessment is needed to minimize default risk [4]. Approval process is conducted through 3 steps, in-house fund manager committee, DEDE’s working group, and Investment Committee (IC) that requires about four months [9]. The IC, comprising qualified persons from both public and private sectors, appointed by DEDE, and chaired by DEDE Director General, will approve granting investment and regulate fund managers. Borrowers have to repay principal and interest to fund managers within five years. Fund managers charge performance-based management fees within promoting period as up to 25 MB. For monitoring period, they can charge the expenses up to a half of received investment return. ESCO Fund was allocated 1,119 MB for implementing 148 projects, with stimulating total investment of 6,121 MB. It leads to reduce energy consumption of total 66.67 ktoe/year.

**Table 3. ESCO Fund performance**

|                      | Unit  | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Total   |
|----------------------|-------|---------|---------|---------|---------|---------|
| Promoting Year       | -     | 2008–2010 | 2010–2013 | 2013–2014 | 2015–2017 |         |
| Monitoring Year      | -     | 2010–2015 | 2013–2018 | 2015–2020 | 2017–2022 |         |
| ESCO Fund budget MB  | MB    | 500.00  | 500.00  | 500.00  | 500.00  | 2,000.00 |
| ESCO Fund allocation MB | MB   | 314.74  | 471.67  | 161.85  | 170.83  | 1,119.09 |
| No. of projects      | Projects | 32      | 69      | 26      | 21      | 148     |
| Total investment MB  | MB    | 3,512.69 | 2,058.80 | 179.85  | 369.84  | 6,121.18 |
| Energy savings ktoe  | MB    | 20.61   | 30.73   | 2.20    | 13.13   | 66.67   |
| Interest rate        | -     | 4%      | 4%      | 4%      | 3.5%    | -       |

2.3. **Demand Side Management Bidding (DSM Bidding)**

DSM Bidding is performance-based EE investment subsidy, which the subsidy is granted based on actual energy saving generated in a year at the requested rate [10]. This program was implemented in 2016-2017. DSM Bidding was allocated budget from ENCON Fund which is the total of 512.13 MB.

The program was established to encourage energy end-users for implementing EE measures and to raise technological confidence [10]. Investment subsidy instrument is used for increasing cost attractive of EE measures, which public supports some portion of cost, that mitigates resistance of EE investment. DSM Bidding mechanism allows public to support only that lowest requested subsidy price and not more than the setting ceiling. Widely implementation of EE measure according to cost attractive by investment subsidy enhances familiarity with EE technology, reducing market price, and actual energy savings illustration that is indirectly increasing technological confidence.

Energy end-users or ESCOs, who plan to install Light Emitting Diode (LED) lighting and high efficiency variable speed air conditioning, are eligible to bid their proposed incentive rate. There are two ceiling rates which are 1 baht/kWh savings for DF&Bs and 2 baht/kWh savings for non-DF&Bs [10]. ESCOs are eligible for applying when energy facility’s owner allowing, which the ceiling depends on type of energy facility. Bidder who proposed the lowest rate is granted first, then, higher rate is granted respectively. Maximum incentive size is 100 MB per company. Eligible project must have energy saving potential higher than 50,000 kWh per year. There are requirements for equipment’s certification for ensuring quality. Conducting M&V plan as provided guideline is requested.

Energy end-users submit the bidding proposal. Program contractor, who has been hired by DEDE, and DEDE’s working group handle bidding process, which is analysis and evaluation to their eligibility and proposed rate. Winning bidders are announced and signed contract with DEDE. Bidders implement EE measures and conduct M&V plan. Program contractor verifies M&V process for certify the achieved energy savings and releases the funding to bidders. The program typically takes around 12 months from the submission until funding is finally awarded or the proposal is finally rejected [10]. DSM Bidding
has supported to 201 projects. The total allocated budget was 168.42 MB. The program has generated energy savings of 11.62 ktoe or energy cost savings of 545.6 MB.

**Table 4. DSM Bidding performance**

| Unit        | Phase 1         |
|-------------|-----------------|
| Year        | 2016 – 2017     |
| No. of projects | Projects 201   |
| Budget      | MB 512.13       |
| Allocation  | MB 168.42       |
| Total investment | MB n/a         |
| Energy cost saving | MB 545.60   |
| Energy saving | ktoe/y 11.62   |

3. Discussion

Opportunities and challenges analysis of EE financial incentive programs are illustrated in this section. The programs are analyzed towards instrument design and operation process against the targets.

3.1. Energy Efficiency Revolving Fund (EERF)

Government provides credit line to commercial banks, which public has no risk of principal fund loss. Soft loan allows companies to decide to invest easier because it provides up-front cost with 3.5% effective interest rate that is lower than commercial rate of 6.5% effective rate. Suitable target is large company who has strong financial profile. Banks takes care for financial assessment and repayment process that helps public to reduce duty and budget, however, public still needs to take care for technical assessment and administration.

EERF is limited success to transform to be private EE financing, which commercial banks create own EE portfolio and take care throughout process. Customers take both technical and financial risks because the program does not require for Energy Performance Contract (EPC) and M&V, and banks will assign new interest at commercial rate for any default customer. The allowing five years lending period that is shorter than seven years payback period hinders final decision to invest EE measure. There is low dissemination of the program. ESCOs are limited access loan fund due to they are mostly small company and have weak financial profile.

3.2. Energy Service Company Revolving Fund (ESCO Fund)

EE equipment leasing is designed friendly for low collateral capacity companies, that financial assessment is based on technical feasibility. It mitigates high up-front investment cost barriers. According to strict technical requirements which are equipment certificate, EPC guarantee and standard M&V implementation, the program helps customers to reduce technical risk. There are best practices that are suitable for small company such as eligible project cost including both equipment cost itself and associated cost, no lending fee, grace period for both principal and interests up to six months, which can be replicated by financial institute who is designed to provide financing to limited financial capacity company. There is an opportunity for implementing new EE technology because the program uses project-based assessment, which it can be a case study for widely use and banks to provide a loan.

Government has to take risk on default projects to enhance financial access of low collateral capacity proponents. However, public can receive investment return at least 1.75% (a half of interest rate) which can be used to manage defaulted portion. Project cost is higher than purchasing equipment alone that it is including equipment, O&M, M&V and insurance costs to meet technical requirements. Equipment leasing is distractive by ESCOs due to they are reluctance to implement shared-saving guarantee for their customers. Further, the maximum loan fund is limited to 20 MB per company, which is only enough to implement small project at a time. The 3.5% flat rate for five years loan is equal to 6.54% effective rate, which it causes insufficient encouraging to implement EE project. There are some challenges about the process of the program, which are low program dissemination, long-time approval process, limited quality of ESCOs, high equipment quality and price requirements, and lack of standard M&V plan.
3.3. Demand Side Management Bidding (DSM Bidding)

DSM Bidding, performance-based subsidy, allows market mechanism to establish economical subsidy rate, which is more cost-effective than cost-based subsidy. Suitable target is strong financial companies who have capability to invest high up-front cost measures themselves. Suitable measures can be widely including simple measures until complex measures such as improving energy consumption throughout production process, which are required to implement with standard M&V for ensuring energy savings.

There are some challenges about the process that can be improved for the next phase. The openness of technology should not limit to only two well-known measures, which are LED lighting and variable speed air conditioning. The award payment at once after completing projects is not friendly for winning bidders when EE measures are high investment cost and complex technology. There is suggestion to be ensured that the total requested incentive should be over 1.2 times of budget for successful competitive bidding mechanism [5]. Ceiling should be improved each round according to such as previous average cost, present EE investment cost and other transaction cost.

4. Conclusion

For promoting EE investment, EERF, ESCO Fund and DSM Bidding were established. The emerging body of evidence of the programs offers an opportunity to improve our understanding of the EE promoting policy. Policy instruments are designed to mitigate EE implementation barriers, which they are designed to be suitable for type of energy end-users (large or small financial capacity) and for type of EE measures (complex or simple measure, new or well-known measure).

EERF is successful for providing financing to large company who has strong financial profile. EE measures are mostly well-known technologies. However, technical and financial risks bearing by customers, limit five years lending period, low dissemination of the program and limited access loan fund by ESCOs are still challenges. ESCO Fund is well-designed for low collateral capacity company. Strict technical requirements help to reduce technical risk. EE measures are openness from well-known to new technologies according to project-based analyzing basis. However, government has to take risk on default projects and 3.5% flat interest rate is insufficient to encourage EE investment. Low program dissemination, long-time approval process, limited quality of ESCOs, high equipment quality and price requirements, and lack of standard M&V plan are need to be improved. DSM Bidding can be designed for strong financial company and for wide-range EE measures from simple to complex measures. There are some challenges that can be improved, i.e., openness of technology, ensuring total requested incentive over 1.2 times of the budget and continuous ceiling improving each round.

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