Evaluation Methods and Results of EGAT’s Labeling Programs

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Presentation Outline

❖ Program Summary
❖ Evaluation Approach
❖ Program Evaluation Results
❖ What was learned?
❖ Next Steps
Program Summary

Objectives:
To transform the market so that high efficiency refrigeration or air conditioning (A/C) are the norm in five years (since 1995 and 1996).

Major Market Barriers:
- Availability on EE models (A/C, Refrigeration)
- Customer Information on relative EE (A/C, Refrigeration)
- Price (A/C)

Strategies:
Promote the use of efficient refrigeration and A/C (label #4 and #5) over the standard ones (label #3) by obtaining voluntary agreements with manufacturers to affix labels in exchange for EGAT’s promotion supports.
Program Summary – Refrigerator Labeling

- Commenced in 1995 with focus on residential refrigerators.
- Negotiation with 5 local manufacturers to initiate voluntary labeling scheme for single-door models (dominant market share).
- Large public campaign to raise consumer awareness and aggressively promote level 5 label.
- In 1998, labels have been made mandatory for single-door models and EGAT has expanded to include two-door models for voluntary labeling.
- Starting in Jan 2001, the efficiency level for each of the 5 ranking categories was increased by 20%.
<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 5</td>
<td>Annual electricity consumption is at least 25% below the mean consumption of tested refrigerators.</td>
</tr>
<tr>
<td>Level 4</td>
<td>Annual electricity consumption is 10% to 25% less than the mean consumption of tested refrigerators.</td>
</tr>
<tr>
<td>Level 3</td>
<td>Annual electricity consumption is within +/-10% of the mean consumption of tested refrigerators.</td>
</tr>
<tr>
<td>Level 2</td>
<td>Annual electricity consumption is 10% to 25% more than the mean consumption of tested refrigerators.</td>
</tr>
<tr>
<td>Level 1</td>
<td>Annual electricity consumption is at least 25% more than the mean consumption of tested refrigerators.</td>
</tr>
</tbody>
</table>
Rating Scale 1=low, 2=fair, 3=medium, 4=good, 5=very good

The label shows the efficiency of the electric appliance

Type of appliance: Refrigerator (NON-CFC)

Efficiency: volume/kWh
Electricity cost/year
Electricity consumption: kWh/year
Program Summary – Air Conditioner Labeling

- Commenced in 1996 with focus on room A/C (7,000-24,000 Btu/hr)
- Similar to refrigerator labeling but dealing with 55 manufacturers
- Product price differentials were significant, as a result;
  - interest free loan to customer
  - rebates to A/C retail shops
- Mandatory still not possible due to higher number of participating manufacturers.
## A/C Efficiency Levels

<table>
<thead>
<tr>
<th>Level</th>
<th>Value</th>
<th>EER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 5</td>
<td>10.6</td>
<td>&lt; EER</td>
</tr>
<tr>
<td>Level 4</td>
<td>9.6</td>
<td>&lt; EER &lt; 10.6</td>
</tr>
<tr>
<td>Level 3</td>
<td>8.6</td>
<td>&lt; EER &lt; 9.6</td>
</tr>
<tr>
<td>Level 2</td>
<td>7.6</td>
<td>&lt; EER &lt; 8.6</td>
</tr>
<tr>
<td>Level 1</td>
<td></td>
<td>EER &lt; 7.6</td>
</tr>
<tr>
<td>Label</td>
<td>Value</td>
<td></td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>Rating for this appliance</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>&quot;The label shows the efficiency of the electric appliance&quot;</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Type of appliance</td>
<td>Aircon</td>
<td></td>
</tr>
<tr>
<td>Size X btu/hour</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producer and model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EER (British thermal unit)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity price baht/year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity use units/year</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Logos from EGAT, MEA, PEA

"We can work together and save energy"
EGAT’s Program Evaluation Framework

1997 Initial estimates by EGAT staff using engineering methods

1999 Consultants’ supplemental evaluation work

Assessed and Accepted by The World Bank ICR Mission

An Independent Monitoring and Evaluation Agency (IMEA)

GEF requirement to assess validity and ensure that the GEF goals were met.

Further analysis conducted in-house and has been accepted by IMEA

1998, 1999 and June 2000 Evaluation
Evaluation Objective

❖ To quantitatively and qualitatively assess two EGAT’s labeling programs in terms of energy and environmental impacts.

❖ Program Goals

<table>
<thead>
<tr>
<th></th>
<th>MW</th>
<th>GWh</th>
<th>CO₂ reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerator</td>
<td>27</td>
<td>185</td>
<td>not specified</td>
</tr>
<tr>
<td>Air Conditioner</td>
<td>22</td>
<td>117</td>
<td>not specified</td>
</tr>
</tbody>
</table>
Evaluation Methods - Engineering Estimates

❖ Engineering Algorithms Share Similar Features

\[
\text{GWh savings} = \text{Number of units} \times \text{savings per unit} \times \\
\text{hours of operation} \times (1 - \text{free rider rate})
\]

\[
\text{Peak MW Reduction} = \text{Number of units} \times \text{savings per unit} \times \\
\text{coincident peak factor} \times (1 - \text{free rider rate})
\]

❖ EGAT's spreadsheet monthly reports since 1997 provided quantitative estimates of program impacts based on assumptions and program data tracking
## Comparison of Savings Target and Achieved to Date as of June 2000

Based on Afternoon Peak (2:00 p.m.)

<table>
<thead>
<tr>
<th>PROGRAM</th>
<th>Launch Date</th>
<th>Savings Target (1998)</th>
<th>Achieved To Date</th>
<th>Percent Achieved</th>
<th>CO₂ Reduction (Tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>MW</td>
<td>GWh</td>
<td>MW</td>
<td>GWh</td>
</tr>
<tr>
<td>Lighting</td>
<td>Sept. 1993</td>
<td>139</td>
<td>759</td>
<td>628.84</td>
<td>2,373.85</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>Sept. 1994</td>
<td>27</td>
<td>186</td>
<td>72.96</td>
<td>532.63</td>
</tr>
<tr>
<td>Air Conditioner</td>
<td>Sept. 1995</td>
<td>22</td>
<td>117</td>
<td>44.66</td>
<td>679.28</td>
</tr>
<tr>
<td>Motor</td>
<td>Dec. 1996</td>
<td>30</td>
<td>225</td>
<td>0.21</td>
<td>1.23</td>
</tr>
<tr>
<td>Commercial Building</td>
<td>Oct. 1995</td>
<td>20</td>
<td>140</td>
<td>8.20</td>
<td>23.50</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>238</strong></td>
<td><strong>1,427</strong></td>
<td><strong>755</strong></td>
<td><strong>3,610</strong></td>
</tr>
</tbody>
</table>

### Note:
1. Cost Effectiveness of DSM Program
   - Estimated Total DSM Expenditures to Date = 1,814.50 million Baht
   - Cost of Peak Demand Saving = 2,403.69 Baht/kW
   - Cost of Energy Saving = 0.5026 Baht/kWh

2. Lighting Program
   - Fluorescent Tube: 627.55 MW, 2,279.96 GWh
   - CFL: - MW, 2,279.69 GWh
   - Low-Loss Ballast: 1.29 MW, 5.78 GWh
   - HPSV Street Light: - MW, 16.48 GWh

3. Commercial Bldg. Program
   - Fluorescent Tubes & Reflectors: 1.14 MW, 3.47 GWh
   - CFL: 6.58 MW, 20.03 GWh
   - Thermal Energy Storage at EGAT: 0.48 MW, - GWh

EGAT 13
Calibration of Engineering Estimates

- Surveys, Interviews, and Metering Study by Consulting firms

  - Survey Samples
    - Participant: 247 (Refrigerator), 216 (AC)
    - Non-participant: 229 (Refrigerator), 209 (AC)

  - Metered Samples (Hours of Operation)
    - Participant: 75 (Refrigerator), 64 (AC)
    - Non-participant: 52 (Refrigerator), 65 (AC)

- No. of manufacturers interviewed: 10 (Refrigerator), 32 (AC)

- Mail questionnaires sent to distributors: 170

- In-person interviews with EGAT DSMO Staff
Adjustments due to IMEA comments and spot-metered data

Refrigerator Baseline

Before IMEA’s comment: average value of efficiency tested before program (Nov. 1994) 435 kWh/year/unit
After IMEA’s comment: market average efficiency in Jan 1995 i.e. 435 kWh/year/unit

A/C Baseline

<table>
<thead>
<tr>
<th></th>
<th>IMEA Baseline EER</th>
<th>EGAT Baseline EER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonresidential</td>
<td>80</td>
<td>7.6</td>
</tr>
<tr>
<td>Residential</td>
<td>83</td>
<td>7.6</td>
</tr>
<tr>
<td>Total</td>
<td>82</td>
<td>7.6</td>
</tr>
</tbody>
</table>
Adjustments due to EGAT’s internal analysis and data

Refrigerator
- Coincident peak factor based on maximum kW metered values (not average values).
- Adjusted new with load consumption factor.

A/C
- Coincident peak factor based on maximum kW metered values (not average values).
- Separate A/C sales to residential sector (80%) and non-residential sector (20%) based on in-house telephone survey.
Final Analysis and Finally Reported Results
( Calibration of Engineering Estimates 3 )

As of June 2000

<table>
<thead>
<tr>
<th></th>
<th>Refrigerator</th>
<th>A/C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Demand Reduction (MW)</td>
<td>84</td>
<td>84</td>
</tr>
<tr>
<td>Energy Savings (GWh)</td>
<td>849</td>
<td>318</td>
</tr>
<tr>
<td>CO₂ Reduction (Tons)</td>
<td>627,365</td>
<td>235,314</td>
</tr>
<tr>
<td>Benefit-Cost Ratio</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant Test</td>
<td>65</td>
<td>16</td>
</tr>
<tr>
<td>Utility Test</td>
<td>175</td>
<td>145</td>
</tr>
<tr>
<td>Total Resource Cost Test</td>
<td>16</td>
<td>11</td>
</tr>
</tbody>
</table>
**Market & Process Evaluation**

**Refrigerator (single-door models)**

- High consumer awareness
- 100% Market impact for single-door models (~80% of total market)
- Consumers & manufacturers satisfied
- Improvements recommended
  - Testing speed and accuracy
  - Update labeling scheme
  - Target promotions to salespeople
Average Electricity Consumption of Refrigerator in Program

Average electricity use of refriger participating in the program by 12% since 1995.
Market & Process Evaluation

Air Conditioner

- High consumer awareness
- Manufacturers and consumers satisfied
- Retailers (Green Shops) were less satisfied due to inadequate market support by EGAT
- Market impacts from 19% (1996) to 38% (1998)
- Improvements recommended
  - Testing speed and capacity
  - Simplify loan program
  - Make labeling mandatory
Average EER of Air Conditioner in Program

Average EER of A/C participating in the program by 2% since 1996.
Overall Program Impacts

- Capability building for program implementation & evaluation
- Domestic manufacturer awareness and capability to produce higher efficiency appliances
- Local testing capability improvement at TISI and MEA
- Introduction of Mandatory Energy Efficiency Standards by NEPO for six key end-uses by 2004 (Refrig., A/C, Electric Motors, Ballast, Fluorescent Lamps, Compact Fluorescents)
What was learned?

**Implementation**

- Program delivery is more effective for markets with fewer manufacturers and less price differentials.
- Efficiency and availability of testing facilities are important factors for effective delivery and continuity in operation.
- Voluntary labeling should be first introduced before extending to mandatory status of MEPS.
What was learned?

Reliable pre- and post-program data such as baseline efficiency, market data, and end-use profiles are crucial to enable evaluators to correctly measure program impacts.

Process evaluation is needed during early implementation to provide sufficient feedback to improve program delivery and program design.
## DSM Five-year Plan & Labeling Programs

### Peak Demand and Energy Reductions Expected by Program (2001-2005)

<table>
<thead>
<tr>
<th>Program</th>
<th>Peak Demand Reductions (MW)</th>
<th>Energy Saving (GWh)</th>
<th>B/C Ratios (TRC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refrigerator</td>
<td>108</td>
<td>1,095</td>
<td>1.78</td>
</tr>
<tr>
<td>Air Conditioner</td>
<td>102</td>
<td>388</td>
<td>1.26</td>
</tr>
<tr>
<td>CFL</td>
<td>30</td>
<td>173</td>
<td>1.11</td>
</tr>
<tr>
<td>Ballast</td>
<td>3</td>
<td>18</td>
<td>0.95</td>
</tr>
<tr>
<td>HEM</td>
<td>56</td>
<td>380</td>
<td>1.38</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>299</strong></td>
<td><strong>2,054</strong></td>
<td><strong>1.43</strong></td>
</tr>
</tbody>
</table>

### Labeling Programs primarily focus on residential sector and account for about 57% and 93% of total DSM peak demand and energy reduction targets.