

# **DSM in Thailand: A Case Study**

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**October 2000**

Joint UNDP/World Bank Energy Sector Management Assistance  
Programme (ESMAP)

# DSM in Thailand: A Case Study

by

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## Abstract

In 1993, Thailand initiated a US\$189 million demand-side management (DSM) program to help curb electricity demand growth and promote more energy-efficiency equipment and cost-effective energy services within the country. Since then, EGAT's DSM Office has developed a strong portfolio of DSM measures, including 19 DSM programs targeting a wide range of sub-sectors and end-uses, and substantially surpassed its original peak reduction and energy conservation targets. EGAT has created substantial public awareness of energy conservation and actively promoted private sector participation in providing such services. And, EGAT's DSM Office has been recognized internationally for its success in designing DSM programs that fit within an Asian context as well as its innovation and partnerships with other agencies. While the overall Program results have been positive, EGAT has had limited impacts in certain areas and experienced a number of implementation issues, many of which are now being resolved. This paper examines the creation of Thailand's DSM Program, discusses programs and results to date, offers analyses and lessons learned from the Program and discusses future prospects for DSM programs in Thailand and elsewhere.

## I. Introduction

In the early 1990s, Thailand had one of Asia's fastest growing economies, with GDP increasing over 10 percent on average from 1990-93, and showed signs of continued economic expansion. Such economic growth was expected to require substantial investment in the power sector, with average annual growth projected at 14 percent annually, or about 2 GW per year. To meet this challenge, the Government of Thailand (GOT) established a strategy for the power sector that required: (a) increasing power sector investments substantially; (b) accelerating the pace of privatization in the power supply industry; (c) making a strong thrust towards energy conservation; and (d) placing an increased emphasis on environ-mentally-sound and sustainable development.

To support energy conservation activities, the GOT passed the Energy Conservation Promotion Act, or ENCON Act, in 1992<sup>1</sup>, to provide a regulatory framework for energy conservation and efficiency programs and investments. This Act included the creation of an Energy Conservation Promotion Fund<sup>2</sup> (ECF) to provide

working capital, grants and subsidies to promote and facilitate energy conservation measures and select renewable energy initiatives. Under the ENCON Act, the Department of Energy Development and Promotion (DEDP) was appointed as the executing agency for the Compulsory (energy audits and public/private building efficiency investments) and Complementary<sup>3</sup> (public relations and training) Programs and the National Energy Policy Office (NEPO) was authorized to manage the Voluntary Program (demonstrations/pilots, renewables and research and development). In parallel, and by Cabinet resolution, the Electricity Generating Authority of Thailand (EGAT), the national generation and transmission utility<sup>4</sup>, established a National DSM Program, with support from NEPO, to improve the capability of the power sector to deliver cost-effective energy services and promote the adoption of energy-efficient equipment throughout the country.

In 1993, EGAT launched a US\$189 million DSM Program, with primary financing from an automatic tariff mechanism ( $F_t$ ).<sup>5</sup> In addition, the

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<sup>1</sup> The ENCON Act was not made effective until the Ministerial Order was released in 1995.

<sup>2</sup> The ECF was initially endowed with 1.5 billion Baht (about US\$60 million in 1992) and receives annual revenues of about 2 billion Baht (\$57 million) from a levy imposed on petroleum fuels.

<sup>3</sup> Responsibility for the Complementary Program was shifted from DEDP to NEPO in late 1999.

<sup>4</sup> In 1999, EGAT had over 15 GW in installed capacity, over 90 TWh in electricity sales and more than 136 billion Baht (US\$3.5 billion) in revenues (source: EGAT 1999 Annual Report).

<sup>5</sup> While the  $F_t$  does support DSM, it is primarily a fuel adjustment mechanism.

Program received a \$9.5 million grant from the Global Environment Facility (GEF), \$6.0 million grant from the Government of Australia and a \$25 million concessional loan from the Overseas Economic Cooperation Fund of Japan (OECF).<sup>i</sup> A DSM Office (DSMO) was established within EGAT to develop, implement and evaluate national DSM programs and measures, with an overall target of reducing peak demand by 238 MW and achieving annual cumulative energy savings of 1,427 GWh by the end of 1998<sup>6</sup>. The DSMO reports to EGAT management for day-to-day operations, but is also overseen by a DSM Sub-Committee, chaired by the Prime Minister's National Energy Policy Council, which reviews program plans, discusses related policy issues and coordinates DSM in concert with other energy-related government agencies, including NEPO, DEDP and both regional electricity distribution companies, MEA and PEA.<sup>7</sup>

### **Objectives**

EGAT's stated objectives for DSM are:

- To implement and pursue energy efficiency and load management programs to maximize benefits for consumers and the country;
- To offer education, increase awareness and actively promote energy conservation among electricity consumers and affect a change in public attitude;
- To stimulate local manufacturers and importers to produce or import energy-efficient appliances; and
- To build sufficient institutional capacity in the electricity sector and the energy-related private sector to deliver cost-effective energy services throughout the economy.<sup>ii</sup>

This paper seeks to examine EGAT's national DSM Program, results to date, overall conclusions, experience and lessons learned and implications for the future of DSM in Thailand and DSM programs elsewhere.

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<sup>6</sup> Due to initial implementation delays, the project was extended and closed on June 30, 2000.

<sup>7</sup> MEA, the Metropolitan Electricity Authority, is responsible for distribution in the greater Bangkok area and PEA, the Provincial Electricity Authority, is responsible for distribution in the rest of Thailand.

## **II. Program Design**

The original five-year DSM Master Plan called for EGAT to design and implement programs targeted to all three major sectors (e.g. residential, commercial and industrial). The Program components included DSM program design, implementation and evaluation, DSM funding mechanisms, energy efficiency codes and standards, testing facilities and protocols, integrated resource planning, load management and private sector DSM capability building. At the time the DSM Program was established, Thailand had no experience with designing or implementing DSM programs. As a result, the World Bank, in partnership with the United Nations Development Program (UNDP) and the International Institute of Energy Conservation (IIEC), an international non-governmental organization, assisted EGAT in developing initial program strategies.

The initial program design was largely based on the U.S. experience, relying on manufacturer and consumer rebates, since there were no other demonstrated models at the time.<sup>iii</sup> During early implementation, DSMO staff determined such approaches to be inconsistent with Thai culture, fearing that financial incentives to manufacturers and participating customers may be perceived as inequitable. The DSMO thus shifted its strategy during implementation to focus more on voluntary manufacturer negotiations than financial rebates, using its financial resources to support major marketing and publicity campaigns, bulk purchase of high-efficiency products, and other information dissemination activities (e.g., labeling, energy audits, demonstrations, data collection/analysis, etc.).

### **Program Staffing**

The DSMO was staffed initially with about 40 EGAT employees in 1993, and grew to about 177 permanent staff in early 2000. EGAT has also made extensive use of temporary staff, local and international consultants, expert advisors, etc. to provide specific skills and manpower based on program needs. Such flexible staffing arrangements have served the DSMO well, as their DSM programs have required changing skill mixes and staff requirements during various stages of implementation, and short-term staff

allow a degree of flexibility from EGAT's more rigid employment policies. These staff work under two DSM divisions, DSM Planning and Administration and DSM Operations and Implementation, and report to the Deputy Governor, Policy and Planning within EGAT.

### III. Implementation

During the first few years, EGAT decided to launch a few initiatives first, in order to gain experience and build in-house capabilities, before expanding its activities. Thus, between 1993-96, the DSMO initiated four programs to address energy use for lighting, refrigerators, air conditioners and commercial buildings.

#### *Initial DSM Programs*

Fluorescent Tube Lamps: With about 20% of electricity consumption attributed to lighting and fluorescent tube lamp (FTL) sales increasing 10% per year, the DSMO targeted this end-use in its first DSM program in late 1993. Given the low number of domestic manufacturers (five in 1993), the DSMO decided to negotiate directly with manufacturers to switch production from T-12 40 W/20 W to T-8 36 W/18 W FTLs, or "thin tubes." EGAT also entered into a partnership with the Thailand Industrial Standards Institute (TISI) to test the FTL life and lumen output for each manufacturer to ensure consistent quality under the program.

While T-8 lamps were already proven technology in developed countries, the manufacturers were concerned over public acceptance in such a dramatic shift in production. EGAT agreed to support the cost of an approximate US\$8 million public campaign, using major stars and TV advertisements, to educate the public about the benefits of these "thin tubes" in exchange for the manufacturers' agreement to phase out production of T-12 lamps. Since the production technology was readily available and the incremental cost for T-8 FTLs was minimal (T-8s require less material to produce), no additional financial incentives were offered to the manufacturers or consumers.

The results were dramatic. Within one year, all manufacturers had completely switched production to thin tube lamps and EGAT's advertising campaign substantially facilitated and

even accelerated public acceptance of this transition. Shortly thereafter, the one major importer of FTLs had also complied with the agreement to discontinue distribution of T-12 lamps. This effective partnership with manufacturers provided the DSMO with a positive track record and experience that it then used to launch its subsequent programs.

Refrigerators: Building upon its experience and success with FTLs, the DSMO approached the five domestic manufacturers of refrigerators in early 1994 and negotiated a voluntary labeling scheme for all single-door models<sup>8</sup>, hoping that market forces would be sufficient to achieve a substantial and sustainable transformation of the market. The labeling scheme used a rating scale, with the unweighted market average of 485 kWh/yr (with load) as a level 3.<sup>9</sup> The DSMO partnered with TISI to test the domestically available refrigerator models and provided labels to manufacturers directly.

As with the FTL program, EGAT sponsored a large publicity campaign to educate consumers about the energy labels and aggressively promoted the level 5 label. Since many of the level 5 models only had a marginal incremental cost, no financial incentives were offered by the DSMO to the consumers. In early 1997, GOT implemented a complete phase out of CFC-based coolants, which resulted in a slight decline in refrigerator efficiency. In this regard, the DSMO adjusted the labeling scheme upward by 10%.

In early 1998, the DSMO worked with the Thai Consumer Protection Agency and made single-door refrigerator labeling mandatory and, in early 1999, the DSMO reached agreement with the manufacturers to increase the requirements for each label level for single-door models by 20% by January 2001, contingent upon EGAT's agreement to sponsor promotional campaigns to inform consumers about this change. In mid-1998, the DSMO also began labeling two-door

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<sup>8</sup> Initial program included sizes from 150-180 liters (l) and was expanded in 1997 to include 90-210 l capacities.

<sup>9</sup> Models with consumption within 10% of the average receive level 3 labels; those with 10-25% less than mean receive a level 4; models with greater than 25% below the mean are rated as a level 5. Since the labels were voluntary, level 1 and 2 models were not labeled.

models,<sup>10</sup> and it is expected that these labels will become mandatory by 2002.

Program impacts were slower than with the FTLs but no less dramatic. In 1994, only one model qualified as a level 5, although it was produced in anticipation of the DSMO's labeling program, and only 2% of single-door models sold were level 5. To date, all single-door and 60% of the two-door refrigerators sold in 2000 meet the level 5 requirements. The DSMO estimates that about 84% of all refrigerators sold in Thailand now have the level 5 label and that the program has contributed to a 21% reduction in overall refrigerator energy consumption. On average, refrigerators receiving the level 5 label in Thailand are slightly less efficient than those qualifying for the "Energy Star" label in the U.S.

Air Conditioners: In late 1995, the DSMO targeted air conditioners (ACs) as its next end-use and proposed a voluntary label system similar to the refrigerator scheme. The labels were based on an energy efficiency ratio (EER) of 7.4, which represented the average of models sold locally, and rated on a scale similar to the refrigerators. TISI tested the models, including both split-system and unitary (window) models<sup>11</sup>, and the DSMO began supplying labels to the manufacturers by early 1996.

Despite initial positive indications from the label program, the DSMO found that level 5 ACs were substantially more challenging to promote than the refrigerators. In contrast to the small number of FTL and refrigerator manufacturers, the Thai AC industry was more diverse and fragmented, with more than 55 different manufacturers, many of which are small, local assembly operations.<sup>iv</sup> And, the incremental cost for higher level ACs was significant. Therefore, the DSMO worked with local credit card companies to offer interest-free loans for the incremental cost of level 5 ACs. The DSMO also offered 500 Baht rebates to shop owners (under a Green Shop initiative) who sold

level 5 models during promotional summer periods.<sup>12</sup>

Results of the AC program have been less than anticipated. Due to the higher incremental cost, the DSMO estimates that only about 38% of ACs have a level 5 label and none of the lower efficiency models are labeled at all. Despite EGAT receiving approval from the DSM Sub-Committee to make AC labels mandatory in early 1999, the DSMO has been unable to reach agreement with the AC industry on a suitable timetable for mandatory labels or increased requirements for each level of the label scheme. Without this agreement, it is unclear how further efficiency gains or energy savings impacts can be achieved under this program.

Green Buildings: In late 1995, the DSMO launched a program to promote the adoption of energy-efficient end-uses in existing commercial buildings. Under this program, the DSMO offers participants preliminary and detailed energy audits as well as investment consultation for high return efficiency retrofits for lighting, cooling, load management and building envelope measures. This program was designed to support DEDP's Compulsory Program, which requires audits and adherence to the building code in "designated buildings."<sup>13</sup>

Since the program began, over 433 building owners/managers have applied to participate in the program, with about 240 being designated buildings. The DSMO has focused on designated buildings, as the audit costs are partially reimbursable through the ECF. The DSMO had conducted 252 preliminary audits by early 2000, however, only 34 have been approved, due, in part, to a backlog of audits currently under review by DEDP.

In addition to the audits, the DSMO implemented four demonstration projects, by providing interest-free loans to replace lighting and chiller equipment. The DSMO also procured and installed 120 ELCONTROL load management systems in customer premises to demonstrate the

<sup>10</sup> Sizes range from 160-500 l.

<sup>11</sup> Program initially included capacities from 7,000-24,000 Btu/hr and incorporated sizes up to 30,000 Btu/hr in late 1999.

<sup>12</sup> Both financial incentive programs were discontinued in 1999 due to budgetary constraints.

<sup>13</sup> Under the ENCON Act, a designated building is defined as a commercial building with demand over 1 MW.

potential benefits of managing customer loads. While interest from building owners has remained high for this program, significant impacts may not be possible unless DEDP's audit approval process is significantly improved and the DSMO is able to identify viable financing mechanisms, to follow-up audits with investments. It is also noted that there is considerable room for improved coordination and collaboration between the DSMO and DEDP to complement each agency's efforts on promoting efficient end-uses in commercial buildings.

### ***DSM Program Expansion***

In 1996, the DSMO began to expand its portfolio of DSM programs and target new end-uses and sectors and, between 1996-98, launched about 15 new DSM operations. While a number of these later programs employed similar strategies and approaches, some were substantially more innovative. A summary of these programs can be found in Table 1 (pp. 6-7).

### ***Complementary Programs***

In addition to customer-oriented programs, the DSMO initiated three programs to strengthen its program planning and implementation efforts: (i) **end-use load research** to create end-use profiles, determine future end-use priorities and better estimate program impacts; (ii) **integrated resource planning (IRP)** to catalogue end-uses and DSM measure for each sector and assess expected impacts, cost effectiveness and technical feasibility; and (iii) a **DSM management information database** to allow improved integration of program data to support planning, evaluation and administration efforts.

### ***MEA Programs***

Recognizing that EGAT, as the generation and transmission utility, does not sell directly to end-users, EGAT entered into a strategic partnership with MEA in 1996 to support a number of mutually beneficial DSM efforts. These included: (i) establishment of a motor testing facility (expected to be operational by December 2000); (ii) development of an end-user load research program within MEA's service territory (ongoing); (iii) initiation of a load control program (on hold due to existing capacity surpluses); and (iv) creation of an ESCO business

unit within MEA (first three contracts now under negotiation).

## **IV. Program Evaluation**

When EGAT's DSM Program was first established, systematic evaluations of its DSM programs was considered a critical component. The evaluation component was meant to allow regular impact reporting to the DSM Subcommittee and Program donors as well as to help improve program designs for existing and new DSM initiatives. The GEF also requested the use of an Independent Monitoring and Evaluation Agency (IMEA) to assess and confirm the validity of EGAT's evaluation results.

Due largely to limited in-house expertise, the DSMO relied on engineering estimates to determine energy/demand savings and greenhouse gas (GHG) emissions reductions attributable to each DSM program from 1994-98. However, the DSMO recognized the need for increasing the precision of these estimates with supplemental information, such as customer/manufacturer surveys, vendor sales data, end-use metering, billing information, etc. to improve engineering assumptions (e.g., penetration rates, coincidence factors, free rider rates, etc.) and enhance the statistical accuracy of program impacts.

In 1999, the DSMO hired consultants to conduct market and other studies, as well as determine preliminary impact estimates, to support EGAT's evaluation efforts of the initial programs through 1998. The IMEA provided an independent review of these studies and reported impact estimates. The results, now complete, have offered a number of key findings regarding program design and implementation and have been used to support EGAT's IRP and future DSM program design and selection. Based on the experience gained by DSMO staff from the consultant work, the 1999-2000 evaluation work was conducted entirely in-house, with methodology endorsed by the IMEA.

### ***Conservation Programs***

EGAT classified five programs as conservation programs – FTLs, refrigerators, ACs, CFLs and street lighting. The supplemental evaluation work involved five major data collection

**Table 1. EGAT's Expanded DSM Program Portfolio**

<b>Program</b>	<b>Sector</b>	<b>Program Description</b>	<b>Incentive Mechanism</b>
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.
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.
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.
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.
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.
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.
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

Table 1 (continued)

<b>Program</b>	<b>Sector</b>	<b>Program Description</b>	<b>Incentive Mechanism</b>
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.
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.
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-use concessional financing.
Load Management <sup>14</sup>	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.
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.
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.

<sup>14</sup> Since these load management initiatives all involve tariff incentives, they were launched and are managed by NEPO, not EGAT. However, EGAT provided some assistance in customer recruitment and the DSMO has evaluated some of these programs to determine the impacts and customer response.



measures: participating and non-participating residential customer surveys; participating/non-participating non-residential customer surveys; interviews with lighting/appliance manufacturers and importers; interviews with EGAT DSMO and Systems Planning Department personnel, and PEA staff (street lighting only); and sample end-use metering to determine operating hours for lighting and appliance compressors.

**Reported Versus Evaluated Savings:** There were considerable differences between EGAT's engineering estimates and those evaluated by the consultants for these conservation programs, demonstrating that engineering estimates alone are insufficient to determine accurate DSM program impacts. The main factors included: (i) differences in wattage assumed for baseline refrigerator and CFL programs; (ii) measured coincidence factors varied from EGAT's assumptions for ACs and CFLs; (iii) FTL sales data was lower than EGAT's assumptions, partly due to the 1997 financial crisis; (iv) EGAT's low estimate for energy savings from using the thin tubes with the standard magnetic ballasts; (v) differences in estimated and measured average daily run time of AC compressors; and (vi) differences in the estimated refrigerator efficiency loss when non-CFC refrigerators were introduced.<sup>v</sup>

**Load Management Programs**

EGAT also evaluated several load management and reduction efforts, including the Green Buildings Program and NEPO's three voluntary tariff load reduction programs. The supplemental evaluation work involved surveying participating customers, interviewing program staff and

sample participant and non-participant metering to compare actual load shapes and consumption with EGAT's pre-program projections. However, due to very limited baseline data, poor program monitoring, and other problems, these impact numbers were not reported.

**Attitude Creation Programs**

EGAT's program to promote energy efficiency through advertising campaigns, strategic partnerships with various ministries and other agencies, and energy conservation public education was also evaluated, using extensive market surveys and focus groups. While this evaluation effort did not generate specific impact figures, it did assess the overall impacts of the public campaigns and found that 87 percent of the Thai population was aware of public energy conservation programs. Based on consumer surveys, the consultant found that consumers were generally aware that EGAT sponsored these programs and EGAT received higher favorable ratings than either MEA or PEA, which can be partially attributed to the DSMO's efforts. The Green Learning Room initiative with schools was particularly noted as effective in raising awareness among students and teachers in energy use and its links to the environment.

**Overall Impact Results**

Despite the differences between EGAT's engineering estimates and the evaluated results, it is clear that EGAT exceeded their overall targets (see Table 2). From 1993- June 2000, EGAT's DSM programs have resulted in an aggregate peak load reduction of 566 MW, or 4 percent of EGAT's total 1999 capacity, and cumulative annual energy savings of 3,140 GWh,

**Table 2. DSM Program Savings Through June 2000**

Program	Launch Date	Savings Targets			Evaluated Results			Percent of Target Achieved		
		Peak (MW)	Energy (GWh/yr)	CO <sub>2</sub> (tons)	Peak (MW)	Energy (GWh/yr)	CO <sub>2</sub> (tons)	Peak	Energy	CO <sub>2</sub>
Lighting	Sept. 1993	139	759	-	399	1973	1,457,807	287%	260%	
Refrigerators	Sept. 1994	27	186	-	84	849	627,365	310%	456%	
Air Conditioners	Sept. 1995	22	117	-	84	318	235,314	381%	272%	
Motors	Dec. 1996	30	225	-	-	-		-	-	
Commercial Buildings	Oct. 1995	20	140	-	-	-		-	-	
<b>TOTAL</b>		<b>238</b>	<b>1,427</b>	<b>1,160,000</b>	<b>566</b>	<b>3,140</b>	<b>2,320,486</b>	<b>238%</b>	<b>220%</b>	<b>200%</b>

representing more than double the original energy savings Program targets. The Program also reduced CO<sub>2</sub> emissions by 2.32 million tons per year.

**Program Targets Versus Results:** While it is clear that the DSMO surpassed the original impact targets, there were a few key Program assumptions that were substantially different than actually observed, which may indicate that the original targets were not appropriate. First, the original DSM Program had a five-year implementation period, whereas the actual project life was about six-and-a-half years. This suggests that the original targets may have been low for the actual Program period. Second, the original plans assumed that the peak period, which was 6-9pm in 1992 would remain constant. However, in 1997, EGAT's peak period shifted from the evening hours to 2-5pm. Since many of the DSMO's programs targeted residential sector end-uses, this shift in peak time reduced the coincidence factors and thus the load shaving impacts of these measures. Third, the unforeseen 1997 financial crisis in Thailand had a considerable adverse impact on DSM program savings, causing substantial reductions in equipment sales and baseline energy consumption. In the absence of the crisis, the DSMO's impacts would have been significantly higher. Finally, the GOT's implementation of

the phase out of CFC-based coolants was not anticipated in 1992 and, as a result, original targets may have been high.

It is, of course, difficult to conclude whether the original program impact targets were in fact reasonable. Clearly, much of the difference between the targets and evaluated results can be attributed to the much higher penetration rate for the FTLs than was initially projected, with FTL program impacts accounting for 68% of the total Program peak reduction and 60% of total Program energy savings. However, this was less of an underestimation of the original targets than an over achievement by EGAT in its highly effective manufacturer negotiations. Nevertheless, it is instructive to identify where original program assumptions differ from actual results, in order to better understand Program performance and assess results.

**Process Evaluations**

The consultants also gauged the DSM programs in terms of their overall effectiveness, market transformation effects and cost-effectiveness. Major findings from these efforts are summarized in Table 3. Snap back effects were not observed based on the surveys and persistence could not be determined, since many of the programs had only been in operation a few years.

**Table 3: Process Evaluation Results**

Program	Market Impacts		Recommendations
	Baseline %	Results %	
FTL (T8)	40%	100%	Promote low-loss (magnetic/electronic) ballasts
Refrigerators (single-door)	2.3%	100%	Update labeling scheme Improve testing speed and accuracy Target promotions to sales people Provide more info about CFC phase-out
Air conditioners (Level 5)	19%	38%	Introduce minimum performance standards Simplify loan programs Decrease testing lead time
CFL	6-10%	6-10%	Include all CFL sizes in program Use conventional outlets to sell CFLs Provide information on trade-offs between price and quality
Green Building	--	--	Define priority customer groups Calibrate and standardize customer services Improve customer communications
TOU Tariffs	--	--	Provide more information on differences between TOU and TOD tariffs
TOD Tariffs	--	--	Consider changing billing and charging annual subscribed energy demand level, beyond which excess energy demand will be surcharged

In terms of free ridership, none of the programs, except the AC program, offered financial incentives, thus no free ridership was experienced. For the AC program, free ridership was estimated at 14% of those that participated in the interest-free loan initiative. Participants that responded to surveys indicating that they would have purchased the efficient equipment with or without the DSMO programs were not considered free riders, but were accounted for in the baseline projections.

It is important to note that EGAT's baseline scenario for its programs was considered to be static over the program life. While this may not seem reasonable or intuitive, both the consultants and IMEA determined that it was unreasonable to assume any significant efficiency gains without some government intervention. Also, since the number of domestic manufacturers for these end-uses was relatively small, it was concluded that the DSMO should take full credit for all changes in production given the comprehensive nature of EGAT's market interventions and depth of their campaigns.

Program Cost-Effectiveness: There are a number of tests commonly used to assess a DSM program's cost-effectiveness, developed in the U.S., based on perspectives of various stakeholders in the process. The first two analyses used by EGAT are based on the perspectives of the utility and the participants (known as the Utility Test<sup>15</sup> and Participant Test<sup>16</sup>). A more comprehensive tool is the Total Resource Cost Test (TRC), which compares the avoided cost of supply with both the utility and participant costs of a DSM measure. A benefit-cost ratio of more than 1.0 indicates that, for the particular group of economic actors, program benefits outweigh costs, and the program can be considered cost-effective. For all these tests, the benefits and costs are relative to the perspective and converted into present value terms. Table 4 summarizes these tests results for EGAT's evaluated conservation programs.

<sup>15</sup> The Utility Test measures the net costs of DSM as a resource option based on costs incurred by the utility against the avoided costs of supply.

<sup>16</sup> The Participant Test measures the quantifiable benefits and costs to the customer for a given DSM measure.

From the table, it is clear that the portfolio of DSM programs was cost-effective, based on these tests. The FTL program was clearly the most cost-effective, with very high benefit-cost ratios, and both the refrigerator and AC programs had ratios above 1.0. The CFL program passed the Utility and Participant Tests, but not the TRC. This was likely due to the high costs to non-participants, or those rate payers that incurred the DSM surcharge but did not participate in the program. The street lighting program was clearly not cost-effective, due to the high local costs of the high-pressure sodium vapor (HPS) lamps and low coincidence factor, although these tests may not be appropriate ratios due to the nature of this program.

While these tests may be useful indications of cost-effectiveness, their use alone is insufficient to capture the comprehensive impacts of EGAT's Program. For example, the Participant Test assumes that higher cost equipment is for improved efficiency only, when in fact some of the higher costs can be attributed to additional features that are energy neutral, such as longer lasting components, aesthetics, etc. Also, since EGAT's programs were largely focused on public awareness building and market transformations, for which quantified economic benefits are less easy to determine, such tests do not adequately reflect program benefits. Nor do these tests capture benefits from delayed new capacity investments, improved customer service, sectoral externalities, such as environmental benefits, reduced fuel imports, or other benefits commonly associated with DSM programs.

It should also be noted that these tests were developed in the U.S. context to assist the regulator in determining the appropriateness and justification of for various utility DSM programs and may not be appropriate for EGAT's programs. For example, a DSM measure that passes the DSMO's Utility Test implies that the program is cost-effective to EGAT, when in fact each kWh of DSM savings represents a reduction in total electricity sales.

## V. Analysis of DSM Program

While the overall assessment of the DSMO's results should be considered very remarkable, a number of key issues have now been identified,

**Table 4: Program Cost Effectiveness\***

Benefit Cost Ratio	Air					Street Lighting <sup>†</sup>	Total**
	FTL	CFL	Conditioner	Refrigerator			
<b>Participant</b>	54.6	2.3	1.6	6.5		0.8	<b>5.3</b>
<b>Utility</b>	28.5	2.2	14.5	17.5		0.003	<b>15.9</b>
<b>TRC</b>	13.8	0.7	1.1	1.6		0.005	<b>1.9</b>

\* 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 these five programs only and not all the DSM programs implemented to date.

which will need to be addressed if the DSMO is to maintain its successes in the future.

**Key Program Issues To Date**

Program Selection, Design and Evaluation: Since development of the initial DSM plans in the early 1990s, the DSMO’s process for identifying program priorities and designing appropriate promotional strategies has lacked a systematic and rigorous approach. This is due, in part, to EGAT’s view that its programs serve a public purpose and, therefore, should offer programs for all key customer segments and end-uses. The lack of a formal process for identifying, selecting, implementing and evaluating programs has led to programs being fielded before they are fully developed, or before market research assessing their potential has been conducted or completed. As a result, some of EGAT’s programs were designed based more on anecdotal information than market research.

Another issue was the lack of proper baseline data and end-use profiles to adequately determine end-use priorities, program selection and evaluation impacts. While EGAT now has an active end-use load research program, the effort was launched only in 1998, after many of the end-use programs had already been selected. It is noted, though, that EGAT faced pressure to get programs on the ground and had to make trade-offs early on between its data collection/market research efforts and program implementation.

Until 1999, there had been no formal program evaluation to identify areas within the program design process that could be improved. While the DSMO has taken steps to remedy this weakness, the evaluation late in the Program prevented sufficient feedback to improve program implementation and incorporate evaluation findings into new program designs. Future periodic evaluations will be needed to continue improving planning and program design techniques and efforts.

During early implementation, it became clear that DSM program approaches from other countries could not be implemented without adaptation for Thailand. An unintended result was that EGAT perceived many program screening techniques used and tested elsewhere as also being “too Western” and thus did not apply them, nor develop viable alternatives. Also, EGAT rejected many Western DSM strategies, such as customer rebates, but failed to develop and test new strategies, often relying on early approaches such as manufacturer negotiations and labeling, which now appear to be insufficient for more complex end-use markets with higher incremental costs, such as ballasts and motors.

EGAT has now accepted the need for more systematic planning and its current IRP plans have incorporated considerably more rigorous analyses and coherent strategic plans. EGAT has also taken measures to improve the links between program planning and implementation functions and develop evaluation plans with program plans.

Labeling: The success of EGAT's labeling efforts to shift the market to higher efficiency refrigerators and AC models can be attributed to two main factors: manufacturer willingness to label their products; and consumer awareness and understanding of the labels. The labels have had a well-documented, positive effect on modifying consumer purchasing behavior, and evaluation results clearly demonstrate that they achieved measurable market shifts.

An unintended consequence of EGAT's highly effective "level 5" label promotions has been that only these highest rating labels are recognized as quality models. Manufacturers, who label their products voluntarily, are reluctant to affix any label below level 5 on their products, with the result that consumers effectively have only two choices: level 5 models and unlabeled models. The outcome is that the voluntary labels, combined with active promotion of the highest level labels have served to create of a "level 5" quality brand label, rather than the rating scale originally designed. EGAT's plans to expand its labeling efforts to a wider range of refrigerator and AC models, as well as low-loss ballasts and high-efficiency motors, may have limited results unless EGAT takes steps to educate consumers on the rating aspects of the labels.

### ***Lessons Learned***

Based on the overall DSM Program results and recent evaluation findings, a number of lessons have emerged and are under consideration by EGAT as it plans future activities. These lessons may also be useful for those implementing or considering DSM programs elsewhere. The lessons include:

Design Programs Based on Local Context: EGAT's most effective initiatives were implemented using a Thai approach of combining manufacturer collaboration and public promotions. Local cultural aspects are also crucial to ensure high consumer acceptance and participation in such measures. It may be more useful to limit outside expertise to discrete assignments and training activities, leaving the local utility staff to design the programs based on market research conducted and strategies developed in-house.

Identify DSM Champions: Without the strong proactive approach taken by the second DSMO director, it is unlikely that EGAT's program would have developed and grown over the years. DSM programs require strong management and marketing, both to utility management and to the public, to ensure that programs receive the support needed to meet their objectives. Utilities should also seek measures to help insulate DSM operations from periodic management changes.

Define Clear DSM Program Objectives: EGAT continually confronted competing objectives, e.g., public purpose or commercial, and EGAT management commitment to DSM wavered, particularly in the face of capacity surpluses after the 1997 financial crisis. An important lesson is that DSM objectives should be clearly defined up front and have long-term in addition to shorter-term objectives, to help maintain continuity in operations. These objectives should address such issues as: public purpose or commercial; load management or energy conservation; economic/environmental benefits or financial gains; sectoral priorities; etc. The priorities identified will drive how programs develop.

Establish DSM Programs in Context of Reforms: EGAT's eventual privatization was not considered at the time the DSM Program was first established. Potential privatization and restructuring, tariff reforms, etc. should be taken into consideration at the time DSM programs are considered, and an appropriate framework designed. Program financing is a key component of this framework, and should be able to accommodate eventual pricing reforms and include appropriate regulation, oversight, institutional and incentive schemes, e.g., DSM operational expenses and lost revenue cost recovery schemes.

Generation Versus Distribution Utility DSM: Some of EGAT's programs were partially constrained because EGAT does not sell directly to end-users and, therefore, did not have previous relationships with consumers. In many cases, distribution utilities may be a more appropriate home for most DSM programs. In those countries that still have vertically-integrated utilities, any introduction of DSM efforts should explicitly involve the distribution staff and provide for gradually shifting appropriate DSM

program responsibilities to distribution utilities as reforms progress to make use of their established and unique customer relationships.

Systematic Planning and Evaluation: Proper program prioritization and screening play a key role in designing and implementing successful DSM programs. Evaluation plans should be developed concurrently with program plans to identify clear objectives and performance indicators that will be used to assess program performance. Program designs should also include proper development of end-use consumption patterns, market research and baseline data. The design phase should consider a range of intervention strategies and assess the cost-effectiveness of each option. There should also be a functional process for feeding evaluation results back into program design and make relevant adjustments.

Phased Implementation: EGAT's experience demonstrates the importance of implementing programs using a phased approach, although this could have been further strengthened by timely evaluation and program redesign. It is preferable to implement pilot initiatives, and then evaluate and refine them before expanding and scaling-up implementation efforts. A second advantage of this approach in countries/utilities new to DSM is that it allows staff to gradually build their competency and improve their program design and analysis skills.

Financing Facilities: EGAT's limited success in its commercial and industrial sector programs was largely due to a lack of viable financing sources. Thailand's future DSM efforts, and programs elsewhere, should actively address this barrier and arrange for complementary financing programs to support industrial and commercial energy audit programs, ESCO development and non-residential end-use programs, such as motors and chillers. Where viable financing and other programs for energy efficiency exist, such as the framework of the ENCON Act in Thailand, clear links should be established between utility DSM programs and other government efforts to ensure adequate coordination and complementarity between initiatives.

Voluntary Versus Mandatory Labeling: Voluntary labels are not effective as rating

mechanisms, since they provide no incentives for manufacturers to label lower efficiency models. In those countries where voluntary labels are the preferred option, a simple quality brand label would be the preferable option.

## **VI. Conclusion**

Overall, EGAT has substantially met its DSM Program objectives of creating substantial institutional capability within EGAT to design, implement and evaluate DSM programs and achieving increased supply and adoption of high-efficiency equipment in Thailand. EGAT has maintained strong ownership of the Program and has developed DSM programs suited to Thai conditions and culture. EGAT has exceeded its energy savings targets based on verified evaluation figures. EGAT's DSMO is widely recognized for its innovative programs, such as its Green Leaf, Green Learning Room and public campaigns, as well as its strong management and capable staff. EGAT has also worked well with several other GOT agencies, such as the Ministries of Health and Education, the Bangkok Metropolitan Administration and MEA, to jointly develop programs that meet shared goals.

However, there are a number of areas in which the programs can be improved in the future. The DSM Sub-Committee, established in part to ensure proper coordination between EGAT and ENCON Act agencies such as NEPO and DEDP, has not been very effective. The result is that a number of energy efficiency programs, such as labeling and commercial/industrial programs, appear to be competing and/or overlapping. This has caused confusion among consumers and created some inter-agency disputes regarding institutional roles and responsibilities.

EGAT's residential programs have achieved strong public recognition and participation, but the commercial and industrial programs have had limited impacts due, in part, to a lack of viable financing sources. EGAT's programs include successful activities such as the FTL, refrigerator and Green Leaf programs, but other programs, notably ballasts and motors, have not achieved significant results. EGAT's greatest successes are with technologies for which the incremental cost for the higher efficiency equipment was not substantial (e.g., FTLs, refrigerators), while the

DSM Program has had only marginal impacts when larger price differentials existed (e.g., air conditioners, CFLs, ballasts, motors). Given the relative youth of EGAT's Program, the overall results have still been remarkable. In future years, however, the DSMO will need to become more sophisticated with its analysis and program strategies and should be evaluated on this basis.

Some of EGAT's programs have shown limited progress over the past few years, which EGAT attributes largely to the uncertainty of future operations because of the power sector restructuring and EGAT's movements towards privatization. While no programs have been cancelled, no existing programs have been expanded nor new initiatives launched. Donor funds have largely been exhausted and the GEF grant finally closed on June 30, 2000. These developments, along with the recent decision to eliminate DSM funding from the F<sub>1</sub>, have raised serious concerns over the DSM Program's sustainability and the appropriateness of maintaining existing institutional arrangements.

### *The Future of DSM in Thailand*

In 1998, Thailand embarked on a plan to privatize its electric supply industry (ESI). In September of that year, GOT endorsed NEPO's Privatization Master Plan, which envisions that Thailand's ESI will open to competition in three stages between 1998 and 2003. While many of the details are still being determined, the general direction in which the industry is moving is clear as is the fact that existing institutional and financing mechanisms used to support DSM in the past may no longer be appropriate.

The future ESI plans calls for EGAT's privatization and end to supporting DSM through the F<sub>1</sub>. New funding mechanisms will be essential for programs and operations to be sustained. As EGAT proceeds with privatization plans, the continued placement of the DSMO within EGAT may become increasingly inappropriate. EGAT and NEPO are now considering mechanisms for continued DSM program support.

There are a number of issues to be considered surrounding DSM in restructured ESI. First, it probably is unrealistic to assume that the private sector is in a position to deliver services offered by the DSMO. Thailand's nascent ESCO

industry is likely to target only large end-users with strong financial backing. It is unlikely that the private sector would be willing to work with local manufacturers to upgrade existing production lines, to offer services to small and medium enterprises or the residential sector, or to target efficient end-users rather than packaged services, all of which the DSMO has been doing.

Second, it may also be unrealistic to shift responsibility for the DSMO's program to the public sector. Despite the GOT's commitment to energy efficiency, the ENCON Act has not yet shown significant achievements and implementation results. The DSMO is the only government-supported efficiency program with a proven track record in program implementation over the past several years, and its staff have unique skills and experience in program identification and design, implementation and evaluation. Any sudden shift in institutional arrangements, such as transferring DSMO staff to another government entity, would severely compromise the effectiveness of DSMO's operations and have major staffing implications.

Third, while the DSMO has largely met its performance objectives, there is room for improved Program implementation and coordination. In the restructured ESI, the DSMO oversight function could be strengthened by shifting to a power sector regulator, rather than remaining with the DSM Sub-Committee. DSM Program funding, could be subject to increased competition, thus forcing the DSMO to be more cost conscious and judicious with future efforts and even compete with other agencies for funding. There may be scope for the DSMO to increase its efforts in promoting private sector participation in DSM activities, through more ESCO development activities, bidding out DSM program implementation and services, or allowing new DSM agencies, independent or private, to compete for public funding for various DSM programs.

It is not obvious, nor is there currently consensus, on how DSM activities should be sustained in the future, if at all, and how such programs would be institutionally and financially supported. NEPO and EGAT have considered a number of short-term and longer-term solutions which include: (i) using ECF funds for public purpose programs

and either maintaining the DSMO in the government-owned portion of EGAT, linked to the system planning function, or shifting the DSMO under NEPO; (ii) transferring responsibilities for DSM implementation to the distribution utilities under appropriate regulatory regimes; (iii) requiring independent power producers or other private integrated energy service providers to package and bid on a combination of supply and DSM electric services; and (iv) ceasing all publicly-supported DSM and allowing the private sector to provide services where the returns are sufficient.

In the near-term, EGAT and NEPO have now reached agreement that the DSMO can recover DSM administration costs through EGAT's base tariff and remain within EGAT for at least the next few years. The DSMO is now preparing a detailed funding proposal, which will include a five year program, 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. While this plan may allow the DSMO to continue operating with minimal changes over the short-term, it is unlikely to be a viable longer-term solution. How the DSMO's role will develop in the context of the restructured ESI and over the longer term remains to be seen.

### *Implications for DSM Programs Elsewhere*

DSM program implementation should depend on a country's or utility's objectives for power sector development and whether DSM can offer cost-effective, viable solutions. Objectives relating to environmental protection, commitment to energy efficiency, energy security and other related concerns also need to be defined. While DSM can be considered a viable tool to help address some of a country's concerns, it remains a contentious intervention mechanism. In countries with severe power shortages and capacity constraints, utilities may have incentives to reduce peak loads to delay new capacity investments or to target load management programs in areas of high network congestion. Other potential incentives include implementing energy conservation in low tariff customer classes, and bundling DSM services in order to recruit additional customers. Such concerns need to be carefully weighed against potential conflicts between DSM and utility revenues, introduction

of appropriate incentives for all stakeholders, equity of financing mechanisms and costs of such efforts.

Financing DSM remains a significant issue in most places. Many countries, like Thailand, have imposed DSM taxes within power tariff schemes – usually with greater demands for accountability than those imposed on EGAT. Other governments have opted to fund DSM programs for low-income customers as a social program, and effectively pay the utility to implement the program. Some countries are interested in introducing DSM as an integral part of their power sector development plans, but face considerable hurdles with bringing electricity tariffs to cost recovery levels that make DSM surcharges unfeasible at present. In any case, DSM financing should be linked to the decision whether or not to implement DSM programs, with financing mechanisms designed in the context of the program goals.

Regardless of the objectives and mechanisms a country might prefer, Thailand's DSM program offers considerable insights into the major issues associated with implementing DSM programs, and of the potential benefits that can accrue. Not all of its DSM programs have achieved their intended impacts, but EGAT achieved its overall peak and energy reduction goals at a cost far less than would have been needed to add new generation during this period, benefiting the country from an economic point of view. While every country's and utility's context is unique, EGAT's experience offers a number of useful lessons that cut across geographical boundaries. And, whether or not Thailand decides to sustain its DSM activities, the markets that the DSMO helped transform and energy savings achieved will continue.

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<sup>i</sup> Thailand Promotion of Electricity Energy Efficiency Project, GEF Project Appraisal Document, April 1993.

<sup>ii</sup> Thailand Promotion of Electricity Energy Efficiency Project, World Bank/GEF Mid-Term Review Report, September 1996.

<sup>iii</sup> Thailand Promotion of Electricity Energy Efficiency Project, Pre-Investment Appraisal Report, IIEC, October 1992.

<sup>iv</sup> du Pont, et. al. "Lessons from Thailand: Experience Implementing Energy Efficiency Programs." June 1997.

<sup>v</sup> Sulyma, et. al. "Taking the Pulse of Thailand's DSM Market Transformation Programs." August 2000.