

**Document of
The World Bank**

FOR OFFICIAL USE ONLY

Report No: 21510

IMPLEMENTATION COMPLETION REPORT
(TF-28637; TF-21221)

ON A

GLOBAL ENVIRONMENT FACILITY GRANT

IN THE AMOUNT OF SDR 6.9 MILLION

TO THE

KINGDOM OF THAILAND

FOR A

PROMOTION OF ELECTRICITY ENERGY
EFFICIENCY PROJECT

DECEMBER 28, 2000

**Energy and Mining Sector Unit
East Asia and Pacific Region**

This document has a restricted distribution and may be used by recipients only in the performance of their official duties. Its contents may not otherwise be disclosed without World Bank authorization.

CURRENCY EQUIVALENTS

Currency Unit	Thai Baht (B)
	=
US\$ 1.0	= B 40.0
B 1.0	= US\$0.025

FISCAL YEAR

October 1 September 30

ABBREVIATIONS AND ACRONYMS

ASTAE	-	Asia Alternative Energy Program
CFL	-	Compact fluorescent lamp
CO ₂	-	Carbon dioxide
DEDP	-	Department of Energy Development and Promotion
DSM	-	Demand-side management
DSMO	-	Demand-Side Management Office
ECF	-	Thai Energy Conservation Promotion Fund
EGAT	-	Electricity Generating Authority of Thailand
ENCON Act	-	Energy Conservation Promotion Act of Thailand
ESCO	-	Energy service company
GEF	-	Global Environment Facility
GOA	-	Government of Australia
GWh	-	Gigawatt-hour (one million kilowatt-hours)
IIEC	-	International Institute for Energy Conservation
IMEA	-	Independent Monitoring and Evaluation Agency
IRP	-	Integrated resource planning
JBIC	-	Japan Bank for International Cooperation
MEA	-	Metropolitan Electricity Authority
MOD	-	Memorandum of the Director
MW	-	Megawatt (1,000,000 watts)
NEPO	-	National Energy Policy Office
OECF	-	Overseas Economic Cooperation Fund of Japan
PEA	-	Provincial Electricity Authority
SME	-	Small and medium enterprise
TISI	-	Thailand Industrial Standards Institute
TRC	-	Total Resource Cost
UNDP	-	United Nations Development Program

Vice President:	Jemal-ud-din Kassum
Country Manager/Director:	Jayasankar Shivakumar
Sector Manager/Director:	Yoshihiko Sumi
Task Team Leader/Task Manager:	Jas Singh

CONTENTS

	Page No.
1. Project Data	1
2. Principal Performance Ratings	2
3. Assessment of Development Objective and Design, and of Quality at Entry	3
4. Achievement of Objective and Outputs	5
5. Major Factors Affecting Implementation and Outcome	9
6. Sustainability	12
7. Bank and Borrower Performance	13
8. Lessons Learned	15
9. Partner Comments	16
10. Additional Information	16
Annex 1. Key Performance Indicators/Log Frame Matrix	19
Annex 2. Project Costs and Financing	20
Annex 3. Economic Costs and Benefits	22
Annex 4. Bank Inputs	23
Annex 5. Ratings for Achievement of Objectives/Outputs of Components	25
Annex 6. Ratings of Bank and Borrower Performance	26
Annex 7. List of Supporting Documents	27
Annex 8 ICR Mission Aide-Memoire	28
Annex 9 Beneficiary's Project Completion Report	34
Annex 10 Borrower Comments	44
Map: IBRD No. 23925R	

This document has a restricted distribution and may be used by recipients only in the performance of their official duties. Its contents may not be otherwise disclosed without World Bank authorization.

Project ID: P004647
Team Leader: Darayes Bahadur Mehta

Project Name: GEF-ELECTRICITY EGY
TL Unit: EASEG

ICR Type: Core ICR

Report Date: December 28, 2000

1. Project Data

<i>Name:</i>	GEF-ELECTRICITY EGY	<i>L/C/TF Number:</i>	TF-28637; TF-21221
<i>Country/Department</i>	THAILAND	<i>Region:</i>	East Asia and Pacific Region
<i>Sector/subsector:</i>	PY - Other Power & Energy Conversion		

KEY DATES

		<i>Original</i>	<i>Revised/Actual</i>
<i>PCD:</i>	06/10/91	<i>Effective:</i> 08/15/93	07/30/93
<i>Appraisal:</i>	12/03/92	<i>MTR:</i> 03/05/96	03/05/96
<i>Approval:</i>	04/07/93	<i>Closing:</i> 12/31/98	06/30/2000

Borrower/Implementing Agency: EGAT
Other Partners: OECF/JBIC, Government of Australia

STAFF	Current	At Appraisal
<i>Vice President:</i>	Jemal-ud-din Kassum	Gautam Kaji
<i>Country Manager:</i>	Jayasankar Shivakumar	Callisto E. Madavo
<i>Sector Manager:</i>	Yoshihiko Sumi	Vineet Nayyar
<i>Team Leader at ICR:</i>	Jas Singh	Darayes Bahadur Mehta
<i>ICR Primary Authors:</i>	Adam Hinge (Consultant) and Jas Singh	

2. Principal Performance Ratings

(HS=Highly Satisfactory, S=Satisfactory, U=Unsatisfactory, HL=Highly Likely, L=Likely, UN=Unlikely, HUN=Highly Unlikely, HU=Highly Unsatisfactory, H=High, SU=Substantial, M=Modest, N=Negligible)

Outcome: HS
Sustainability: L
Institutional Development Impact: H
Bank Performance: S
Borrower Performance: S

	QAG (if available)	ICR
<i>Quality at Entry:</i>		S
<i>Project at Risk at Any Time:</i>	No	No

3. Assessment of Development Objective and Design, and of Quality at Entry

3.1 Original Objective:

In 1993, the World Bank, in conjunction with the Global Environment Facility (GEF), approved the Thailand Promotion of Electricity Energy Efficiency Project. The Project had two major objectives: (a) to build sufficient institutional capability in the Thai electric power sector and the energy-related private sector to deliver cost-effective energy services throughout the economy; and (b) to pursue policies and actions that would lead to the development, manufacture and adoption of energy efficient equipment and processes within the country. The main GEF objective in funding the Project was to demonstrate on a large scale, and within a reasonable time frame: (i) the potential for electricity savings to replace substantial fossil fuel power generation, thereby avoiding additional CO₂ (NO_x and SO₂) emissions; and (ii) the capacity of the electric power sector and other relevant agencies, public and private, to achieve those savings. The broader, global objective was to generate among utilities in other developing countries a similar commitment to undertake large-scale demand-side management (DSM) programs.

The Project, which was to be implemented by the Demand-Side Management Office (DSMO) within the Electricity Generating Authority of Thailand (EGAT), consisted of a five-year DSM Plan, with a budget of US\$189.0 million. The Project had a four-pronged approach: (a) to provide user and manufacturer incentives and consumer education to influence practices and attitudes towards energy-efficient technologies; (b) to develop efficiency standards and testing capabilities to exercise control and monitor efficiency improvements; (c) to develop and promulgate building and appliance codes in order to enforce minimum efficiency standards; and (d) to continue pursuing technological improvements and their adaptation to Thai conditions.

The objectives and approach were appropriate, and were intended to demonstrate the potential for capturing cost-effective energy efficiency savings potential (with resulting fossil fuel savings and emissions reductions) through utility-based DSM activities. The original project plan was based on DSM experience in other parts of the world, most specifically North America, and was intended to test/demonstrate whether these DSM concepts could be successful in developing regions as well. Thailand, with a rapidly growing demand for energy, was an appropriate candidate for testing such a model for potential replication in other Asian countries.

3.2 Revised Objective:

No revisions.

3.3 Original Components:

The Project comprised a five-year DSM Plan (1993-97) with targets of 238 MW in peak reduction and cumulative annual energy savings of 1,427 GWh, which corresponded to 1.16 million tons of carbon dioxide (CO₂) emission reductions.

The Project was designed with the following elements: (a) creating a DSMO within EGAT to implement DSM programs; (b) developing and implementing technological and market intervention strategies in the residential, commercial and industrial sectors; (c) developing financial mechanisms to assure the market adopts the various energy efficiency programs; (d) promulgating codes and standards to support efficient equipment; (e) establishing testing laboratories; (f) developing project evaluation and monitoring systems and protocols; (g) developing and training energy management companies and DSM program contractors; (h) integrating supply-side and demand-side planning in the electricity planning process; (i) developing a direct utility load control program; and (j) undertaking special studies as needed.

3.4 Revised Components:

The DSMO did not revise the original project components per se. However, the program priorities and strategies developed during project preparation were modified during implementation to better reflect the Thai context. For example, instead of providing direct financial incentives for end-users to customers as envisioned during appraisal, the DSMO's implementation strategy focused on voluntary negotiations with manufacturers combined with aggressive public awareness and marketing campaigns to transform targeted end-use markets to higher efficiency models, as well as bulk distribution of high-efficiency products and other information dissemination activities (e.g., labeling, energy audits, demonstrations, data collection/analysis, etc.). The implementation arrangements¹ were expanded in 1997 to include and leverage additional support from MEA, through the IBRD-supported Metropolitan Distribution Reinforcement Project, to take advantage of MEA's existing customer base, brand name recognition and strong electric power engineering expertise.

During project preparation, it was envisaged that EGAT would engage consultants for specific assignments to support its activities and analyses. After a number of assignments were completed, the DSMO became increasingly frustrated with the significant resources required to assist consultants to understand the background and context for its programs and to ensure that the consultant outputs were sufficiently customized to meet EGAT's program needs. Therefore, in late 1997, the DSMO proposed a scheme, which the Bank approved, to hire several full-time advisors to conduct many of the assignments in-house with DSMO staff in order to reduce consultant costs, improve transfer of know-how to the DSMO and improve the quality and relevance of the outputs. The recruitment of these advisors was a challenge, but the results were favorable, with the aggregate program evaluation report, integrated resource planning (IRP) program development, management of the ESCO pilot project development and other tasks all completed in-house, at a low cost and with a very high quality.

The Project was extended twice (March 18, 1998 and October 12, 1999) and closed on June 30, 2000, one-and-a-half years later than the original Closing Date.

Assessment of Design

The original project design was based on the recommendations of a UNDP GEF-supported, Bank supervised pre-feasibility study for a large-scale utility energy conservation program conducted by an international non-governmental organization (the International Institute for Energy Conservation, IIEC), based on experience with DSM in North America. This was an appropriate starting point for the project design, since no other tested models existed at the time. However, once project implementation began, the DSMO became aware that the Western strategies for DSM had to be appropriately modified to better suit Thai conditions. This took time and resulted in initial implementation delays. The Bank actively supported EGAT's modifications to DSM program approaches, showed patience and allowed considerable flexibility to the DSMO in this regard. Once the Bank and EGAT agreed on modified strategies and program plans, progress improved dramatically.

Given the lack of similar large-scale DSM programs in other developing countries at the time of preparation, the project design was comprehensive and well-formulated. Although the project objectives of – introducing changes in the power sector, the private sector, and consumer

¹ The initial project design proposed a larger implementation role by the distribution utilities, MEA and PEA. However, they showed minimal interest during project preparation, thus EGAT accepted the lead role. EGAT's ability to develop a successful and vibrant program eventually led both distribution utilities to participate in selected programs that met shared interests; PEA with the street lighting program and MEA for load research, equipment testing, energy service company (ESCO) services and load control.

purchasing practices, all in one project to be done by a relatively new institution unfamiliar with DSM – were ambitious, they were largely achieved. Responsibility for promulgating building codes and equipment standards may have been inappropriately assigned to the DSMO, though their implementation was nevertheless achieved during the project period due to the DSMO's active follow-up with concerned agencies. The MOD also proposed an ambitious implementation schedule, expecting the DSMO to launch several programs simultaneously, while developing new program plans, baseline scenarios, evaluation plans and developing in-house skills. However, recognizing the importance to gain initial experience, develop staff skills, and refine intervention strategies, the situation was remedied by EGAT and the Bank agreeing on a revised timetable. This allowed the DSMO to design and implement pilot DSM programs and launch full-scale efforts once initial experience was gained.

The Project appropriately proposed the setting up of a DSM Sub-Committee to exercise oversight and improve coordination and cooperation among the concerned Thai agencies (EGAT, NEPO, DEDP, MEA, PEA). In practice, this Sub-Committee served a useful purpose. However, the informal nature of the Sub-Committee (a Thai culture model) may have limited its abilities to ensure adequate coordination and resolve interagency disputes and the Sub-Committee exercised little clout in enforcing its decisions. The Project would have benefited if stronger linkages were established at the start between EGAT's DSM program and the Energy Conservation Promotion Act (ENCON Act) and its agencies. This would have improved EGAT's access to Energy Conservation Promotion Fund (ECF) financing for its commercial and industrial programs and reduced overlapping efforts and competing initiatives among agencies. However, it is recognized that such linkages in the early years would have limited EGAT's autonomy to proactively pursue its various DSM initiatives.

During project negotiations, the GEF requested that the Project include funds for an Independent Monitoring and Evaluation Agency (IMEA) to review EGAT's program impacts and assess the validity of their estimates. While the rationale was clear, the IMEA position was perceived by the DSMO to be "culturally incongruent," with international consultants appearing to be evaluating the DSMO rather than just the program impacts. Since the project funds were allocated to EGAT under the Grant Agreement, EGAT signed the contract with the IMEA and, as a result, the IMEA reported to EGAT when it may have been more appropriate for the IMEA to report to the DSM Sub-Committee, World Bank or GEF. During project implementation, EGAT decided to hire international consultants to perform much of the evaluation work, which resulted in the IMEA assessing other international consultant reports, which was not anticipated during project preparation. Future projects should carefully consider the need for independent evaluation and, if necessary, develop suitable contractual and reporting arrangements at the start.

4. Achievement of Objective and Outputs

4.1 Outcome/Achievement of objective:

Overall, EGAT has met its DSM Program objectives of creating substantial institutional capability within the DSMO to design, implement and evaluate DSM programs and achieving increased supply and adoption of high-efficiency equipment in Thailand. EGAT created an institution in the DSMO which evolved from 40 staff initially, to a peak level of over 200 trained and skilled staff. EGAT has worked effectively with several other Thai agencies, such as the Ministries of Health and Education, the Bangkok Metropolitan Administration, MEA and PEA, to jointly develop programs that meet shared goals. The DSMO also fostered public/private partnerships with manufacturers, DSM contractors, ESCOs and electricity consumers to support its program efforts. And, the DSMO is widely recognized in Asia and worldwide for its innovative programs, such as its Green Leaf, Green Learning Room, and public campaigns, as well as its strong management and capable staff.

After initial modifications in the strategic approach, EGAT has developed a strong and significant portfolio of 19 DSM programs (see Section 10, Table 2 for detailed descriptions) suited to Thai conditions and culture, demonstrating the viability of DSM in an Asian context. EGAT has contributed to significant energy savings, which have been verified, under a cost-effective program portfolio; such outputs and criteria have been unmatched by ongoing initiatives under the ENCON Act. EGAT has developed one of the largest and most successful DSM Program supported by the GEF, compared with the smaller albeit successful GEF-supported DSM programs in Jamaica, Mexico and Sri Lanka. The Project has clearly demonstrated that substantial electricity savings can be achieved on a large scale through utility DSM programs and such programs can be effectively delivered by local utilities and other agencies/private firms. The demonstration and catalytic effects are also evident. The Program was expanded in 1997 to involve the Bangkok distribution utility, MEA, and a portion of the project funds were allocated to MEA to help them initiate their own DSM programs, which complemented EGAT's efforts, under the IBRD-supported Metropolitan Distribution Reinforcement Project. EGAT's ESCO development activities have directly led to a follow-on proposed GEF operation (the ESCO Development Project) that would seek to remove barriers to expanded commercial financing of energy efficiency investments. This operation is expected to offer affordable project financing for energy efficiency investments and directly support the development of an ESCO industry in Thailand as well as support EGAT's ongoing Green Buildings Program and industrial audits. Additionally, the experience gained by EGAT in its early years of implementation contributed towards improving the designs of the IDA/GEF-assisted DSM component of the Sri Lanka Energy Services Delivery Project and the Swedish International Development Agency (Sida)-sponsored DSM Project in Vietnam, managed by the Bank under the IDA-supported Transmission, Distribution and Disaster Reconstruction Project. It should be noted, though, that the broader GEF goal of encouraging other countries to undertake large-scale utility-based DSM programs was only marginally achieved. A major constraint has been the fact that many utilities in the region are undergoing an unbundling and privatization process, which is altering the rationale for utilities to undertake such initiatives.

EGAT has fully met and significantly exceeded its energy savings targets based on verified evaluation figures (see Annex 1). The Project also met and exceeded the global environmental objectives that were established. The MOD had set a target of 1.16 million tons of CO₂ reduction, at a cost of approximately US\$8.2 per ton for the GEF funds. Final project results showed CO₂ reduction of 2.32 million tons at a cost of only US\$4.2 per ton for the GEF funds, due to the higher achieved energy savings than originally projected.

4.2 Outputs by components:

Substantial results were obtained from EGAT's DSM program portfolio. Annex 1 shows the evaluated results of EGAT's first five programs, which have resulted in a 566 MW reduction in peak demand and energy savings of 3,140 GWh/year, more than double the original targets of 238 MW and 1,427 GWh/year, although it should be noted that the actual project period was six-and-a-half years versus the five year original implementation period. These do not include several other DSM programs launched to date, for which evaluated savings could not be or have not yet been determined. More importantly, a number of key end-use markets have been permanently transformed and the Thai public has become significantly more aware of energy conservation and efficiency issues. Thus the overall assessment of the project outputs is rated as highly satisfactory.

While these overall Program results have been positive, results from individual programs have been mixed. Some programs, such as the fluorescent tube and refrigerator programs, were highly successful, with significant savings at a relatively low cost. The energy savings from the fluorescent tube program were so high, that impacts from this program alone exceeded the MOD

targets for the entire Project. Other programs, such as the motor and low-loss ballast programs, did not achieve expected results during the project period, although EGAT plans to revise strategies and re-launch these programs in its next 5-year plan based on experience gained during the Project.

Residential Sector: EGAT's residential customer DSM programs were largely successful and accounted for the majority of program impact figures. These programs were well-suited to EGAT's public campaigns, were considered cost-effective and largely met their individual program impact targets. This was in part due to the fact that several of the earlier programs promoted equipment with a relatively low or negligible incremental cost for the higher-efficiency models. Key achievements include:

- Market share of T-8 "thin tube" fluorescent lamps grew from 40 percent at the program launch to 100 percent in 1997, resulting in a peak reduction of 388 MW and annual energy savings of 1,892 GWh;
- Increase in market share of "level 5" single-door refrigerator models (through labeling) from 2.3 percent to 100 percent, reducing the peak demand by 84 MW and energy use by 849 GWh/year and contributing to a 21 percent reduction in overall refrigerator energy consumption;
- Growth in "level 5" air conditioner sales (using appliance labels) from 19 percent to 38 percent during project period, resulting in a peak reduction of 84 MW and cumulative annual energy savings of 318 GWh;
- Over 900,000 compact fluorescent lamps (CFLs) sold during project period at 40 percent below the prevailing market price (without direct subsidy); and
- 59 brands of brown jasmine rice, which require about 40 percent less energy to process than white rice, have been labeled and promoted.

Commercial/Industrial Sector: Overall, impacts from the commercial buildings and factory programs were less successful than the residential activities. One major barrier was the lack of viable financing mechanisms to follow-up EGAT's energy audits and consultations. Key program results included:

- 252 commercial and industrial energy audits conducted, energy management systems demonstrated in customer premises, and four commercial building demonstration projects implemented;
- Four pilot ESCO projects developed, fully prepared and financing now under negotiation, which are expected to lead to the first energy performance contracts in Thailand;
- 14 demonstration investments implemented in pre-defined end-uses for small and medium enterprises (SMEs);
- Over 86 hotels audited, six hotel seminars conducted and 59 hotels rated with "Green Leaf" certification;
- A 350 kW demonstration thermal storage facility constructed and being tested for commercial viability; and
- MEA's motor testing laboratory constructed and operational.

Public Sector: The street lighting program resulted in the installation of 275,000 high-pressure sodium vapor (HPS) lamps throughout the country and have saved 17 GWh/year. Over 200 Green Learning Rooms, an education module in primary and secondary schools, were constructed and are now operational. A follow-up evaluation of students that had been trained using this educational tool found that over 98 percent were aware of energy conservation issues and the link between energy use and the environment.

Institutional/Evaluation: EGAT completed comprehensive evaluations of conservation, load management, and attitude creation programs to assess their impacts and effectiveness. Also, during the project period, the DSMO established key informational databases, such as end-use profiles from EGAT, end-user profiles from MEA, a five-year IRP review of sector-specific DSM measures and their relative potentials and costs, and an integrated tracking database system for DSM program data (e.g., program participants, equipment data, energy consumption profiles, administration costs, evaluation results, etc.). The IRP efforts provided substantial improvements to the DSMO's planning techniques and considerably more rigor in the program screening, design and development process.

Project Components Financed By Other Sources

EGAT provided about US\$31.66 million for DSM program expenses, largely from the automatic tariff mechanism (Ft). The majority of these funds were used to support public campaigns and DSMO administration costs and the balance was used for certain program expenses not covered by the other project funds.

GOA provided AUD8.5 million (US\$5.4 million) for DSMO program support, which was managed by the Bank. The funds, which were fully utilized, supported EGAT's and MEA's load research programs, MEA's testing laboratory, MEA's ESCO business unit, and several consulting assignments and studies to support the DSM Program.

OECD/JBIC provided a JY2.8 billion (US\$25 million) concessional loan to EGAT to support DSM efforts, although only about 48.5 percent has been disbursed to date. Funds have been used to support construction of EGAT's pilot thermal storage facility, laboratory testing equipment for TISI, computer systems and public relation activities.

4.3 Net Present Value/Economic Rate of Return

The overall cost effectiveness of the Project, when calculated through the standard DSM total resource cost (TRC) analysis methodology, resulted in a benefit-cost ratio of 1.7, indicating that the program was economically attractive. When measured by this TRC Test, the net present value of savings of all the programs, over the life of the measures included, was over US\$144 million (5.75 billion Baht). If the value of reduced CO₂ is included, at a cost of \$50/ton, the net present savings increases to US\$763 million (30.52 billion Baht). Although there was no aggregate TRC ratio estimated at appraisal, it can be assumed that the actual returns substantially exceeded appraisal estimates, since twice as much energy was saved at roughly one-third the cost. It should be noted that these actual results are conservative estimates, as these only include benefits from the five evaluated programs but costs of all EGAT programs launched to date, many of which had substantial, unquantified benefits or savings that have not yet been determined.

While the overall results were favorable, it was observed that individual program TRC ratios differed substantially from appraisal estimates. A major factor for this difference was the assumption at appraisal that EGAT would follow the U.S. model of offering direct financial incentives to program participants and would be assessed on a resource acquisition basis. Instead, EGAT employed market transformation strategies which had lower avoided cost benefits to EGAT but higher societal benefits and more sustainable energy efficiency results. Another reason was the change in peak period during the Project, which significantly reduced the coincidence factors of many of the programs designed for residential use, thus decreasing peak reduction benefits to EGAT. The CFL and street lighting programs had unfavorable TRC results, in part, due to the unique nature of these programs, and may have been better assessed using alternative economic analyses. It was concluded that the street lighting program, which served as a demonstration program only, was not cost-effective and should not be replicated or expanded

without modifications to the program approach. (Annex 3 contains a comparison of TRC ratios at appraisal and actual results. A full discussion of the cost-effectiveness issues is contained in EGAT's DSM Program Evaluation Report, October 2000, available in the Project file.)

4.4 Financial Rate of Return

N/A.

4.5 Institutional Development Impact

The institutional development impact of this Project has been significant. A very strong institutional capacity has been developed within the DSMO, probably the strongest in any region outside of North America. From an initial level of 40 staff with limited DSM expertise, EGAT now has over 176 dedicated, trained DSM professionals in place as well as 166 long-term contractors. The Project has developed a strong planning, implementation and evaluation capability within EGAT as well as some DSM capacity within MEA. Based on capability and experience gained during the Project, EGAT has developed its next 5-year DSM plan, based on its detailed IRP analyses, which includes substantially more sophisticated analyses of future DSM plans along with technical and cost-effectiveness potentials and savings targets for future efforts. EGAT's generation system planning process now includes a provision from DSM program savings.

The Project also include significant provisions for training. Rather than formal training courses and workshops, as expected during project preparation, EGAT included training tasks under each consulting assignment, to allow DSMO staff to have hands-on training and more learning-by-doing, which helped activities initiated by the consultants be sustained and expanded by the DSMO. Selected training activities were also implemented by the resident advisors while completing in-house assignments, which was very effective. Also, with support from the Bank's Asia Alternative Energy Program (ASTAE), a utility DSM twinning program was implemented in 1996, where four DSMO staff worked in a DSM group in two U.S. utilities (in Portland, Oregon and Austin, Texas) for three months, with very positive results.

Outside the utility sector, substantial progress has been achieved in improving private sector interest and capabilities to provide energy efficiency products and services. EGAT's manufacturer negotiations fostered improved domestic manufacturer awareness and capability to produce higher efficiency appliances and other products. Through the pilot ESCO program, the first four ESCOs in Thailand were established and the first energy performance contracts are expected to be signed shortly, though implementation of these investment projects did not occur during the project period. EGAT successfully worked with TISI to improve local testing capabilities, increasing the capacity ranges and end-uses that can be tested, and supported MEA's construction of a new testing facility for motors and ballasts. EGAT's attitude creation programs have significantly increased consumer awareness in energy efficiency, with its labeling programs among the most well-recognized product labels in the country. EGAT's effective labeling programs have led to the proposed introduction of mandatory energy efficiency equipment standards by NEPO for six key end-uses, which are now expected to become effective in 2002-3. Although outside EGAT's purview, energy efficiency building codes were developed and enacted for both commercial and industrial facilities. Finally, commercial building and hotel owners/managers have become more aware of energy efficiency issues associated with their business operations.

5. Major Factors Affecting Implementation and Outcome

5.1 Factors outside the control of government or implementing agency

The 1997 Asian financial crisis had a major adverse impact on the implementation and outcome of the Project. Projected load growth and consumption, which EGAT used to determine the

initial targets and savings projections, did not anticipate the reduced energy use and operating times that resulted during this period. The crisis also reduced the viability of some of EGAT's planned initiatives, which had to be put on hold or cancelled, such as the New Buildings Program due to the depressed real estate market, and several load management programs due to the post-crisis power capacity surplus. The economic recession severely dampened equipment sales, which was the basis for many of EGAT's programs. For example, sales of fluorescent tubes showed steady increases from 1993 to 1996 (48 million in 1996) but then decreased significantly after 1997 (30 million in 1998), less than half of EGAT's projected sales volume for that year. Also during this period, large industrial and commercial end-users became increasingly focused on their core businesses and the investment climate for energy efficiency was severely diminished. The combination of the high non-performing loan portfolios in the local banking sector and the lack of creditworthy customers during this time period significantly reduced the potential for meaningful energy efficiency investments in the DSMO's programs in these sectors. While maintaining its overall commitment to the DSM Program, circumstances required that EGAT's management temporarily tailor the DSMO's efforts to suit the severe financial constraints imposed by the Government and its dwindling revenues; all in an environment when the country was anxiously awaiting growth in demand as a sign of economic recovery. The fact that the DSMO management was able to maintain forward progress during this difficult period, and accomplish the level of savings that has been documented, is remarkable.

The shift in EGAT's peak period from the evening hours (6pm-9pm) to the afternoon (2pm-5pm) also affected the expected program impacts. During appraisal, many of the initial programs selected were designed to target residential uses to affect a reduction in the evening peak demand. Once this shift in peak period to the afternoon was realized, the estimated coincidence factors for many of the programs were substantially reduced, effectively reducing the avoided cost of supply benefits for these measures. The street lighting program, for example, was designed to contribute to a peak load reduction, but did not result in any avoided capacity after the shift in peak period.

A third factor was the introduction of imported, low quality CFLs into the Thai market. These lamps, which had a much lower average operating life, severely affected public perception with CFL technology and became a major barrier to EGAT's CFL program. EGAT was eventually able to overcome this problem by active testing and labeling of the lamps, but not before severe damage to CFL public confidence and a substantial delay in program implementation was experienced.

5.2 Factors generally subject to government control

While the Government was generally supportive of the DSM Program and EGAT's efforts throughout, specific directives by the DSM Sub-Committee to concerned agencies could have led to a better coordinated program and enhanced program results, particularly with the programs designed to mobilize ECF resources to promote energy efficiency investments in the commercial and industrial sectors. The result is that all three energy efficiency agencies (NEPO, EGAT, DEDP) have had some overlapping or even competing initiatives (i.e., equipment labeling, audits), which has resulted in an inefficient use of government resources and created some confusion among consumers. The limited coordination between EGAT and DEDP, in particular, as well as structural problems with DEDP's audit program, caused unnecessary delays and affected program performance and results. As long as all three agencies have some responsibilities for energy efficiency programs, there is a substantial need for a clear delineation of roles and responsibilities in the future.

5.3 Factors generally subject to implementing agency control

While EGAT generally managed the DSM Program well and assumed a very high level of ownership throughout the Project, certain aspects could have been improved. The DSMO's process for identifying program priorities and designing appropriate promotional strategies lacked

a systematic and rigorous approach in the initial years, although it is noted that the DSMO has improved its capability in the DSM planning process significantly as demonstrated in its IRP report. Until 1999, there had been no formal program evaluation to identify areas within the program design process that could be improved. EGAT has now completed a comprehensive evaluation of its initial programs and has incorporated its findings into future program plans. The late findings, however, did not allow sufficient feedback to improve program implementation during the project period. EGAT was only partially successful in developing and testing new program strategies, often relying on early approaches such as manufacturer negotiations and labeling, which were insufficient for more complex end-use markets with higher incremental costs, such as ballasts and motors. As a result, EGAT was unable to achieve significant progress on these latter programs. EGAT's commercial and industrial programs had limited impacts due, in part, to a lack of viable financing sources to follow-up EGAT's energy audits and consultations. Such programs did not lend themselves well to the public campaigns and required more customized support, which was more difficult for EGAT to provide.

While the DSMO management was generally very strong and proactive, there were five managers over the seven year project period, which affected program implementation and continuity. These management changes did contribute to the limited progress on many of the DSM programs in the latter years, although much of this slow down resulted from EGAT's financial position after the 1997 crisis. Also, had MEA and PEA showed greater interest and involvement in the Project's early years, customer recruitment and participation may have been further improved.

Financial Operations and Reporting

The DSMO charged eligible expenditures against the project grant in accordance with the grant conditions. Program expenditures which could not be reimbursed from the grants/JBIC loan were covered by the Ft. Consequently, revenues and expenditures in the Statement of Revenues and Expenditures have generally been on balance. However, in FY98, the DSMO was required by the Auditor to report a deficit when it could not account for all inventoried equipment, much of which was undergoing testing and demonstrations in customer premises. After an internal investigation was conducted, over 96 percent of the equipment was accounted for and the FY00 accounts were adjusted to reverse the deficit, with the outstanding funds covered by the Ft. EGAT management has taken several actions to prevent such occurrences in the future and the Bank is satisfied with the resolution of this issue.

The results of operations and the assets and liabilities of the DSMO are aggregated in the Financial Statements of EGAT, however, a separate report and audited statements are prepared to show its financial position and results of operation in accordance with the grant agreement. The balance sheets and the Statement of Revenues and Expenditures for the accounting periods, FY93-97 were audited by the Auditor General and submitted to the Bank. The financial statements, which were audited in accordance with generally accepted accounting principles and standards, were given unqualified opinion by the auditors. The financial statements for FY98-99 were received and the findings of the report were reviewed by the Bank and found to be in accordance with the grant agreement requirements. However, the audited financial statements including the auditor's opinion for the FY98 and FY99 audits have not yet been certified by the Auditor General in view of the Auditor's requirement to consolidate the reporting of MEA's DSM account with that of DSMO. The consolidation is now underway and the report will be submitted to the Bank shortly.

5.4 Costs and Financing

As noted in Annex 2, the overall program costs were US\$59.3 million, about one-third of the US\$189 million estimated at appraisal, with much of the reduction from the counterpart funds that were to be raised through the Ft and other government sources (e.g., ECF). Much of this reduction in investment can be attributed to the shift in implementation strategy, from direct

customer incentives to manufacturer negotiations, labeling and promotions, which have inherently lower costs. As a result, direct program costs were generally much lower than planned and promotion costs much higher. EGAT was also driven to reduce DSM expenses during the recovery period after the financial crisis. Overall results were very positive, with EGAT requiring one-third the expected resources to achieve twice the impacts.

It should be noted that the total Program investment would have been much higher had EGAT been able to mobilize additional ECF and/or commercial resources for its commercial and industrial programs. The total reported investment also does not include the estimated \$8-10 million currently being negotiated for EGAT's pilot ESCO projects as these negotiations were not concluded within the project period, although completion is expected within the coming months. These additional investments would have generated additional energy savings and other Project benefits. It is also expected that these investments could have improved the overall cost-effectiveness ratios, since the total Project costs include some development costs for these programs but few benefits since many of these investments were never made. Thus while EGAT still implemented a cost-effective DSM program, there was scope for EGAT to implement a larger investment program with higher energy savings and a potentially higher overall TRC ratio.

6. Sustainability

6.1 Rationale for sustainability rating

Sustainability of the DSMO and its activities has been a matter of great debate over the latter years, due largely to impending power sector and EGAT restructuring plans, EGAT's eventual privatization as well as the recent decision to eliminate DSM funding through the tariff adjustment². EGAT commissioned a study to review options for sustaining the DSM activities through the restructuring period and has made recommendations to EGAT management, the DSM Sub-Committee and NEPO in this regard. EGAT has also prepared a Five-Year (2001-2005) DSM Plan based on recommendations of its IRP study, with targets of 612 MW in peak load reduction and annual energy savings of 3,949 GWh at a cost of about 1.5 billion Baht, with program funding to be made available through EGAT's base tariff and the ECF. NEPO has agreed in principle to support EGAT's DSM efforts through the ECF during this period. Institutionally, NEPO and EGAT have reached agreement, which has also been supported by a Cabinet Resolution, for the DSMO to remain under EGAT until the successful commissioning of the power pool (about 2004)³. Under this plan, the DSM divisions would remain intact and be combined with EGAT's Research and Development Office around 2002. These developments bode well for the medium-term sustainability of EGAT's DSM Program. MEA's DSM business units (testing laboratory and ESCO unit) are likely to remain functional until such time as they can be reasonably spun-off as non-core business groups, in accordance with current restructuring plans. However, neither has yet proven its marketability nor commercial viability at present and sustainability of MEA's program will heavily depend on their operations over the next 1-2 years.

Sustained operation of the DSMO, at least under the current arrangements, after the next few years is less certain. Once the power pool is operational, government energy policy officials and

² The New Base Tariff structure approved by the Government with effect from October 1, 2000 consisted of an Ft-inclusive average base tariff and a revised Ft calculation. The Ft was re-based to zero from October 1, 2000 and allowed for the automatic pass through for variations in energy charge, foreign exchange, and inflation. DSM expenses were removed from the Ft formula.

³ EGAT's proposed privatization plan calls for three-stages: (i) transitional phase, to commercialize EGAT and privatize selected thermal generation (completed); (ii) corporatization of thermal Genco, where EGAT would establish a subsidiary thermal Genco and separate grid and power purchase functions (2001-3); and (iii) commencement of power pool, where EGAT would assume a minority shareholder of the thermal Genco, establish power pool rules and operate the transmission, hydropower and power pool systems (2004 onwards).

the national regulatory commission, yet to be created, will have to determine appropriate longer-term arrangements for the DSMO. At present, it is proposed that the DSMO may be spun-off into an independent service provider and implement programs to support public and private measures on a fee-for-service basis. Other options are likely to arise and receive consideration during this period.

6.2 Transition arrangement to regular operations

Despite the end of the GEF Project and depletion of grant funds, the DSMO continues to operate and the 176 staff positions remain. With the expected availability of the ECF to support future operation and clearer institutional arrangements over the near term, it is expected that the DSM programs initiated under the Project will be sustained and new programs launched in the coming years. However, given the longer-term changes proposed to the electric power sector and eventual privatization of EGAT, it is recommended that the World Bank continue to monitor DSM program activities in its dialogue with the government in order to help ensure the sustainability of the DSMO programs and capabilities strengthened under the Project. This can be accomplished under the next proposed GEF operation, but will be increasingly difficult as the Bank phases out its energy sector lending in Thailand.

7. Bank and Borrower Performance

Bank

7.1 Preparation

The Project was proposed based on the findings of the UNDP GEF study, conducted by IIEC, to assess the feasibility of launching a national DSM program in Thailand. Given the Bank's active involvement in the sector and its strong established relationship with EGAT, it was proposed that the Bank manage this operation. The Bank's participation, along with the GEF grant resources provided, were critical elements to gather Government support for this Project. Thereafter, the Bank provided appropriate inputs to adequately prepare the Project.

7.2 Supervision

Since this was among the first GEF DSM projects to be implemented, and it had a unique demonstration objective for neighboring countries, the Bank provided intensive supervision to this Project, with 1-2 missions per year over the seven-year project period, with appropriately staffed teams. During the early years of implementation, the Bank provided substantial support to the DSMO by offering extensive technical support and guidance and allowing the DSMO considerable flexibility to move forward with its programs, which was critical to the Project's success. The supervision resources were more than expected at project appraisal, which can be attributed to the one-and-a-half year extension of the Closing Date. The supervision team also helped mobilize support through ASTAE for the Thai/U.S. utility DSM twinning program, translation of a Thai DSM CD-ROM into English, and implementation of an ESCO Business Practices Workshop in Bangkok in 1999.

While the intensity and the extent of the supervision efforts may be deemed highly satisfactory, there were some areas where the Bank could have done more. A number of key recommendations were stressed by the Bank missions to improve overall project performance, such as expediting implementation of the low-loss ballast and high-efficiency motor programs and more systematic and timely program and evaluation plans, but the Bank team could have better ensured that these recommendations were adequately addressed. Another issue noted during supervision was the limited coordination among relevant Thai agencies on energy efficiency programs and the Bank team could have been more proactive in this regard, although it was recognized that the Bank had limited influence with these other agencies, particularly DEDP.

7.3 Overall Bank Performance

With the exception of a few key areas that could have been more forcefully addressed, the Bank performance would have been considered highly satisfactory, with its strong guidance, support and flexibility, and was well appreciated by EGAT. Taking into consideration the aforementioned shortcomings, overall Bank performance for the Project is rated satisfactory.

Borrower

7.4 Preparation

Since the DSMO was only getting started during project preparation and was generally unfamiliar with DSM planning techniques, substantial inputs into the project design may not have been possible by EGAT. Had EGAT been able to provide more inputs at the project design stage, some early implementation delays may have been avoided. Given the lack of interest and support offered by MEA and PEA, EGAT showed and provided considerable support to preparation activities and shouldered the added burden.

7.5 Government Implementation Performance

Generally, the Government performance was satisfactory and it offered considerable support to the Project, setting up the DSM Sub-Committee to coordinate project activities, providing for funding through the Ft, and through parallel activities such as the development of energy efficiency commercial and industrial building codes and equipment standards. NEPO offered considerable support to the DSMO in order to approve DSM program plans in the Sub-Committee and improve government support for the Project, although coordination among other members of the government's DSM Sub-Committee could have been strengthened further. The ENCON Act agencies inability to provide ECF funds to support several of the DSMO's activities requiring substantial capital investments limited program impacts in these areas and, as a result, some energy savings opportunities were missed.

Given the substantial tasks and issues relating to the ongoing sector restructuring efforts, sustainability of the DSMO was not given as much attention as it should have been by the government/EGAT, which contributed in some measure to greater uncertainty in the latter years. However, it was difficult for the Government to propose a viable long-term institutional plan for future DSM operations, given the very limited range of successful models from other countries to sustain DSM efforts in a post-restructured power sector. Nevertheless, NEPO has been very supportive of the DSMO's efforts and pledged to ensure that DSM operations continue after the Project.

7.6 Implementing Agency

With the exception of a few programs that achieved limited results, of which some were outside the DSMO's control, EGAT's performance has been highly satisfactory. The DSMO was successful in adapting the Western DSM concept to local conditions and cultural realities. Specifically, EGAT's public campaigns and voluntary agreements with manufacturers were customized to match Thai culture and values, and the delivery channels for energy-efficient products and information were well-suited to Thai preferences. The DSMO showed considerable proactivity during the Project and has implemented several very successful and innovative initiatives. EGAT's ability and resolve to sustain DSM programs during and after the financial crisis was also exceptional. And, EGAT significantly exceeded the established savings targets and did so at a much lower cost than expected.

The Project would have benefited further from more systematic planning of programs by the DSMO. Earlier program evaluation would have allowed the DSMO to refine its program strategies and could have resulted in higher impacts than achieved. The DSMO could have been more successful in improving implementation results for a few of its programs, such as motors

and ballasts, though its future plans, supported by the IRP study, have sufficiently addressed these initial deficiencies. EGAT could have done more to work with DEDP and NEPO to mobilize ECF funds for its Pilot ESCO and Green Buildings Programs.

7.7 Overall Borrower Performance

For much of the program, EGAT's performance was considered to be highly satisfactory, showing strong commitment, innovation and a results-oriented approach. However, considering some of the performance shortcomings noted previously, overall EGAT performance for the Project is rated satisfactory.

8. Lessons Learned

The above analysis of project implementation suggests that the key lessons learned from the Project are:

DSM programs should be designed with due consideration of local cultural realities to ensure high consumer acceptance and participation and to achieve meaningful impacts (*Sections 3.4, 4.1, 7.6*).

Mechanisms for transfer of competency and skills should be carefully assessed to determine appropriate use of consultants and consider short as well as longer term assignments to maximize effectiveness (*Sections 3.4, 4.5*).

Project designs should carefully consider the need for independent evaluation and, if necessary, develop suitable contractual and reporting arrangements from the start (*Section 3.4*).

DSM efforts should be linked with financing facilities to ensure that utility efforts, largely in the industrial and commercial sectors, can be followed-up with meaningful investments (*Sections 3.4, 4.2, 5.2, 5.3, 7.5, 7.6*).

Strong Bank support and flexibility are particularly critical elements for ensuring new types of projects are successful (*Sections 3.4, 7.2*).

Where multiple government energy efficiency programs including DSM exist, appropriate linkages should be developed to improve coordination and minimize potential overlaps (*Sections 3.4, 5.2, 7.5*).

Supportive government policies and agencies and proactive DSM cells are critical to the success of such activities (*Sections 4.1, 6.1*).

DSM programs should be established in the context of reforms to ensure sustainability, taking into account proposed institutional structures, pricing reforms, appropriate regulation and oversight, incentive and funding schemes, established customer relationships, etc. (*Sections 4.1, 6.1, 6.2*).

Well-designed and extensive DSM marketing can help programs achieve significant savings impacts at relatively low costs (*Sections 4.2, 4.3, 4.5*).

Where public purpose DSM programs have unquantifiable benefits, efforts should be made at the project design stage to determine appropriate measures for monitoring and assessment (*Section 4.3*).

Utility management should seek measures to better insulate DSM operations from ongoing staffing and institutional changes to ensure that operations, funding and strategic directions are maintained (*Section 5.3*).

9. Partner Comments

(a) Borrower/implementing agency:
See Annex 10.

(b) Cofinanciers:
None received.

(c) Other partners (NGOs/private sector):
None received.

10. Additional Information

Table 1. Key Studies and Consulting Assignments

Name of Assignment (<i>Contractor</i>)	Outputs/Results
1. IMEA (<i>Barakat & Chamberlin, USA; Hagler Bailly, USA</i>)	Reviewed program evaluation methodology, conducted independent metering and evaluation surveys, verified reported impact figures, provided general guidance on program planning and evaluation efforts.
2. End-Use Load Research (<i>Electric Power Research Institute, USA</i>)	Designed and delivered a turn-key end-use load research program which involved conducting an end-use metering benchmark study, developing in-house data storage and analysis functions, determining end-use and customer load profiles, providing substantial training on end-use metering and data analysis.
3. Renewable Energy Potential and Development Study (<i>AEA Technology, U.K.</i>)	Reviewed renewable resources and potential for commercial development, conducted financial assessments for various applications, developed recommendations and a proposed action plan for a national program, strategy and priority areas (Bank to discuss appropriate follow-up with NEPO/ EGAT).
4. Appliance Testing Laboratory Feasibility Study and Market Assessment (<i>KEMA, the Netherlands</i>)	Reviewed potential demand for appliance testing, determined feasibility for MEA facility, and specified testing equipment needs for lab operation (Lab now operational).
5. DSM Under a Privatized Electricity Supply Industry (<i>Convecton Consulting, N.A., USA</i>)	Benchmark study of restructured DSM programs in other countries, analysis of Thai funding/ institutional arrangements and proposed restructuring plans, proposed options for future DSM operations in Thailand.
6. Energy Conservation Program Evaluation (<i>AGRA Monenco, Canada</i>)	Conducted extensive surveys, interviews, market research, end-use metering and DSMO data to determine DSM program impacts, assess DSM program strategies, estimate program environmental impacts, and determine market penetration and impacts for five end-use programs.
7. Load Management Program Evaluation (<i>EDF, France</i>)	Estimated program impacts for three programs through interviews, surveys and metering to compare load shapes, assessed program strategies, recommended program enhancements.
8. DSM Attitude Creation Program Evaluation (<i>Thammasat University-RAC, Thailand</i>)	Provided qualitative and some quantitative evaluation of DSMO's marketing using extensive market surveys and focus groups.
9. Design of Tracking MIS (<i>T.N. Information Systems Ltd., Thailand</i>)	Developed a database warehouse architecture to integrate DSM program data (evaluation, load research, program data, equipment information, budgets and costs, etc.)

Table 2. EGAT's DSM Program Portfolio

Program	Sector	Program Description	Incentive Mechanism	Status/Results
Fluorescent Tube Lamps	Residential, Commercial, Industrial	Direct negotiations with 5 local manufacturers and one importer to completely switch production/distribution of T-12 (40 W/20 W) tubes to T-8 (18 W/36 W) lamps. TISI tested the lamp life and lumen output for each manufacturer to ensure consistent quality.	Public campaigns launched to educate consumers about the benefits of these "thin tubes" in exchange for the manufacturers' agreement to phase out production of T-12 lamps.	Program completed. Within one year, all manufacturers had completely switched production to T-8 lamps and the one importer complied shortly thereafter.
Refrigerators	Residential	Negotiation with 5 local manufacturers to initiate voluntary labeling scheme for single-door models. TISI tested models and provided labels to manufacturers directly. These labels have since been made mandatory and EGAT has expanded the program to include two-door models.	Large public campaign implemented to raise consumer awareness about the labels and to aggressively promote the level 5 label.	Market share of single-door level 5 models increased from 2% to 100% during program and 84% of all refrigerators sold are now level 5. Program has contributed to a 21% reduction of overall refrigerator energy consumption. Label requirements will be updated in 2001.
Air Conditioners	Residential, Commercial	Voluntary labeling of split and unitary (window) AC models for 55 domestic manufacturers. TISI tested the models and the DSMO provided the labels to the manufacturers.	Public campaign initiated to promote the labeled models. EGAT also offered interest-free loans to customers through local credit cards for the incremental cost of level 5 ACs and rebates to shop owners who sold level 5 models during promotional periods.	Market share of level 5 ACs increased from 19% to 38% during program period. EGAT hopes to reach agreement with manufacturers to make the label mandatory within the next few years.
Green Buildings	Commercial	Promotion of energy-efficient end-uses in existing commercial buildings, through energy audits, consultations, demonstrations and promotional activities. This program was designed to support DEDP's Compulsory Program, which requires audits and adherence to the building code in "designated buildings" (over 1000 kW demand).	Free energy audits, partially reimbursed by the ECF, and investment consultation for retrofit programs. EGAT also offered use of demonstration ELCONTROL energy management systems and provided interest-free loans for some demonstration projects.	The DSMO has conducted 252 commercial and industrial energy audits, installed 120 ELCONTROL systems in customer premises, and implemented four commercial building demonstration projects.
Compact Fluorescent Lamps (CFLs)	Residential, Commercial	Agreement with distribution outlets to sell CFLs from participating manufacturers. EGAT bore advertising costs of program and tested/labeled lamps to ensure consistent quality.	Bulk distribution and partnership with franchised retail outlets allowed substantial reduction in transaction costs.	Over 900,000 CFLs sold to date under program at 40% below prevailing market price.
Street Lighting	Municipal	Pilot program with PEA to procure and distribute high-pressure sodium vapor (HPS) street lamps to municipalities throughout Thailand.	Grant funds used to pay for higher incremental cost of HPS lamps to demonstrate technology.	275,000 lamps procured and installed with subsidy of 200 Baht per lamp. Future promotion contingent upon substantial reduction in local HPS costs.
Green Leaf	Commercial (hotels)	Audits and certification of energy-efficient hotels based on predefined measures; dissemination of information on energy efficiency and comprehensive resource management in hotels.	Free workshops and audits/certification for hotels. Results disseminated through national tourism publications.	Six seminars conducted, 86 audits conducted, 59 hotels rated. Six hotels received highest rating – 5 green leaves.

Table 2 (continued)

Program	Sector	Program Description	Incentive Mechanism	Status/Results
New Buildings	Commercial	Analysis of viability of all efficiency measures in buildings and support to construction companies for all viable efficiency measures that exceed building code requirements.	Demonstration buildings, technical assistance and possible financial incentives.	Program placed on hold after financial crisis and resulting dip in new building construction market.
Brown Rice	Residential, Agricultural, Education	Promotion of less energy-intensive and nutritional brown rice through advertising and labeling; distribution of brown rice in public school lunch programs.	Promotional campaign in partnership with Ministries of Health, Agriculture, Interior and Education.	59 brands of brown jasmine rice now receive labels. Evaluation of program is now underway.
High-Efficiency Motors (HEMs)	Industrial	Catalyzation of HEM market through testing/ labeling, demonstrations, information dissemination and manufacturer negotiations. Future efforts may include brochures on motor sizing, HEM payback periods and technical assistance for rewinding and drive systems.	EGAT-sponsored promotional campaigns, interest-free loans and demonstrations.	62 motors procured for demonstration/testing purposes, but only about four customers have purchased HEMs to date; motor testing lab now operational.
Low-Loss Ballasts	Commercial, Residential, Industrial	Promotion of low-loss magnetic ballasts through bulk distribution arrangement and through green buildings/industrial cost reduction programs. The program would promote new ballasts only and not retrofits of existing equipment.	Labeling and informational campaigns sponsored by EGAT.	Since 1997, about 545,000 number 5 labels were distributed to 11 manufacturers, although no promotion was done. The program is now on hold due to funding constraints.
Pilot ESCO	Industrial	Demonstration of ESCO concept through development of four pilot projects and dissemination of results.	EGAT bore development and audit cost for pilots and would seek an interest subsidy from the ECF.	Four investment grade audits completed. Negotiations with ECF, commercial banks and customers are underway.
Industrial Cost Reduction	Industrial	Similar to the Green Buildings Program, this program promotes retrofits and investments in industrial end-user premises.	Audits and technical advice is provided to participants as well as assistance in accessing ECF funding.	30 audits conducted to date. Future program will depend upon HEM and ESCO programs as well as availability of suitable financing facilities.
Small and Medium Enterprises (SME)	Commercial, Industrial	Preparation of action plan and workshop to support predefined efficiency measures in SME premises; proposed plan to include concessional ECF financing.	EGAT sponsored workshops, brochures and standardized applications for certain end-uses, concessional financing.	Fourteen demonstration projects conducted; negotiations with ECF underway for large-scale implementation and financing.
Load Management*	Commercial, Industrial	Voluntary programs to encourage load management through stand-by generation, interruptible load and time-of-use tariff schemes.	Participants are eligible for a concessional tariff scheme.	Although some 190 customers have expressed interest in participating, programs are on hold pending current capacity surpluses.
Thermal Storage	Commercial	Demonstration 350 kW thermal storage system was constructed on EGAT premises for testing and assessment of commercial viability.	Construction of demonstration facility.	Future promotion of technology is dependent upon financial viability, which is marginal at present.
Attitude Creation	Residential, Commercial, Industrial, Educational	Comprehensive portfolio of publicity campaigns for specific DSM measures as well as energy conservation in general through all media. Program also includes a Green Learning Room in public schools to educate students on the importance of energy conservation and the link between energy and the environment.	EGAT-sponsored public campaigns and advertising; grants to schools to support Green Learning Room equipment and training materials.	Substantial increased awareness for energy conservation; 87% of survey respondents are aware of energy efficiency issues; over 200 Green Learning Rooms now operational.

* Since these load management initiatives all involve tariff incentives, they were launched and are managed by NEPO, not EGAT. However, EGAT and the other utilities have provided some assistance in customer recruitment and the DSMO has evaluated some of these programs to determined the impacts and customer response.

Annex 1. Key Performance Indicators/Log Frame Matrix

Original Performance Indicators

Indicator	Projected in MOD	Actual*
Energy Savings (MWh)	1,427	3,140
Peak Reduction (MW)	238	566
CO ₂ emissions reduction (tons)	1,160,000	2,320,486

* It should be noted that the projected savings were based on a five-year implementation period whereas the actual savings are based on a six-and-a-half year project. Actual impact estimates are conservative as these are based on evaluation results from five energy conservation programs only (fluorescent tube lamps, CFLs, refrigerators, air conditioners and street lighting). Due to poor baseline data, program monitoring and a lack of confidence by EGAT and the IMEA in the load management evaluation consultant's conclusions, impact figures for the Green Buildings Program were not reported. Impacts from other programs launched since 1997 have also not been reported since these programs have not yet achieved full-scale implementation and have thus not been evaluated. (See EGAT's DSM Program Evaluation Report, October 2000 in the Project file for further discussion.)

Retrofitted Performance Indicators (as of February 1997)

Outcome / Impact Indicators:

Indicator/Matrix	Projected in last PSR	Actual/Latest Estimate
Energy savings by program: (a) Lighting (139 MW; 759 GWh/yr) (b) Refrigerators (27 MW; 185 GWh/yr) (c) Air conditioners (22 MW; 117 GWh/yr) (d) Green buildings (20 MW; 140 GWh/yr) (e) Motors (30 MW; 225 GWh/yr) (f) TOTAL (238 MW; 1,427 GWh/yr)	Energy savings by program: (a) 273 MW; 1,446 GWh/yr (b) 18 MW; 340 GWh/yr (c) 26 MW; 251 GWh/yr (d) 0 MW; 0 GWh/yr (e) 0 MW; 0 GWh/yr (f) 317 MW; 2,037 GWh/yr	Energy savings by program: (a) 399 MW; 1,973 GWh/yr (b) 84 MW; 849 GWh/yr (c) 84 MW; 318 GWh/yr (d) 0 MW; 0 GWh/yr (e) 0 MW; 0 GWh/yr (f) 566 MW; 3,140 GWh/yr
Carbon dioxide reductions by program: (a) Lighting (b) Refrigerators (c) Air conditioners (d) Green buildings (e) Motors (f) TOTAL (1,160,000 tons)	CO ₂ reduction by program: (a) 895,099 tons (b) 210,365 tons (c) 155,174 tons (d) 0 tons (e) 0 tons (f) 1,260,638 tons	CO ₂ reduction by program: (a) 1,457,807 tons (b) 627,365 tons (c) 235,314 tons (d) 0 tons (e) 0 tons (f) 2,320,486 tons
Program evaluation	Programs evaluated.	Programs evaluated.
Implementation of 4 pilot ESCO projects	4 projects prepared and financing secured.	4 projects prepared and financing under negotiation.
Capacity building	Training programs developed and implemented.	Training programs developed and implemented.
Initiate load research	170 meters installed and data collected and analyzed.	170 meters installed and data collected and analyzed.

Annex 2. Project Costs and Financing

Project Cost by Component (in US\$ million equivalent)

	Appraisal Estimate	Actual/Latest Estimate	Percentage of Appraisal
Project Cost By Component	US\$ million	US\$ million*	
DSM Program Implementation: Residential	74.00	5.21	7.04
DSM Program Implementation: Commercial	39.10	2.41	6.16
DSM Program Implementation: Industrial	18.80	2.58	13.72
Laboratory, Testing Equipment	4.00	1.67	41.75
Consulting Services	4.00	5.09	127.25
Training	5.00	0.50**	10.00
Public Relations	9.00	24.39	271.00
DSM Administration	15.00	12.37	82.47
DSM Program Monitoring/Evaluation	8.60	5.03	58.49
Total Baseline Cost	177.50	59.26	33.38
Physical Contingencies	11.50		
Total Project Costs	189.00	59.26	31.35
Total Financing Required	189.00	59.26	31.35

* All component costs include DSM program expenses from EGAT and MEA. Expenses before July 1, 1997 are based on an exchange rate of B 25=USD 1; after July 1, 1997 an exchange rate of B 40=USD 1 was used.

** During project implementation, EGAT determined that it would be more appropriate to include training tasks with all major consulting assignments rather than hire consultants only for training, thus the estimated training expenses reported appear much lower than actual expenses.

Project Costs by Procurement Arrangements (Appraisal Estimate) (US\$ million equivalent)

Expenditure Category	ICB	Procurement		N.B.F.	Total Cost
		NCB	Method ¹ Other ²		
1. Works	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	0.00 (0.00)
2. Goods	3.00 (2.00)	4.00 (2.50)	1.00 (0.50)	87.40	95.4 (5.00)
3. Services Marketing, engineering, installation, testing, monitoring and evaluation	0.00 (0.00)	7.00 (4.50)	1.00 (0.50)	29.30	37.30 (5.00)
4. Consulting Technical assistance and training	0.00 (0.00)	0.00 (0.00)	6.00 (5.50)	6.50	12.50 (5.50)
5. DSMO Administration	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	14.50	14.50 (0.00)
6. Miscellaneous (Incentives)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	29.3	29.30 (0.00)
Total	3.00 (2.00)	11.00 (7.00)	8.00 (6.50)	167.00	189.00 (15.50)

Project Costs by Procurement Arrangements (Actual/Latest Estimate) (US\$ million equivalent)

Expenditure Category	ICB	Procurement NCB	Method¹ Other²	N.B.F.	Total Cost
1. Works	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	0.00 (0.00)
2. Goods	0.68 (0.48)	6.10 (4.27)	0.61 (0.42)	4.95	12.34 (5.18)
3. Services Marketing, engineering, installation, testing, monitoring and evaluation	0.00 (0.00)	0.63 (0.44)	2.30 (2.02)	24.14	27.07 (2.46)
4. Consulting Technical assistance and training	0.00 (0.00)	0.70 (0.70)	6.78 (6.78)	0.00	7.48 (7.48)
5. DSMO Administration	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	12.37	12.37 (0.00)
6. Miscellaneous (Incentives)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00	0.00 (0.00)
Total	0.68 (0.48)	7.44 (5.42)	9.69 (9.22)	41.46	59.26 (15.12)

1/ Figures in parenthesis are the amounts to be financed by the Bank Loan. All costs include contingencies.

2/ Includes civil works and goods to be procured through national shopping, consulting services, services of contracted staff of the project management office, training, technical assistance services, and incremental operating costs related to (i) managing the project, and (ii) re-lending project funds to local government units.

Annex 3: Economic Costs and Benefits

DSM Program Cost-Effectiveness (Appraisal Estimates)

PROGRAM	TRC
Residential Sector	
Refrigerators	6.85
Air Conditioners	9.86
Lighting	2.00
Commercial and Government Sectors	
Lighting	2.00
New Buildings	2.60
Industrial Sector	
Lighting	2.00
Motor Systems	3.60

DSM Program Cost Effectiveness (Actual Estimates*)

Program	Participant Test	Utility Test	TRC
Fluorescent tube lamps	54.6	28.5	13.8
CFLs	2.3	2.2	0.7
Air Conditioners	1.6	14.5	1.1
Refrigerators	6.5	17.5	1.6
Street Lighting**	0.8	0.003	0.005
TOTAL***	5.3	7.0	1.7

- * The following assumptions are used in calculating cost-effectiveness:
 Marginal cost of electricity production 0.8198 Baht/kWh (US\$0.0205)
 Marginal cost of new capacity 6,999 Baht/peak kW (US\$175)
 Discount rate 10%
- ** While the cost tests clearly indicate that this program was not cost-effective, and the DSMO accepted the result, these tests may not be appropriate to properly assess the unique nature of this program.
- *** These totals are based on the benefits of these five programs, but include the costs of all the DSM programs implemented to date.

Annex 4. Bank Inputs

(a) Missions:

Stage of Project Cycle Month/Year	Count	No. of Persons and Specialty (e.g. 2 Economists, 1 FMS, etc.) Specialty	Implementation Progress	Performance Rating Development Objective
Identification/Preparation 10/91	2	Task Manager, DSM Specialist		
4/92	1	Task Manager		
Appraisal/Negotiation 12/92	4	Task Manager, Lawyer, 2 DSM Specialists		
3/93	3	Task Manager, Lawyer, DSM Specialist		
Supervision 5/95	2	Operations Officer, DSM Specialist	S	S
8/95	2	Operations Officer, DSM Specialist	S	S
3/96	4	Task Manager, Operations Officer, DSM Specialist, Operations Analyst	S	S
2/97	2	Operations Officer, Technical Specialist	S	S
12/97	2	Operations Officer, Technical Specialist	S	S
6/98	2	Operations Officer, Technical Specialist	S	U
12/99	2	Task Manager, DSM Specialist	S	S
4/00	3	Task Manager, DSM Specialist, DSM Evaluation Specialist	S	S
ICR 10/00	2	DSM Specialist, DSM Evaluation Specialist	S	S

(b) Staff:

Stage of Project Cycle	Actual/Latest Estimate	
	No. Staff weeks	US\$ (,000)
Identification/Preparation	15.00	37.50
Appraisal/Negotiation	18.95	47.37
Supervision	87.97	367.63
ICR	10.00	47.30
Total	131.92	499.79

Annex 5. Ratings for Achievement of Objectives/Outputs of Components

(H=High, SU=Substantial, M=Modest, N=Negligible, NA=Not Applicable)

	<i>Rating</i>
<input type="checkbox"/> <i>Macro policies</i>	<input type="radio"/> H <input type="radio"/> SU <input checked="" type="radio"/> M <input type="radio"/> N <input type="radio"/> NA
<input type="checkbox"/> <i>Sector Policies</i>	<input type="radio"/> H <input checked="" type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input type="radio"/> NA
<input type="checkbox"/> <i>Physical</i>	<input type="radio"/> H <input type="radio"/> SU <input type="radio"/> M <input checked="" type="radio"/> N <input type="radio"/> NA
<input type="checkbox"/> <i>Financial</i>	<input type="radio"/> H <input type="radio"/> SU <input checked="" type="radio"/> M <input type="radio"/> N <input type="radio"/> NA
<input type="checkbox"/> <i>Institutional Development</i>	<input checked="" type="radio"/> H <input type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input type="radio"/> NA
<input type="checkbox"/> <i>Environmental</i>	<input type="radio"/> H <input type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input checked="" type="radio"/> NA

Social

<input type="checkbox"/> <i>Poverty Reduction</i>	<input type="radio"/> H <input type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input checked="" type="radio"/> NA
<input type="checkbox"/> <i>Gender</i>	<input type="radio"/> H <input type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input checked="" type="radio"/> NA
<input type="checkbox"/> <i>Other (Please specify)</i>	<input type="radio"/> H <input type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input checked="" type="radio"/> NA
<input type="checkbox"/> <i>Private sector development</i>	<input type="radio"/> H <input checked="" type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input type="radio"/> NA
<input type="checkbox"/> <i>Public sector management</i>	<input type="radio"/> H <input type="radio"/> SU <input checked="" type="radio"/> M <input type="radio"/> N <input type="radio"/> NA
<input type="checkbox"/> <i>Other (Please specify)</i>	<input type="radio"/> H <input checked="" type="radio"/> SU <input type="radio"/> M <input type="radio"/> N <input type="radio"/> NA

Local/National Market Conditions

Annex 6. Ratings of Bank and Borrower Performance

(HS=Highly Satisfactory, S=Satisfactory, U=Unsatisfactory, HU=Highly Unsatisfactory)

6.1 Bank performance

Rating

- | | | | | |
|--------------------------------------|--------------------------|------------------------------------|-------------------------|--------------------------|
| <input type="checkbox"/> Lending | <input type="radio"/> HS | <input checked="" type="radio"/> S | <input type="radio"/> U | <input type="radio"/> HU |
| <input type="checkbox"/> Supervision | <input type="radio"/> HS | <input checked="" type="radio"/> S | <input type="radio"/> U | <input type="radio"/> HU |
| <input type="checkbox"/> Overall | <input type="radio"/> HS | <input checked="" type="radio"/> S | <input type="radio"/> U | <input type="radio"/> HU |

6.2 Borrower performance

Rating

- | | | | | |
|--|--------------------------|------------------------------------|-------------------------|--------------------------|
| <input type="checkbox"/> Preparation | <input type="radio"/> HS | <input checked="" type="radio"/> S | <input type="radio"/> U | <input type="radio"/> HU |
| <input type="checkbox"/> Government implementation performance | <input type="radio"/> HS | <input checked="" type="radio"/> S | <input type="radio"/> U | <input type="radio"/> HU |
| <input type="checkbox"/> Implementation agency performance | <input type="radio"/> HS | <input checked="" type="radio"/> S | <input type="radio"/> U | <input type="radio"/> HU |
| <input type="checkbox"/> Overall | <input type="radio"/> HS | <input checked="" type="radio"/> S | <input type="radio"/> U | <input type="radio"/> HU |

Annex 7. List of Supporting Documents

See Project file for:

1. Global Environment Trust Fund Grant Agreement, July 30, 1993.
2. Global Environment Facility Memorandum and Recommendation of the Director, East Asia and Pacific Country Department I, to the Regional Vice President, April 7, 1993.
3. Pre-Investment Appraisal Report, IIEC, October 1992.
4. Supervision Aide Memoires, February 10, 1994 through April 3, 2000.
5. World Bank/GEF Mid-Term Review Report, September 1996.
6. EGAT DSM Program Evaluation Report, October 2000.
7. EGAT DSM Five-Year Plan (2001-2005), October 2000.

October 10, 2000

AIDE-MEMOIRE**World Bank ICR Mission
GEF - Promotion of Electricity Energy Efficiency Project (TH-GE-28637)****A. INTRODUCTION**

1. A World Bank mission composed of Jas Singh (Energy Efficiency Specialist) and Adam Hinge (Consultant) visited the Electricity Generating Authority of Thailand (EGAT) from September 27 – October 10, 2000, to conduct an Implementation Completion Report (ICR) mission of the above-mentioned GEF Project. The mission met with staff from EGAT's Demand-Side Management Office (DSMO), the Metropolitan Electricity Authority (MEA), the National Energy Policy Office (NEPO), the Department of Energy Development and Promotion (DEDP), and the Australian Embassy. The mission also attended the opening ceremony of a Green Learning Room at Satee Nonthaburi Secondary School and a Green Leaf Certification Ceremony.

2. The mission objectives were to: (i) assess the status of achievement of the Project objectives and completion of the various components; (ii) discuss finalization of the Project Completion Report prepared by the grant beneficiary (EGAT); and (iii) identify and obtain outstanding data requirements for the Bank's ICR. The mission wishes to thank EGAT's DSMO for its excellent preparation and cooperation during its stay.

B. BACKGROUND

3. The Project was approved by the Bank's Executive Board on April 27, 1993 and made effective on November 29, 1993. Based on the original five-year project period, the Closing Date was initially scheduled for December 31, 1998. However, due to initial start-up delays and later than expected completion of DSM program evaluation, the Project's Closing Date was extended twice and closed on June 30, 2000.

C. PROJECT OBJECTIVES AND COMPONENTS

4. Objectives: The GEF Project objectives were to: (a) build sufficient institutional capability in the Thai electric power sector and the energy-related private sector to deliver cost-effective energy services throughout the economy; and (b) pursue policies and actions that would lead to the development, manufacture and adoption of energy-efficient equipment and processes within the country. The main GEF objective in funding the Project was to demonstrate on a large scale, and within a reasonable time frame: (i) the potential for electricity savings to replace substantial fossil fuel power generation, thereby avoiding additional CO₂ (NO_x and SO₂) emissions; and (ii) the capacity of the electric power sector and other relevant agencies, public and private, to achieve those savings. The broader, global objective was to generate among utilities in other developing countries a similar commitment to undertake large-scale DSM programs.

5. The Project was expected to have a significant value for other developing countries in selected energy sub-sectors and end-uses. It was anticipated that the Project would demonstrate: (a) how power utilities and the economy can benefit from investments made in electricity conservation on a sufficiently large scale; (b) how institutional problems can be resolved and the utilities can gear up to manage the program and sustain it in the future; and (c) how major demand-management options can be optimally integrated with supply-side options.

6. Project Components: The original project design had the following components: (a) creation of an organizational unit within EGAT to plan, develop and implement a broad menu of DSM programs across all sectors, along with providing for the required staff training and capability building; (b) development and implementation of technological and market intervention strategies in the residential, commercial and industrial sectors; (c) development of funding and financial mechanisms to assure market adoption of the various energy efficiency programs; (d) development and promulgation of necessary codes and standards to support higher levels of equipment efficiency in all sectors; (e) establishment of testing laboratories and the associated processes of equipment testing and rating; (f) development of project evaluation and monitoring systems including sector-specific evaluation and monitoring protocol; (g) development and training of energy service companies and DSM program contractors in the public and private sectors; (h) integration of supply-side and demand-side planning and incorporation of environmental externalities in the electricity planning process; (i) development of a direct utility load control program; and (j) undertaking special studies as needed to maintain cognizance of emerging technologies with relevance to the Thailand environment.

D. MISSION FINDINGS

7. Status of Components: With respect to the components defined at appraisal, a review of progress was conducted. The extent of completion of these individual components is summarized below in Table 1.

Table 1. Status of Project Components

Component	Status
a) Create DSMO within EGAT	EGAT established a DSMO in 1993 with 40 staff and now has 176 trained DSM staff as well as 166 temporary contractors working on DSM activities in two divisions.
b) Develop and implement DSM programs	The DSMO has initiated or participated in 19 DSM programs in all three sectors.
c) Develop financing mechanisms for DSM	NEPO allowed EGAT to recover DSM expenses through an automatic tariff adjustment (F) from 1993 and throughout the Project term.
d) Develop codes and standards	Although outside EGAT's jurisdiction, a commercial building code was established in 1995 and an industrial code in 1997. Stimulated, in part, by EGAT's labeling programs, NEPO has now developed minimum equipment standards for 5 end-uses, which have been approved in principal and will be mandatory in about 3-4 years.

Component	Status
e) Establish testing capability	EGAT has worked closely with the Thai Industrial Standards Institute (TISI) to develop testing capability and protocol, tested a wide range of appliances and lighting equipment and provided some funds to expand their AC testing capabilities. EGAT also allocated GEF funds to MEA to establish a motor testing lab to support its motor programs.
f) Develop monitoring and evaluation functions	The DSMO has: (i) created a program evaluation department with appropriate staff numbers and skills to monitor and evaluate DSM measures. This group has developed an overall assessment of initial conservation and load management programs; (ii) initiated system-wide load research end-use profiles and supported MEA's end-user load research, which have helped better determine electricity consumption patterns and identify ongoing program impacts and future program priorities; and (iii) established the architecture for a comprehensive tracking database system to assist in future monitoring efforts.
g) Develop private sector capability to deliver DSM	The DSMO launched an industrial pilot ESCO program and supported the development of four investment packages, which will lead to the first performance contracts in Thailand. The DSMO has also made extensive use of local contractors to conduct market surveys, initiate public campaigns, perform evaluation functions, conduct end-use metering and support other DSMO functions.
h) Initiate IRP functions	Due to restructuring, the DSMO did not develop a full IRP program, but did develop a comprehensive demand-side inventory of programs, savings potential, cost and benefit profiles, and technical assessments for future interventions.
i) Develop load control programs	NEPO established voluntary load control programs, with associated tariff schedules, in conjunction with EGAT, MEA and PEA. However, due to the resulting capacity surplus from the financial crisis, these programs have not yet been implemented. The DSMO also demonstrated the use of load management systems in commercial buildings and constructed a pilot thermal storage facility.
j) Undertake special studies	EGAT has explored a number of potential technologies that could support further DSM efforts, including a new buildings end-use and envelope measures, heat pipe technologies, stand-by energy consumption, and renewable energy study.

8. The DSMO has engaged a number of international advisors, consultants and contractors to support its operations. These assignments are now completed and all deliverables, reports, and services have been submitted and certified by DSMO staff. Since the last supervision mission conducted by the Bank, a number of outstanding assignments, including the load research program, impact/process evaluations, IRP program development, tracking database and renewable energy study, have now been completed. The only outstanding program is EGAT's pilot ESCO program, which is discussed further in para 10.

9. Overall Project Results: While implementation varied somewhat from the original plans, due to necessary adjustments to improve local acceptance of DSM program strategies and address other implementation issues, the mission observed that the DSMO has largely fulfilled the Project requirements and completed the individual components. The programs launched have achieved substantial and sustained energy savings and transformed domestic markets for energy-efficiency products and services. And, it was noted that overall impact estimates indicate that EGAT has substantially exceeded the original peak demand reduction, energy savings, and CO₂ emission reduction targets at a cost far less than originally expected.

10. Outstanding Issues: The remaining program, for which the agreed results have not yet been achieved, is EGAT's pilot industrial ESCO program. While all four preliminary and investment-grade audits are completed, financing has still not been secured. The main reason is the substantial delays in EGAT, DEDP and NEPO reaching agreement on a suitable framework to support these pilots with partial funding from the Thai Energy Conservation Promotion Fund (ECF). During the mission, the ECF Compulsory Program Sub-Committee reviewed the first investment project, which involved the ECF providing an interest subsidy and a commercial bank providing the financing, but requested that the ESCO and EGAT guarantee the project performance. This would require the ESCO to pay back the ECF interest subsidy and EGAT to repay its project management fee to the ECF in the event of project savings less than 80% of the expected value. The mission noted that such a request imposed unreasonable conditions on EGAT and the ESCOs and stressed that this program was only designed to demonstrate the concept of performance contracts and should not be held to such unfair standards. EGAT and DEDP will appeal this decision and EGAT agreed to keep the Bank informed on any new developments over the coming weeks. Two additional investment proposals are also being finalized and will be submitted to the Sub-Committee within the next two months, so these negotiations on the first investment are critical. A fourth project was cancelled, due to the customer's unwillingness to continue to wait for the promised ECF interest subsidy and implemented a number of the measures on its own.

11. Sustainability and Operation Plan: Sustainability of the DSMO and its activities has been extremely uncertain over the past several months, due largely to impending restructuring plans and EGAT's eventual privatization as well as the decision to eliminate DSM funding through the F. EGAT informed the mission that NEPO and EGAT have now reached agreement, which has also been supported by a Cabinet Resolution, for the DSMO to remain under EGAT until the successful commissioning of the power pool (about 2003), with program funding to be made available through EGAT's base tariff. Under this plan, the DSMO and EGAT's Research and Development Office would be combined (around 2002) and would seek ECF funding once the base tariff was no longer able to support these functions.¹ The DSMO is still required to submit a detailed proposal for funding for this period, along with an implementation plan and proposed activities to be conducted. Sustained operation after this period, however, is less certain. In the future, the DSMO may be required to be spun-off into an independent service provider and implement programs to support public and private measures on a fee-for-service basis. Given the substantial staffing implications of

¹ The DSMO noted, however, that EGAT's corporate plan has not been revised to reflect this Resolution.

such an arrangement, the mission recommended that EGAT maintain continued dialogue among the relevant agencies over the coming years. EGAT also agreed to submit its future operation plan, which would summarize its detailed proposal to NEPO and outline the plans to sustain activities initiated under the GEF Project, no later than October 31, 2000.

12. The mission noted that, due to EGAT's promotion policies and procedures, the DSMO Director has changed four times in the past few years. While EGAT management expressed its commitment to sustain DSM activities, the mission cautioned EGAT that future operations and successful performance would be critical over the next few years, as are the status of negotiations with NEPO and other agencies over this period. The mission requested that EGAT management seek measures to better insulate DSM operations from future staffing and institutional changes to ensure that operations, funding and strategic direction are maintained during this critical period.

13. Disbursements: Overall Project disbursements now stand at 99.3 percent. During the previous supervision mission, EGAT and the Bank agreed on a four-month grace period for withdrawal applications, which will end on October 31, 2000. The DSMO has recently submitted its final two withdrawal applications for an estimated US\$103,111, which are expected to fully exhaust the grant funds. Once these applications have been processed, EGAT agreed to inform the Bank that disbursements were complete and advise the Bank on any cancellation of remaining grant funds.

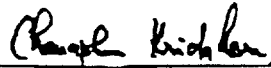
14. Program Evaluation: In early September, EGAT submitted a draft evaluation report of its initial DSM programs to the Bank. During the mission, this report was reviewed and discussed in detail. While the mission accepted the magnitude of savings, which have clearly exceeded GEF Project targets, the mission requested, and EGAT agreed, to the following changes before the report is finalized: (i) EGAT incorporate AMI's estimated free ridership for non-residential participants in its CFL program; (ii) EGAT adjust the free ridership for the air conditioner program to only account for those participants that utilized the interest-free loans; (iii) EGAT report overall cost-effectiveness figures for the entire portfolio of programs as well as those for the programs for which benefits have been accrued; and (iv) EGAT reconsider the appropriateness of the baseline scenarios for the refrigerator program and make necessary adjustments.

E. AGREEMENTS/NEXT STEPS

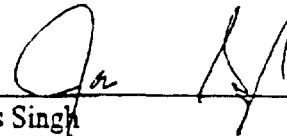
15. In order for the ICR to be completed, the mission team and EGAT agreed to the following schedule:

- a) EGAT will revise and submit its final DSM program evaluation report to the Bank no later than October 31, 2000;
- b) EGAT will finalize and submit its PCR to the Bank no later than October 31, 2000;
- c) EGAT will prepare and submit its operation plan for the next five years, indicating plans to sustain project activities, no later than October 31, 2000;
- d) EGAT will finalize the project cost tables and submit them to the Bank no later than October 31, 2000;

- e) EGAT will submit notification once the final withdrawal applications have been processed and request that the Bank cancel any remaining grant funds from the GEF and GOA accounts before October 31, 2000;
- f) The Bank will submit a draft copy of its ICR to EGAT for review no later than November 30, 2000; and
- g) EGAT will review and provide formal comments on the draft ICR, if any, no later than December 15, 2000.



M. L. Chanaphun Kridakorn
Deputy Governor, Policy and Planning
EGAT



Jas Singh
Energy Efficiency Specialist
The World Bank



Electricity Generating Authority of Thailand

Thailand
Promotion of Electricity Energy Efficiency
(GEF Grant No. TH-28637)

Beneficiary's Project Completion Report

Prepared by
Planning and Evaluation Department
Demand Side Management and Planning Division
October, 2000

Beneficiary's Project Completion Report

Content	Page
Executive Summary	1
A. Statement and Evaluation of Objectives	1
B. Achievement of Objectives	2
C. Implementation Records and Major Factors Affecting the Project	3
D. Project Sustainability	4
E. Bank Performance	4
F. Beneficiary Performance	5
G. Assessment of Outcome	5
H. Future Operation	7
I. Key Lesson Learned	7
Attachment 1	8

List of Abbreviations

BTU	British Thermal Unit
CFC	Chlorofluorocarbon
CFL	Compact Fluorescent Lamp
COP	Coefficient of Performance
DEDP	Department of Energy Development and Promotion
DSM	Demand Side Management
DSMO	Demand Side Management Office
ECF	Energy Conservation Fund
EER	Energy Efficiency Ratio
EGAT	Electricity Generating Authority of Thailand
ESCO	Energy Service Company
ESI	Electric Supply Industry
GEF	Global Environmental Facility
GHG	Greenhouse Gas
GWh	Gigawatt hour (=1,000,000 kilowatt hours)
IMEA	Independent Monitoring and Evaluation Agency
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated Resource Planning
JBIC	Japan Bank for International Cooperation
KW	Kilowatt (= 1,000 watts)
KWh	Kilowatt hour (= 1,000 watts)
MEA	Metropolitan Electricity Authority
MW	Megawatt (=1,000,000 Watts)
NEPO	National Energy Policy Office
PEA	Provincial Electricity Authority
TISI	Thai Industrial Standard Institute

**Promotion of Electricity Energy Efficiency
(GEF Grant No. TH-28637)
Beneficiary's Project Completion Report**

Executive Summary

This report was prepared as a part of the Implementation Completion Report (ICR) of the Thailand Promotion of Electricity Energy Efficiency under the GEF Grant No. TH-28637.

The Project consisted of a five-year DSM Master Plan with a budget of US\$ 189.0 million, of which US\$ 9.5 million was financed by a GEF grant, US\$ 6.0 million by a Government of Australia (GOA) grant through the GEF, and US\$ 28.0 million through a concessional loan from the Overseas Economic Cooperation Fund (OECF) of Japan. The Project targeted the electricity savings of 238 MW and 1,427 GWh (per year) by the end of 1997. Two official extensions of the Project period were made and the final closing date was June 30, 2000.

Over a period of about 7 years, the Project was considered successful with electricity savings of 3,140 GWh per year, peak load reduction by 566 MW and avoided 2.32 million tons of CO₂ emission per year (as of June 2000). The total expenditure to date for all programs is US\$ 59.26 million. The other sustainable benefits from Thai DSM initiatives are public awareness of energy savings and institutional capability development.

Essentially, EGAT was pleased with the project outcome. The achievement of objectives was substantial providing many benefits to the country with costs much lower than anticipated level. This performance experience is not only be of great values to Thailand but also will become the model for other developing economies to understand the economic power of energy conservation.

A. Statement and Evaluation of Objectives

The primary objectives of the Project were to: (a) build sufficient institutional capability in the Thai electric power sector and the energy-related private sector to deliver cost-effective energy services throughout the economy; and (b) pursue policies and actions that would lead to the development, manufacture and adoption of energy-efficient equipment and processes within the country. The main GEF objective in supporting the Project was to demonstrate on a large scale the potential for electricity savings to replace substantial fossil fuel power generation, thereby avoiding greenhouse gas emissions. The GEF's broader, global objective was to generate among utilities in other developing countries a similar commitment to undertake large scale DSM programs.

Based on these objectives, the Project had electricity saving target of 238 MW and 1,427 GWh which simultaneously resulted in reduction of 1.16 million tons of CO₂ emission.

The Project substantially met these objectives as follows;

(a.1) Building institutional capability

The two DSM divisions currently exist in EGAT with about 170 permanent and trained staff. The Project also created an energy efficiency testing facilities at the Thailand Industrial Standard Institute (TISI) and at MEA, the distribution utility. In addition, the Project supported the creation of private sector energy services companies (ESCOs) and the implementation of four pilot ESCO projects. EGAT has also extensively utilized number of local contractors to conduct market and customer surveys, initiate public campaigns, perform evaluation functions, conduct end-use metering and support other implementation functions.

(a.2) Pursuing policies and actions

The Project has implemented sixteen DSM programs initiatives with two programs completed and yielded savings. Three of the programs underway have secured energy efficiency improvements among local and imported products. Other ongoing programs have assured significant participation from end-users in residential, commercial and industrial sectors. (See Attachment 1. for program summary). Regarding EGAT's eventual privatization, agreement has been reached that DSM activities and funding will be remained under EGAT's support until the successful commissioning of the power pool (about 2003). After that, the DSMO may be required to be spun-off into an independent service provider and implement programs to support public and private measures on a fee-for-service basis.

B. Achievement of Objectives

With respect to demonstrating large scale savings, the Project had achieved savings of 3,140 GWh of electricity per year, reduced peak load by 566 MW and avoided 2.32 million tons of carbon dioxide (CO₂) emission per year, as of June 30, 2000 (see Table 1). These savings considerably exceeded targeted value. The Project had created the largest DSM program in Asia and attracted serious interest in DSM from other utilities in the region.

TABLE 1: PROJECT IMPACTS - ACHIEVED AND TARGETED

Impact	Unit	1. ACHIEVED	2. ACHIEVED	3. ACHIEVED	4. TARGET
		(as of 1998)	(as of 1999)	(as of Jun. 2000)	(1993- 1998)
Energy Savings	GWh	2,401	2,836	3,140	1,427
Demand Reduction	MW	432	511	566	238
CO ₂ Emission Reduction	Million Tons	1.77	2.10	2.32	1.16

C. Implementation Records and Major Factors Affecting the Project

There were many important modification and factors affecting the Project implementation and results as follows:

(c.1) The DSM Master Plan and Its Implementation

Instead of providing end-use customer incentives as envisioned by the DSM Master Plan, EGAT's implementation strategy focused on the production-side of the energy efficient technologies, which has led to the virtual elimination of low-efficiency products such as complete transformation of the T12 fluorescent tube (40/20 Watt) market into T8 (36/18 Watt).

(c.2) Project Extensions

The original five-year DSM Master Plan was from 1993-1997 and was automatically expanded to 1998 since the first program was officially launched by the end of 1993. Moreover, two official extensions of the Project implementation period were approved to allow additional time to ensure that the project objectives were fully met and the Project funds fully disbursed. The final closing date was June 30, 2000.

(c.3) Change in System Peak Time Period

The original DSM master plan and the estimated results were developed on the basis that EGAT's system peak occurred during the hours of 6:00-9:00 PM. In 1997, EGAT realized and officially accepted that the system peak period had shifted to the afternoon

hours of 2:00-5:00 PM. This change affected the results of some DSM programs which were originally designed for evening peak period caused by residential demand. To be specific, four programs resulted in lower peak demand savings (three lighting program; Thin tube, CFLs and Street lighting, and one residential refrigerator program) and one program (Air Conditioner) showed higher result.

(c.4) Economic Recession in 1997

Thailand's economic downturn since 1997 was a major factor that decreased sales and manufacturing of energy-efficient equipment. Some DSM initiatives such as low loss ballast and interruptible rate programs were delayed due to less participation than anticipated. ESCO program development was significantly delayed due to difficulties identifying viable sources of project financing, reluctance of lenders to take on any credit risk at the height of the crisis, and the difficulty of ESCOs to find creditworthy customers.

D. Project Sustainability

Under the upcoming restructured electric supply industry (ESI), EGAT will be transformed into transmission company with divestiture of all generation functions. Moreover, the tariff surcharge which had been a major source of funding for EGAT's DSM operation was recently eliminated. Due to the combination of these two factors, it was concluded that the continued placement of the DSMO within EGAT will become increasingly inappropriate. There were several studies and discussions on this issue until recently NEPO and EGAT have reached agreement, which has also been supported by a cabinet resolution, for the DSMO to remain under EGAT until the successful commissioning of the Thailand power pool (about 2003), with program funding to be made available through EGAT's base tariff. Under this plan, The DSMO and EGAT's Renewable Energy Unit (currently under EGAT's Research and Development Office) would be combined (around 2002) and would seek Thai's Energy Conservation Fund once the base tariff was no longer able to support these functions. Accordingly, the DSMO is required to be spun-off into an independent service provider (ISP) and implement programs to support public and private sectors on a fee-for-service basis.

Although details of how EGAT's DSM will develop itself into ISP in the near or longer term is not yet determined, it is apparent, at least, that emerging of the country's energy saving effort initiated by EGAT's DSM will be sustained by support from NEPO and the government.

E. Bank Performance

The Bank personnel provided appropriate and timely advice to the parties concerned with project administration. The quality of the Bank supervisory staff was in general of a very high standard and committed to the achievement of the goals of the Project as evident in support given for the granting of the extensions to the Project's original closing date.

In addition, regarding grant disbursement, the Bank was very cooperative and helpful to EGAT as well. The Bank's overall performance can be rated satisfactory.

F. Beneficiary Performance

During initial project period, there was a slow rate of disbursement due to: (a) the delay in startup of DSM program (September 1993); (b) difficulties in following the Bank's procurement procedures; and (c) an initial focus on building in-house capacity to design and implement low-cost programs such as the High-Efficiency Fluorescent Tube and Refrigerator Program. Regarding procurement difficulties, the situation was remedied by close communication with the procurement specialist at the Resident Mission.

In addition, at the initial period, there was also lack of systematic program planning and proper market research prior to program implementation to pave the way for effective program monitoring and evaluation. However, EGAT has now accepted the need for more systematic planning and the current DSM resource plans (IRP plans) have incorporated more rigorous analyses and coherent strategic plans.

G. Assessment of Outcome

EGAT's DSM obviously met and exceeded the overall energy saving targets as stated in Table 1. With respect to cost-effectiveness analysis, Table 2 shows that EGAT's evaluated conservation programs were cost-effective based on benefit-cost ratio results.

TABLE 2: PROGRAM COST EFFECTIVENESS

<i>DSM Program</i>	Thin Tube	Compact Fluorescent Lamp	Air Conditioner	Refrigerator	Street Lighting	Total
Benefit/Cost Ratio						
Participant Test ^{1/}	54.57	2.33	1.64	6.45	0.7766	5.27
Utility Test ^{2/}	28.53	2.22	14.47	17.51	0.0025	15.90
Total Resource Cost Test ^{3/}	13.78	0.74	1.14	1.57	0.0005	1.92

- Note**
1. Participant Test determines benefits versus costs from DSM measure (s) from the end-users perspective.
 2. Utility Test measures the utility's cost of saving a unit of electricity compared with generating a unit of electricity.
 3. Total Resource Cost Test is the comparison of utility's benefit with the sum of participant and utility costs.

Additionally, further analysis of the Project's overall benefits is summarized in Table 3.

TABLE 3: SUMMARY OF BENEFITS OF EGAT'S DSM INITIATIVES

Item	Summary	
1. Total DSM Program Expenditure as of June 2000	1,915.76	Million Baht
2. Energy Savings	3,139.80	GWh
3. Cost of DSM per kWh saved	0.6102	Baht/kWh
4. Long Run Marginal Cost of Energy	0.8198	Baht/kWh
5. DSM Savings	0.2096	Baht/kWh
6. Total DSM Savings (3,139.80 Cumulative GWh x 0.2096 Baht/kWh)	658.10	Million Baht
7. Annual CO ₂ Emission Reduction	2.32	Million tons
8. Cost of Reducing CO ₂ Emission	283.66	Baht/ton CO ₂
$\left[\frac{3,139.80 \text{ Cumulative GWh} \times 0.2096 \text{ Baht/kWh}}{2.32 \text{ million tons of CO}_2} \right]$		

One of the Project's major achievements that cannot be overlooked was public awareness of energy saving benefits generated through its promotional campaigns and education program. The Green Learning Room initiative with schools was particularly noted as effective and sustainable in raising awareness among students and teachers in energy use and its links to the environment. According to recent research, "Assessment of Public Energy Conservation Attitude by DSM programs", awareness, understanding and attitude of general consumers and business entrepreneurs towards energy conservation participation have been highly raised due to DSM public promotion campaign with 87% of survey respondents are aware of energy efficiency issues. For education program, students and instructors in 200 participating schools are greatly satisfied with the activities and understand energy conservation in a significantly improved level.

Another major achievement was the institutional development evidenced by creation of the DSMO within EGAT with over 170 well-trained staff, expansion of TISI's testing facilities, and establishment of motor testing laboratory at MEA. There are also current development of ESCO concept through EGAT's four pilot projects which are direct creation of ESCO business in Thailand. Although this four pilots are still underway, it has

indirectly encouraged at least three other private sector ESCOs who benefited from EGAT's promotion of the ESCO concept to develop ESCO projects on their own.

H. Future Operation

The DSM resource plan for a five-year time horizon from 2001-2005 was developed to determine DSM resource potential (which is one aspect of the integrated resource planning (IRP) development) and provide a more concrete background for funding proposal preparation.

According to the plan, achievable DSM potential for 2001-2005 will generate cumulatively 612 MW peak demand reduction and 3,949 GWh/year energy savings from 2005 representing 2.6% and 4.1% of the forecast peak demand and energy consumption of the country respectively. Though DSM portfolio in this plan contains mostly the ongoing efforts such as labeling and attitude creation programs, EGAT is strongly confident that future achievement is considerably possible due to experienced staff and well-established connection with concerned agencies in both private and public sector.

I. Key Lessons Learned

EGAT gains valuable lessons from implementation of DSM programs including but not limited to the following issues:

(I.1) Strong proactive with result-oriented style of management was one of the key factors to the Project success.

(I.2) Program design based on local or cultural context was also a critical factor to the success but without systematic planning and adequate market research, the success would be very difficult or even impossible to measure.

(I.3) Secured long-term source of fund is another important factor. Due to not-for-profit nature of EGAT's DSM programs, the firm commitment for long-term funding from authorized government agency is necessary to encourage implementor of all levels.



ELECTRICITY GENERATING AUTHORITY OF THAILAND

BANG KRUI NONTABURI 11130 THAILAND

CABLE : EGAT NONTABURI TLX : 72348,82711 EGAT TH FAX : (662) 433-6317,433-5523,434-4064

NO. EGAT : B3800/56395 DATE : December 15, 2000
TO : Mr. Jas Singh FROM :
Energy Efficiency Specialist
ADD : East Asia & Pacific Energy TLX :
Development Sector Unit TEL : (202) 458-0478
Washington, D.C. FAX : (202) 477-2743
U.S.A. NUMBER OF SHEET (S) : 3

Dear Mr. Singh

TEXT

**Subject : Thailand GEF Promotion of Electricity Energy
Efficiency Project: Draft Project Implementation
Completion Report (ICR) for EGAT Comments**

With reference to your draft Project Implementation Completion Report attached to the fax dated December 5, 2000. After reviewing and requesting comments from other concerning agencies/persons, EGAT found most of the main text in this report acceptable. Nevertheless, representatives from PEA and MEA (DSM Sub-Committee) have made a few notifications for your consideration.

1. In general, there should be an Executive Summary in order to brief the understanding of the executive.
2. All abbreviations and acronyms in the report should be presented in the list.

For detailed comment;

3. In the topic 3.3 *Original Components*: MEA proposed to change "energy management companies" to "energy services companies". However, EGAT prefers the first one.

And; adding the topic (j) *initiating load research system within supply side*; then (k) *undertaking special studies as needed*.

Note: If you do not receive any of the pages or the pages are illegible please call (662)4365282 or fax to the above fax numbers.

4. The report focused too little on PEA implementation.
5. In the topic *8.Lessons Learned* : should consider these recommendations;
 - To avoid the overlapping implementation in Energy Efficiency Program from the involved agencies such as NEPO, EGAT, DEDP, PEA and MEA, a clear delineation of rules and responsibilities of all agencies in the future is a substantial need.
 - To create co-operation, the program planning for the next phase should be participated and coordinated by all involved agencies.

Attached please find finalized Table 3: Project Costs by Procurement Arrangements.

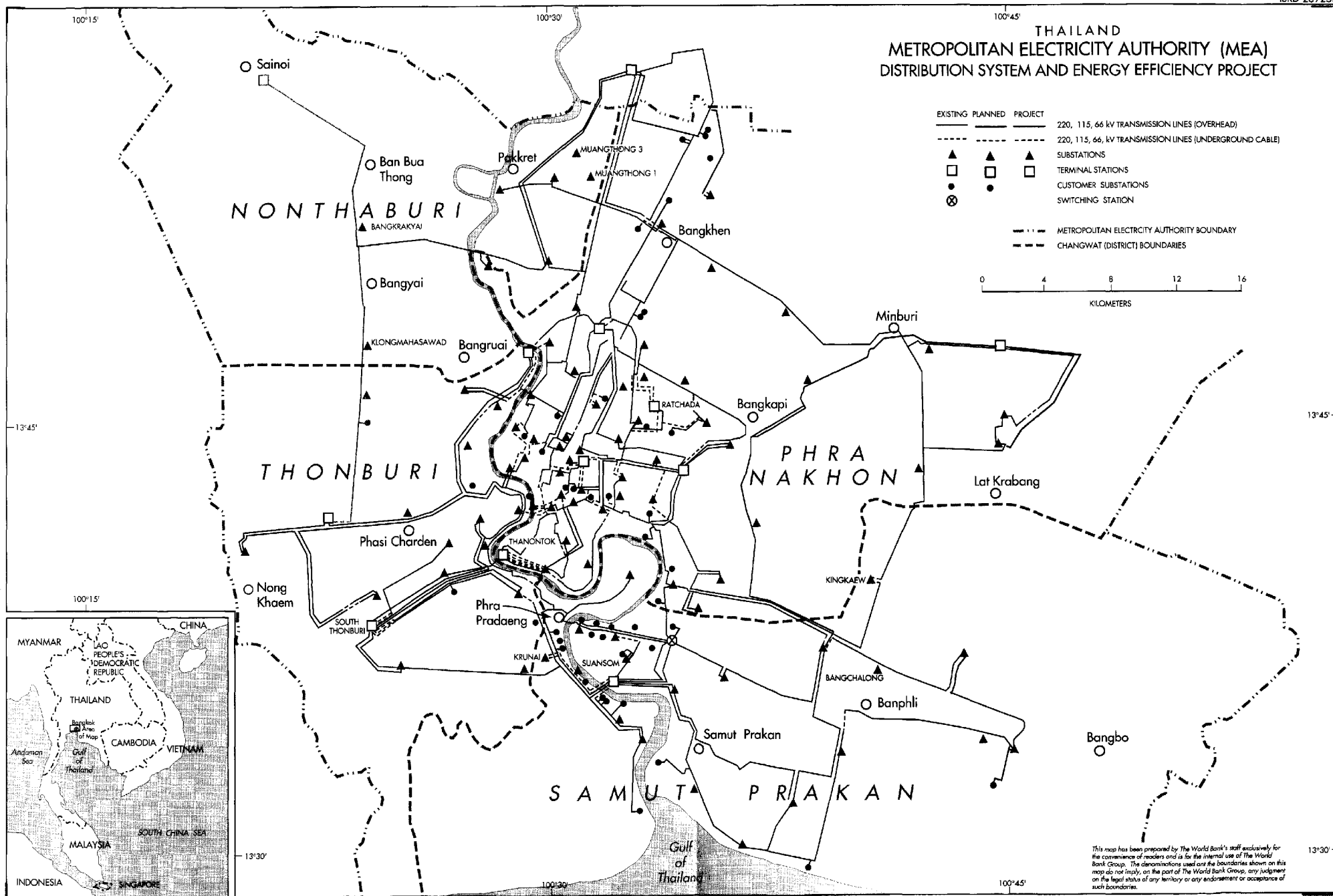
Kindly accept our sincere apologies for a delay in data provision. Should you require any further clarification, please don't hesitate to let us know.

Sincerely yours,



(Mr. Paitoon Pityachawan)
Director, Demand Side Management and Planning Division
Acting on behalf of Governor

Demand Side Management and Planning Division
Tel : (662) 4368150
Fax : (662) 4333329



This map has been prepared by The World Bank's staff exclusively for the convenience of readers and is for the internal use of The World Bank Group. The demarcations used on the boundaries shown on this map do not imply, on the part of The World Bank Group, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.