

Thailand

## Promotion of Electricity Energy Efficiency Project

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Field Survey: August 2006

### 1 . Project Profile and Japan's ODA Loan



Map of project area



Heat condenser equipment installed at EGAT

#### 1.1 Background

The United Nations Framework Convention on Climate Change (UNFCCC) prescribes as a principle that all signatory countries “should take precautionary measures to anticipate, prevent or minimize the causes of climate change and mitigate its adverse effects” (Article 3, section 3). Developing countries are not exempt from this principle, and as Thailand signed the convention in December 1992, it is seeking to reduce greenhouse gases.

#### 1.2 Objective

The project's objective is to strengthen the capacity of the energy sector and related private businesses to supply energy-saving products and services by supporting demand side management for five years nationwide, thereby contributing to the promotion of energy saving, the reduction of global-warming gases and air pollution, the restraint of increases in power generation capacity, and the increase of economic benefits.

### 1.3 Borrower/Executing Agency

Electricity Generating Authority of Thailand (EGAT) (EGAT is guaranteed by the government of the Kingdom of Thailand)

### 1.4 Outline of Loan Agreement

Loan Amount/ Loan Disbursed Amount	2,800 million yen/ 1,425 million yen
Exchange of Notes/Loan Agreement	September 1993/September 1993
Terms and Conditions -Interest Rate -Repayment Period (Grace Period) -Procurement	3.0% 25 years (7 years) General untied
Final Disbursement Date	January 2002
Main Contractors	LEO BURNETT (Thailand), LINTAS THAILAND CO (Thailand), IAM INTER AIR SUPPLY (Thailand), MEE COMPANY LIMITED (Thailand),etc.
Consultant Services	N.A.
Feasibility Study (F/S), etc.	N.A.

## 2 . Evaluation Result

### 2.1 Relevance

#### 2.1.1 Relevance at the time of appraisal

In 1992, the Energy Conservation Promotion Act was enacted, which prescribed the promotion of energy saving. In the same year, the Enhancement and Conservation of the National Environment Quality Act came into effect, and this act required that a wide range of environmental impact assessments (EIA) be conducted. However, it was predicted that this requirement would lengthen the time needed for developing electric power sources, and so ways were sought to reduce the demand for electric power. Meanwhile, a technical committee concerned with the global environment prepared a national report in 1992 which concluded that demand side management would be the most cost-effective measure for reducing CO<sub>2</sub>. In light of this, the project is judged to have been relevant.

### 2.1.2 Relevance at the time of evaluation

The project is considered to have increased in relevance since the time of the appraisal, from the following three perspectives.

#### (i) International policy

Thailand ratified the UNFCCC in December 1994 and put it into effect in March 1995. Moreover, Thailand ratified the Kyoto Protocol to the United Nations Framework on Climate Change in August 2002 and put it into effect in February 2005. The protocol requires all countries which are party to it to “formulate [and] implement programmes containing measures to mitigate climate change” (Article 10(b)).

As the main objective of the project is to reduce greenhouse gases in Thailand, the relevance of the project has further increased since the time of the appraisal due to the ratification of the above documents.

#### (ii) National policy

The Energy Conservation Promotion Act went into actual effect, clearly positioning demand side management as a domestic system. During the 8<sup>th</sup> National Economic and Social Development Plan (1997-2001), an energy development plan was prepared, and in it, promotion of implementation of demand side management was stipulated. Furthermore, in the 9<sup>th</sup> National Economic and Social Development Plan (2002-2006), energy conservation and economical usage are stipulated.

Due to the impact of the Asian currency crisis, growth in the demand for electric power temporarily dropped, but growth in demand subsequently resumed as the economy recovered. Meanwhile, selection of new sites for power plants is becoming increasingly difficult due to the growth of residents' movements.

#### (iii) This project

The Global Environment Facility (GEF) was established through the initiative of the World Bank to assist global environment conservation measures in developing countries using “new and additional” funds, and the trial operation phase was from 1991 to 1994. This project was implemented with the objective of “global warming countermeasures,” which are a target of GEF.

The role of GEF is to locate projects and provide seed money to promote initiatives of various institutions. This project provides an ODA loan together with cofinancing by a GEF grant from the World Bank which includes a grant from the Australian government, in addition to funds from Thailand. Through this, the Japanese government has established a record of contribution to GEF.

## 2.2 Efficiency

### 2.2.1 Outputs

This project is cofinanced by Thai funds, the ODA loan, and GEF. The programs implemented using the ODA loan are as follow.

#### (i) Commercial and public sector

- Improvement of efficiency in energy-saving and air-conditioning equipment
- Manufacture and usage of energy-saving lights
- Installation of heat condenser equipment at the EGAT headquarters for demonstration purposes (additional)

#### (ii) Household sector

-Implementation of advertising concerning energy saving on TV, radio, and posters in trains. (At the time of appraisal, implementation of this advertising was undecided, and EGAT decided to implement it after the start of the project.)

#### (iii) Other

- Development of related monitoring equipment and computer systems

The following programs were implemented with funds from sources other than the ODA loan.

#### (i) Industrial sector

- Promotion of purchases of energy-saving motors

#### (ii) Commercial and public sector

- Conversion of street lights to sodium lamps.

#### (iii) Household sector

- Promotion of conversion from incandescent bulbs to small fluorescent bulbs.
- Promotion of switch to low-loss stabilizers
- Display of energy efficiency on air conditioners' and refrigerators' labels
- Holding of seminars
- Display of the Green Learning Room<sup>1</sup> all over Thailand to educate and inform

#### (d) Other

- Establishment inside EGAT of the Demand Side Management Office (DSMO) to be in charge of this project
- Establishment of an electronic and electric research center to study energy-saving electrical equipment

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<sup>1</sup> A facility set up in borrowed space at elementary schools, etc., for displaying exhibits related to energy saving and for holding lectures and games targeted mainly at kindergarteners and elementary school students.

- Establishment of facilities to test energy efficiency at the Thai Industrial Standards Institute and the Metropolitan Electricity Authority
- Technical guidance for small and medium companies

### 2.2.2 Project period

The loan agreement was signed in September 1993, and the entire ODA loan program was completed in December 2002. So, the actual period was 8 years 4 month, which is 152% of the planned period. Moreover, the period of the overall project was 9 years 4 months, from July 1993 to December 2002. The reasons for the extension are as follow.

- (i) More time than initially anticipated was required for the plan preparation and implementation because the overall shape of the project was not clear at the time of the appraisal and the content of the programs was decided progressively after the start of the project.
- (ii) Growth in demand for energy-saving equipment declined due to the economic crisis
- (ii) There was a delay in the contract signing for a project to improve air-conditioning efficiency in hotels

### 2.2.3 Project cost

The total project cost overall was 6,637 million yen (31% of planned cost). The fund sources were as follow: Thai funds, 3,519 million yen (21% of plan), World Bank grant, 1,693 million yen (98% of plan), and ODA loan, 1,425 million yen (51% of plan).<sup>2</sup>

The reasons for the decline in project cost below the amount of the original plan are as follow.

- (i) Initially, in accordance with the policy of the World Bank, it was planned to grant economic incentives such as discounts to businesses to promote manufacture and purchase of high-efficiency products. However, because the project was altered after it started to emphasize informational and educational activities, the majority of the funds earmarked for use as incentives became unnecessary.
- (ii) It was assumed that a large number of foreign experts would be hired, but subsequently the number hired was reduced in accordance with the government policy.
- (iii) Initially, funds were earmarked at the request of the World Bank for implementation of detailed monitoring and evaluation of each program; however, in actuality the items to be monitored were reduced and the programs were evaluated using secondary data, etc.

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<sup>2</sup> Because EGAT expresses all project costs in US dollars calculated at a fixed exchange rate of 1US\$ = 112 yen, the same practice was adopted in this report. If the project cost is recalculated using the average exchange rate in each year, the total cost is 6,663 million yen (31% of plan), and the Thai funds are 3,535 million yen (21% of plan).

## 2.3 Effectiveness

### 2.3.1 Energy-saving effects according to EGAT

According to EGAT, 1,704.8 GWh of energy saving and 304.7 MW of demand restraint were promoted in 1997, and production of CO<sub>2</sub> in 1997 was reduced by 1.259 million tons. The forecast at the time of appraisal for CO<sub>2</sub> reduction in 1998 was 1.16 million tons, and so this means that Thailand achieved its goal one year early. At the end of 2002 when the project was complete, 4,163.9 GWh of energy saving and 735.7 MW of demand restraint were promoted, and production of CO<sub>2</sub> in 2002 was reduced by 3.077 million tons.

Table 1: Actual Energy Saving and Demand Restraint ( as of 1997 and 2002 )

Year	Energy Saving (GWh)		Demand Restraint (MW)	
	1997	2002	1997	2002
Household	1,698.56	4,152.4	303.8	732.8
Commercial	4.8	10.3	0.7	2.7
Industrial	1.2	1.2	0.2	0.2
Total	1,704.8	4,163.9	304.7	735.7

source: EGAT Project Status Report

Following the completion of this project as well, energy-saving electrical products were sold, gradually replacing the old type of products, and continued increases are expected in the amount of energy saving and the amount of reduction in CO<sub>2</sub>. According to EGAT, 5,533.4 GWh of energy saving and 999.8 MW of demand restraint were promoted during the one-year period of 2004, thereby reducing CO<sub>2</sub> by 4.08 million tons.

### 2.3.2 Observations related to energy-saving effects

Since emphasis was transferred from granting incentives for businesses to informational and educational activities, a large amount of the credit for achievement of the objective lies in the success in switching to energy-saving models of lights, refrigerators, and air conditioners in the household sector. The commercial and industrial sectors fell far short of the original goal because the changes in those sectors were limited to replacement of streetlights and small motors.

According to EGAT, of the 3,610 GWh of energy saved by switching to energy-saving models as of the end of July 2000, a total of 99.4% was contributed by the household sector, with 65.8% from lights, 14.8% from refrigerators, and 18.8% from air conditioners.

A major factor in large achievement in energy savings was the switch to energy-saving models of household electrical appliances by the manufacturers, and so it is probably

incorrect to attribute all of the energy saving to the household sector. Moreover, the main manufacturers of household electrical appliances in Thailand are Japanese and European companies which are riding on the energy-saving trend of the developed countries, and so not all of the energy-saving effects stated in the statistics can be claimed as effects of this project.

The World Bank estimated the effects of the project separately from EGAT. In EGAT's calculations, energy-saving effects of all programs (e.g., informational and educational activities) are added, but the World Bank conservatively utilizes as data only the sales volume figures for lights, refrigerators, and air conditioners. Furthermore, the World Bank estimated the net effects of this project up to 2010 by establishing two scenarios, one in which energy saving progresses satisfactorily in Thailand (high baseline) and one in which it does not progress well (low baseline) even if the project is not implemented (Table 2).

Table 2: World Bank Estimate of Energy Saving and CO<sup>2</sup> Reduction

Year	High Baseline		Low Baseline	
	Energy Saving (GWh)	CO <sub>2</sub> (Mt)	Energy Saving (GWh)	CO <sub>2</sub> (Mt)
1997	1,324	979	1,448	1,070
2002	1,936	1,430	3,056	2,258
2004	2,578	1,905	4,337	3,205
2010	3,747	2,584	7,427	5,488

\*The high baseline posits conservative assumptions regarding the project's effects, and the low baseline posits optimistic assumptions regarding the project's effects

source: World Bank Post-implementation Impact Assessment

The objective of the project is reduction of CO<sub>2</sub>, but there is no market for CO<sub>2</sub>. Even if a price for CO<sub>2</sub> were to be hypothetically set, the potential bases are broad, from 655 yen per ton of CO<sub>2</sub>, which is the environment tax rate proposed by Japan's Ministry of Environment in 2005, to US\$25 to \$30 (equivalent to 3,000 yen to 3,600 yen at 120 yen/US\$), which is the social cost of CO<sub>2</sub> emissions reported by Her Majesty's Treasury in the UK in 2006. Consequently, it is difficult to calculate the benefit and IRR of the project.

### 2.3.3 Qualitative effects

The following energy-saving measures were implemented by this project.

- (i) Through the establishment of the DSMO, EGAT's capacities for study, evaluation, and management related to energy saving were strengthened. Moreover, test facilities for

energy efficiency were set up at the Thai Industrial Standards Institute and the Metropolitan Electricity Authority.

- (ii) Production was switched from the conventional T12 fluorescent tubes to the energy-saving T8 fluorescent tubes. Labels that indicate the energy efficiency of refrigerators and air conditioners were introduced. Thus, manufacture and sales of energy-saving equipment was promoted.
- (iii) The experiences of this project were introduced in developing countries such as India, Sri Lanka, and Vietnam through a joint undertaking by the World Bank and the United Nations Development Programme (UNDP).
- (iv) After the project, it was decided to introduce the Minimum Energy Performance Standards ( MEPS ) in which the Ministry of Energy prescribes minimum standards for energy efficiency of electrical equipment. In 2005, MEPS was applied to air conditioners.
- (v) Public awareness was raised by setting up and running the Green Learning Rooms and by the publicity gained for them using the mass media.
- (vi) The test system for energy-saving equipment is being implemented as planned.

## 2.4 Impact

### 2.4.1 Effects CO<sub>2</sub> reduction and informational and educational activities

In 2002, the year the project was completed, emission of CO<sub>2</sub> was reduced by 3.077 million tons accompanying the reduction in usage of fossil fuels.

When Thammasat University conducted an interview study commissioned by EGAT of 3,000 residents in 2000, 86.9% of the residents were aware of the project. With regard to the television commercial broadcast by this project, 44.7% of the residents were aware of it, and of those, 72.2% thought it resulted in energy-saving activity.

### 2.4.2 Reduction of air pollutants

Accompanying the restraint in the usage of fossil fuels, there was a reduction in air pollutants emitted from thermal power plants, such as dust, SO<sub>x</sub>, and NO<sub>x</sub>. The World Bank estimates that there was a reduction of 5,600 to 7,800 tons of SO<sub>x</sub> as a result of energy saving due to the introduction of energy-saving models of lights, refrigerators, and air conditioners during the period from 1993 to 2004.

### 2.4.3 Reduction of electricity fees

In the implementation of the project, 3,129.26 million bahts were spent up to July 2004, but through this, there was a reduction in electricity fees equivalent to 13,833.5 million bahts.



## 2.5 Sustainability

### 2.5.1 Operation and maintenance system

The full-time staff of the DSMO was increased from 44 persons in 1993 when the project began to 177 persons at the beginning of 2000. In addition, domestic and foreign consultants and external experts were hired. With this type of employment system, an organizationally flexible response was enabled by deploying the different types of expertise and human resources which were required in each implementation stage of the various programs.

A DSMO Sub-committee was set up independent from EGAT as an organ to supervise the implementation of the project. However, the Sub-committee was discontinued when EGAT was placed under the authority of the Ministry of Energy in 2004.

### 2.5.2 Financial status

EGAT consistently enjoyed a financial surplus, but in 2005 it posted a net loss of 170 million bahts, in a sudden change from a net profit of 30.5 billion bahts the previous year. The cause was that EGAT was not permitted to engage in the usual method of sales, where automatic fee adjustments are made so that increases in oil prices are reflected in the sales price of electric power. Since EGAT is permitted to reflect the 4-month oil price forecast in electricity fees starting from October 2005, so there should be no difficulties henceforth.

When the project was initially implemented, DSMO's active funding source was the fuel tax adjustment fund. When this system was abolished in 2000, a budget of 300 million bahts or less was disbursed from EGAT's electricity income as a funding source, and in 2005, DSMO's 5-year planned budget for 2006 to 2010 was approved.

### 2.5.3 Operation and maintenance status

The programs involving the ODA loan in this project were completed as of the end of 2002. The heat condenser equipment installed at EGAT by the ODA loan is being properly managed and operated. Among the programs included in this project, the Green Learning Room was the last to be closed, in 2004.

Following the conclusion of the project, informational and educational activities conducted in the civic sector are actively continuing. Heretofore, 424 Green Learning Rooms have been set up, and it is planned to increase them by 10 per year henceforth. Moreover, products with labels indicating energy efficiency are expanding the usage of fans and rice cookers.

To study consumer awareness, a questionnaire study was implemented by mail (mailed

to 1,000 persons, returns received from 160 persons; response rate of 16.0 %) in the ex-post evaluation (2006). The results are shown on Table 3 together with the results of a study in 2000 containing the same questions on residents' energy-saving behavior.

Table 3: Results of Questionnaire Study on Residents' Energy-saving Behavior  
(unit: %)

	2000	2006
Turn off lights immediately when finished using them	87.4	93.1
Consider the energy-efficiency label when purchasing household electrical appliances	80.8	86.3
Turn off the TV when doing other things.	57.5	45.0
Unplug household electrical appliances after using them.	63.4	61.3

It can be seen that residents' energy-saving behavior is generally being maintained or is improving following the completion of the project. However, it cannot be instantly concluded that this is a result of the project.

The outcome of the project is reduction of the production of CO<sub>2</sub>, and the outputs depend on how this affects society. From this perspective, all fluorescent lights are being switched to the high-efficiency type, and refrigerators and air conditioners are also being steadily switched to the high-efficiency type. Henceforth, it seems unlikely that electrical products would revert to the low-efficiency type. It is clear that consumer awareness has also improved, and further ripple effects can be expected from the project. In other words, the sustainability of the outcome can be considered to be high.

### 3 . Feedback

#### 3.1 Lessons Learned

This project, which was a pioneering project with no precedent, was focused on informational and educational activities, with the main objective of reducing CO<sub>2</sub>. The project started with no models or guides, but it ended successfully.

Meanwhile, it seems that the World Bank did not have a strong sense of ownership toward the project. The World Bank's Bangkok Office did not seem to possess detailed information. Given the likelihood that efficiency would have improved even more if the World Bank had displayed a stronger sense of ownership and if the collaboration between JBIC and the World Bank had been closer, it is likely that JBIC could have accumulated

information related to formation and operation of GEF projects and could have contributed to the formation of the next project.

## 3.2 Recommendations

### 3.2.1 Recommendations for the ex-post evaluation of the ODA loan

The chief aim of this project was to educate residents and to popularize energy-saving products. Naturally the criteria for efficiency and sustainability in this project differ from those in conventional ODA loan projects that build infrastructure. In projects such as this one, in some cases it is likely to be necessary to be flexible enough to recognize at the time of the ex-post evaluation the changes that may have been made in the scope of the project during the implementation. Even supposing that DSMO were to disband, the reduction in CO<sub>2</sub>, which is the outcome of the project, will be sustained henceforth as long as the public's and companies' awareness of energy saving is well rooted and as long as energy-saving electrical products are available in the marketplace. There is also the possibility that the effect of announcing the outcome will lead to further improvement of it. Study is also required concerning regular use of IRR as a criterion.

It is also likely that adjusting the form of the JBIC ex-post evaluation to suit the nature of the project would produce evaluation results of greater relevancy.

### 3.2.2 Recommendations for GEF

Japan is in fact one of the top donors to GEF, and there is an extremely large potential for ODA loans to contribute in this area. However, because GEF project formation primarily involves pioneering projects, it is not easy to participate with ODA loans, which seek to apply established technology. There is also the technical issue of the difficulty involved in coordinating the project cycle with the ODA loan.

Because this project was promoted in the form of multiple sub-programs implemented independently and in parallel by the respective donors, it was fortunate that coordination among the donors was not particularly necessary. However, considering future needs, it is necessary for the Japanese government to improve the ODA loan mechanism to facilitate coordination with GEF, and at the same time, efforts are necessary on the part of GEF to make institutional revisions so as to facilitate coordination with other bilateral donors, including ODA loans.

### Comparison of Original and Actual Scope

Item	Plan	Actual
1. Output	Total: 21,168 million yen Household sector: 8,288 million yen Commercial sector: 4,379 million yen Industrial sector: 2,105 million yen DSMO set-up and operation: 1,680 million yen Other: 4,716 million yen	Total: 6,637 million yen Household sector: 583.5 million yen Commercial sector: 269.9 million yen Industrial sector: 289.0 million yen DSMO set-up and operation: 1,385.7 million yen Energy-saving PR: 2,731.7 million yen Other: 1,377.2 million yen
2. Project Period ODA loan portion	January 1993 – June 1998	September 1993–December 2002
3. Project Cost		
Foreign Currency	4,536 million yen	3,118 million yen (3,128 million yen)
Local Currency	16,632 million yen	3,519 million yen (3,535 million yen)
Total	21,168 million yen	6,637 million yen (6,663 million yen)
ODA Loan Portion	2,800 million yen	1,425 million yen
Exchange Rate	US\$ 1 = 112 yen Local currency was also dollar-denominated	US\$ 1 = 112 yen (Figures in parentheses are amounts recalculated at US\$1=112.5 yen as the weighted average in the year of disbursement)