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Office of Energy and Infrastructure
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GUATEMALA: POWER SECTOR EFFICIENCY ASSESSMENT

Demand-Side Management Draft ~~Final Report~~ Interim Report

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No mention of IDEA contribution

Nathaniel Brackett (IDEA, Inc)

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Nathaniel Brackett (IDEA, Inc)

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Guatemala: Key Economic Indicators (in millions of US $ unless noted)

	1990
Domestic Economy[1]	
Population (millions)	9,000
Population growth	3.0%
GDP	10,300
Per capita GDP (current $)	1,300
GDP growth rate	3.0%
Consumer price index change	41.2%
Distribution of Employment	
Agriculture	36%
Industry and commerce	24%
Services	34%
Construction, mining, utilities	4%
Balance of Payments[2]	
Current account balance	-279.3
Exports (FOB)	1,211.5
Imports (CIF)	1,648.8
Merchandise trade balance	-437.3
Capital account	292.4
Foreign official debt (year-end)	2,601.5
Public sector share	56.5%
Debt service/exports ratio	16.2%
Foreign exchange reserves (year-end)	371.3
U.S. bilateral aid	118.0
Avg. exchange rate (Quetzals/US$)	4.5
Central Government Finances[3]	
Revenues	618.9
Expenditures	701.9
Deficit (-) or surplus	-83.0
Deficit as % of GDP	1.1%
U.S.-Guatemala Trade[3]	
Guatemalan exports to U.S. (FOB)	460.7
Guatemalan imports from the U.S. (CIF)	651.6
Trade balance	-190.9
U.S. share of Guatemalan exports	38.0%
U.S. share of Guatemalan imports	39.5%

[1] United States Department of State, *Background Notes: Guatemala*, April 1992, except for consumer price index from *Guatemala Country Memorandum*, The World Bank, June 1991.

[2] Government of Guatemala, Economic Studies Department, *Estudio Economico y Memoria de Labores del Banco de Guatemala: Año 1990.*

[3] *International Financial Statistics*, Volume XLV, No. 8, IMF, August 1992.

EXECUTIVE SUMMARY

BACKGROUND AND STUDY PURPOSE

The consumption of electricity in Guatemala is expected to grow at an average annual rate of almost 6 percent between 1992 and 2000, and over 3 percent between 2001 and 2010, more than doubling the country's current energy consumption capacity over the period 1992-2010. To meet this demand, Guatemalan utilities have planned to ~~build almost~~ 974 MW of ~~additional generating capacity~~, which is scheduled to come on line between 1994 and 2003 at a cost of about US $1.9 billion, not counting for additional transmission and distribution investments.

This level of expenditure could require unsustainable levels of indebtedness. In 1990, the country's principal generation utility, the Instituto Nacional de Electrificación (INDE) fell behind in servicing its $321 million external debt, a sum that represented nearly 22 percent of the country's public-sector external debt in that year.

The lack of cost recovery and debt service requirements have not only hampered efforts to expand capacity in Guatemala but have also led to a steady deterioration in the reliability of service. Power plants have been poorly maintained and distribution systems are regularly overloaded, contributing to an increase in transmission and distribution losses of about 17 percent in 1992.

Thus, alternatives are needed to the conventional approach to capacity expansion. Although Guatemala is already exploring one of these, private power, it has yet to pursue another major alternative: demand-side management (DSM). DSM consists of measures to increase power sector efficiency by reducing consumption. This can be done through energy conservation and energy-efficient technologies or by shifting the system peak (load management) without sacrificing economic growth or comfort.

DSM can be fully integrated in the planning of supply-side options with the development of an integrated resource plan (IRP). An IRP is a least-cost power plan that selects the most economical options from both the supply and demand sides of the meter. Besides yielding economic benefits, DSM/IRP provide environmental benefits in terms of avoided power plant emissions and reduced effluent discharges.

To assist Guatemala in meeting increased electricity demand at the least cost and in an environmentally sound way, the United States Agency for International Development (USAID), in collaboration with INDE and the principal national distribution company, Empresa Eléctrica de Energía de Guatemala Sociedad Anónima (EEGSA), ~~sponsored~~ a study to initiate analyses required for the development of DSM and an integrated resource plan for the country.

This report is but one component of a broader assessment of Guatemalan power sector efficiency improvements. It develops initial estimates for energy and demand savings in Guatemala between 1994 and 2010. A detailed cost/benefit analysis using a standard utility DSM model used widely in the United States (DSManager) will be conducted in the next phase of this assessment. In parallel, opportunities for greater efficiency on the supply side are being evaluated. Another standard model (LMSTM) will be used to integrate and evaluate the least-cost (supply and demand) options for Guatemala. Finally, these various elements will be brought together into an integrated resource plan for the country.

The principal purpose of this report is to provide *initial* estimates of the achievable potential for energy and demand savings in Guatemala between 1994 and 2010; it is the next phase of this project which will develop more robust estimates of the achievable potential for DSM *and* for supply-side improvements in Guatemala. Although energy conservation "supply curves" are provided, giving some indication of the degree of competitiveness of a given DSM resource, this report does not attempt to prioritize DSM measures that will be addressed in the integrated (supply and demand) assessment.

Indicative estimates of financial versus economic results are also provided here.[1] Financial results are captured in the conservation supply curves found at the end of this summary (Exhibits S-2, S-3, S-4, and S-5); the economic analysis is captured in the internal rates of return calculations performed in Appendices C, D, and E, and summarized in Exhibit S-6 at the end of this section.

Potential savings are estimated at the end-use level in the industrial, commercial, and residential sectors in Guatemala. Savings in public lighting are also examined. The analysis draws attention to those end-uses in each sector that are responsible for the bulk of Guatemalan electricity consumption. The industrial sector, for example, consumes more electricity than any other sector, accounting for 32.3 percent of electricity sales in Guatemala in 1990. Here, substantial amounts of electricity can be saved through improved maintenance of equipment and the use of more efficient motors and drives. The commercial sector consumes 22.5 percent of sales, and lighting and refrigeration account for half of total commercial consumption. The residential sector consumes almost as much electricity as Guatemalan industry (30.2 percent), with household refrigeration and lighting accounting for nearly half.

[1] Financial estimates are provided at the measure level; economic estimates are provided at the program level.

Measures that could favorably affect these specific end-uses were evaluated using a DSM benefit/cost spreadsheet designed for this preliminary assessment (the DSM Impact Spreadsheet). The measures examined for the industrial sector include the installation of highly energy-efficient motors and drives, energy-efficient lighting, and such low- or no-cost measures as air-compressor adjustment. In the commercial sector, opportunities for savings in lighting through the replacement of conventional bulbs with high-efficiency fluorescent lamps, compact fluorescents, and other energy-efficient bulbs were among the measures examined. In the residential sector, the installation of more efficient technologies in lighting, refrigeration, cooking and water heating were examined in addition to measures that could achieve savings in public sector lighting. Several load management measures designed to reduce peak-capacity requirements were also explored in this DSM assessment.

This study does not address institutional and implementation issues such as DSM manpower and skill requirements/availability in Guatemala or possible sources of financing for DSM programs. Also, precise estimates of the amount of actual capacity which could be deferred in Guatemala through the use of DSM are not fully evaluated since the supply-side analysis is still being carried out. Therefore, this report does not provide estimates of the potential financial impact of DSM at the utility level nor the macroeconomic and environmental impacts of DSM in Guatemala, subjects which will be addressed in the more detailed integrated supply and demand assessment to follow.

The report provides some general recommendations regarding next steps which the Government of Guatemala could take to begin implementing DSM. Further related recommendations and the prioritization of measures will be presented following the integration of the demand-side analysis with the supply side.

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PRELIMINARY RESULTS[2]

DSM analyses typically present savings in terms of demand (avoided peak-capacity requirements given in megawatts or MW) and energy (consumption in gigawatt hours or GWh). The preliminary results revealed in this study suggest that Guatemala could reduce its expected growth in electricity demand by nearly 19 percent by 2010 with an aggressive, targeted DSM program to reduce or better manage loads for various end-uses.[3] These preliminary results suggest that the country could save nearly 100 MW, for a savings of $192 million in avoided costs between 1994 and 2010.[4] Savings in energy by 2010 could reach 414 GWh. Demand and energy savings would require DSM investments on the order of only $10.4 million over the same period.[5] These investments would secure a benefit of nearly $41.8 million, yielding an overall benefit:cost ratio of 4:1.[6]

The analysis indicates that the following savings can be obtained in **2010**:

Total Demand Savings	**99.4 MW**
--Demand Savings from DSM	67.8 MW
--Demand Savings from Load Management	31.6 MW
--Projected Peak Demand Reduction in %	8.5%
--Savings in Incremental Peak Demand (1994-2010)	**18.9%**
Total Energy Savings	**414.2 GWh**
--Projected Energy Reduction in %	7.1%
--Savings in Incremental Energy Consumption	**15.7%**

2 These results still need to be re-evaluated and incorporated with the results of assessments of: 1) efficiency improvements on the supply side (e.g., reduction of transmission and distribution line losses), 2) utility investment program, 3) DSM program screening with the DSManager modeling tool, and 4) impact evaluations using the LMSTM model.

3 Based on INDE and EEGSA forecasts between 1994 and 2010.

4 Based on Guatemalan utility estimates of an average avoided capacity cost of $1,930.9/kW.

5 Based on the net present value of program administration and equipment costs, as explained in Chapter 3 on methodology.

6 Ibid.

In terms of peak demand savings, the industrial sector offers the greatest savings potential (50.70 MW), followed by the residential (33.57 MW) and commercial (12.67 MW) sectors. Peak demand savings of 2.5 MW could be achieved for public lighting as well. In the industrial sector, low/no cost measures alone could reduce the peak-demand requirement by nearly 4 percent in 2010; innovative rates such as time-of-use (TOU) and interruptible rates could together reduce this sector's peak capacity requirement by nearly 10 percent. In the residential sector, improvements in lighting efficiency could have an important impact by reducing peak demand by nearly 5 percent. The commercial sector could also favorably affect energy consumption through an exterior lighting DSM program expected to shave the peak by nearly 3 percent in 2010.

In terms of energy savings, the industrial sector (including load management measures) could reduce consumption by about 210 GWh in 2010. Roughly 72 percent of these savings could be achieved at low or no cost (i.e., they could result from measures arising from energy audits including improved operation and maintenance of equipment by adjusting air compressors or better maintaining refrigerators, for example). Another 14 percent could come from the successful implementation of a program designed to promote high-efficiency motors and drives. In the commercial sector, increased energy efficiency could save about 82 GWh in 2010; 45 percent of these savings could come from improvements in interior lighting alone. Residential energy savings could reach about 114 GWh in 2010 with greater efficiency in the use of lamps, *termo duchas* (point-of-use showerheads with integral electric resistance heating element), and refrigerators. These end-uses account for nearly 90 percent of the estimated residential electricity savings estimated in this report. (These results are displayed in Exhibit S-1 and in the conservation supply curves provided at the end of this summary.)

None of the savings pertaining to any of the end-use sectors would require a sacrifice in comfort or economic growth in Guatemala. All of the measures are designed to increase efficiency, not to reduce the number of end-use applications or comfort levels.

RECOMMENDATIONS AND ACTION PLAN

This ~~study~~ report provides a series of preliminary recommendations that the Government of Guatemala may wish to use in the development and implementation of an action plan. These specific recommendations seek to address technical and institutional issues in designing and implementing an effective IRP/DSM program in Guatemala.

The institutional recommendations focus on Guatemala being able to effectively implement an integrated resource plan. The recommended DSM programs consist of packages of measures targeting specific end-uses.

Exhibit S-1
Projected DSM Savings for Guatemala: 1994-2010

Proposed DSM Program	Projected Energy Savings (GWh)	Projected Demand Savings (MW)	Average Cost (US ¢ or $)
Industrial Sector:			
Low/No-Cost and Additional Measures	150.50	13.20	0.00-0.90¢/kWh
Energy-Efficient Motors & Drives	27.81	3.42	1.4-3.4¢/kWh
Energy-Efficient Lighting	5.30	0.73	1.1-4.7¢/kWh
Energy-Efficient Air Conditioning	4.14	0.00	4.2¢/kWh
Power Factor Correction	9.96	1.75	n/a
Total	**197.71**	**19.10**	
Commercial Sector:			
Energy-Efficient Interior Lighting	36.76	2.26	1.2-6.5¢/kWh
Energy-Efficient Exterior Lighting	18.17	6.91	3.4-4.8¢/kWh
Energy-Efficient Air Conditioning	1.63	0.00	5.3-7.2¢/kWh
Energy-Efficient Refrigeration	7.95	1.21	0.0-5.8¢/kWh
Low/No-Cost and Additional Measures	17.64	2.28	0.0-6.8¢/kWh
Total:	**82.16**	**12.67**	
Residential Sector:			
Energy-Efficient Lighting	45.56	24.82	4.3-6.0¢/kWh
Energy Efficient Refrigeration	29.05	3.60	0.0-6.6¢/kWh
Energy-Efficient Cooking	7.90	2.10	1.2¢/kWh
Energy-Efficient Water Heating	31.34	3.06	0.0-9.0¢/kWh
Total:	**113.85**	**33.57**	
Public Lighting Sector:			
Energy-Efficient Lighting	**13.00**	**2.50**	3.5¢/kWh
Load Management Measures:			
Industrial Interruptible Rates*	6.30	21.00	$7.09/kW
Time-of-Use Rates*	6.60	10.60	$12.71/kW
Total	**12.90**	**31.60**	
TOTALS	**419.62**	**99.44**	

* Assumes there are no incentives provided to adopt these rates.

In the industrial sector, the programs identified are: 1) interruptible rates, 2) time-of-use rates, 3) low/no-cost measures (such as improved maintenance), and 4) energy-efficient motors and drives. In the commercial sector, they are: 1) energy-efficient lighting, 2) low/no-cost measures, and 3) and an end-use monitoring program designed to collect better data on end-use consumption. In the residential sector, proposed DSM programs consist of: 1) upgrading existing residential lighting, 2) energy-efficient refrigerators, 3) energy-efficient cooking, 4) energy-efficient water-heater tanks, and 5) smaller-element *termo duchas*. Finally, a lighting program is proposed to achieve savings in the public sector. Based on the economic attractiveness of each program and the major areas of interest for Guatemala, priority measures and programs can now be defined for scoping and implementation.

The major recommendations by area, sector, and application are as follows:

Institutional

Goal: Effectively implement an integrated resource plan.

Action 1: INDE and EEGSA should organize a department that is tasked with the responsibility of developing a demand-side management plan. This department would also be responsible for the design, implementation, and evaluation of DSM programs. Some of these activities can be carried out by local consultants/companies under the supervision of the utilities.

Action 2: Strengthen the technical capabilities of INDE, EEGSA, government regulatory agencies, and local consultants/companies in evaluating and implementing demand-side management programs. This would involve the transfer of experience from other countries to Guatemala.

Action 3: Involve public and private sector institutions in collaborative committees to discuss and analyze the opportunities and needs in the public and private sectors, and make recommendations for specific actions, including the participation of energy services companies (ESCOs) for implementation.

Industrial Sector

Low/No Cost Measures

Goal 1: Promote broad-based measures that can be adopted by most industrial customers.

Expected Savings: 150.5 GWh (energy), 13.20 MW (demand)

Action 1: Develop utility-sponsored programs to offer energy surveys for industrial facilities. This will identify different practices and measures that are specific to individual customers. Training seminars should be offered periodically to increase facility managers' awareness of energy-management techniques.

Action 2: One end-use that may be applicable to the industrial sector is energy-efficient refrigeration systems. These systems include high-efficiency compressors and other components. The utilities should develop brochures and train their energy-service representatives to promote regular maintenance of refrigeration systems.

Action 3: Promote the participation of ESCOs, including the strengthening of local technical capabilities.

Energy-Efficient Motors and Drives

Goal: Improve motor and drive efficiency.

Expected Savings: 27.81 GWh (energy), 3.42 MW (demand)

Action 1: Phase I: Attempt to have customers with burned-out motors begin to replace the old motors with energy-efficient motors instead of rewinding. This can be accomplished through the use of point-of-purchase incentives from the utilities or by government-established efficiency standards. Most of the motors observed in industrial applications were from the United States and had NAEMA efficiency ratings on the nameplate, which will aid in identifying actual efficiencies.

Phase II: Attempt to have industrial customers that use belt-drive mechanisms use cogged V-belts for motors smaller than 10 horsepower and synchronous drives for motors 10 horsepower and greater. Again, these technologies could be promoted through the use of point-of-purchase incentives.

Interruptible Rates

Goal 1: Reduce demand during peak load times.

Goal 2: Help to defer the need for new capacity.

Expected Savings: 6.30 GWh (energy), 21.00 MW (demand)

Action 1: Conduct a survey of industrial and large commercial customers to determine customer interest in this type of program. If the potential market for this program is the same as estimated in this study, then a pilot program should be performed to determine how customers respond to this tariff. This would also allow the utilities to test the system and procedures used in controlling these customers.

Action 2: Implement an interruptible-rates program to take advantage of customers who have back-up generators or have the ability to reduce their demand upon notification by the utility.

Time-of-Use Rates

Goal 1: Shift load from peak to off-peak hours.

Goal 2: Improve system efficiency and reduce operating costs.

Expected Savings: 6.6 GWh (energy), 10.60 MW (demand)

Action 1: Perform a survey of industrial and large commercial customers to determine customer interest in TOU tariffs. The survey can be performed for both TOU and interruptible rates.

Action 2: Once the results of the survey are obtained, the utilities can determine whether a voluntary or mandatory TOU program should be implemented.

Action 3: A time-of-use tariff should be implemented for large industrial customers, who tend to be more responsive to TOU rates than smaller industrial customers. The higher the on-peak to off-peak price ratio, the greater the customer response.

Commercial Sector

Energy-Efficient Lighting

Goal: Implement incentive programs to encourage the use of efficient-lighting technologies for exterior and interior applications.

Expected Savings: 36.76 GWh (energy), 2.26 MW (demand)

Action 1: Focus initially on technologies that are available in Guatemala such as compact fluorescents, energy-efficient fluorescent lamps, and delamping with reflectors.

Action 2: Once the programs are established, expand them to include emerging technologies such as T-8s with electronic ballasts.

Low/No Cost Measures

Goal 1: Promote broad-based measures that can be adopted by most commercial customers.

Goal 2: Promote specific technologies that do not represent major commercial end-uses.

Expected Savings: 17.64 GWh (energy), 2.28 MW (demand)

Action 1: Develop utility-sponsored programs to offer energy audits of commercial facilities. These audits will identify different practices and measures specific to individual customers. Training seminars should be offered periodically to increase facility managers' awareness of energy management techniques.

Action 2: Promote energy-efficient motors through incentives. Motors should be targeted for replacement at the end of their life instead of rewinding. The program should include education on the benefits to commercial customers associated with high-efficiency motors.

Commercial End-Use Monitoring

Goal: Enhanced effectiveness of efficiency programs.

Action 1: Perform end-use monitoring studies of commercial customers to validate the load shapes projected as part of this study. Of particular interest are the load shapes for commercial interior and exterior lighting, and refrigeration, which are the largest commercial contributors to the system peak. This monitoring will provide a basis for use in verifying the reductions obtained from DSM programs.

New Energy-Efficient Buildings

Goal 1: Increase electricity efficiency in new commercial and public buildings.

Goal 2: Initiate research and demonstration of energy-efficient building techniques and technologies.

Goal 3: Build a data base on commercial electricity end-uses.

Goal 4: Assess the need to establish minimum building energy standards.

Action 1: Create an ongoing design workshop for commercial building designs that maximize both natural ventilation and daylighting potential. In addition, a design competition should be initiated among the professional and buildings communities to produce energy-efficient designs. Prizes should be awarded to the winners and their designs published.

Action 2: Prepare energy-efficiency information packets for developers.

Action 3: Review the institutional and financial requirements necessary to establish an energy-efficient building standard in Guatemala, including a training, technical assistance, and enforcement program. The current U.S. ASHRAE 90.1 standard may serve as a useful model. Determine the appropriateness of establishing an energy code.

Action 4: Create an ongoing design workshop for establishing a set of new commercial and public building design and equipment guidelines for a variety of housing types. The workshop would include training for architects and builders in daylighting techniques, lighting system design, and control strategies.

Action 5: Sponsor a design competition for high energy-efficiency commercial and public buildings.

Action 6: Develop a data base of electrical end-uses in the commercial sector. Conduct some end-use metering projects for several building types to estimate baseline electricity use.

Residential Sector

Upgrading Existing Residential Lighting

Goal: Install energy-efficient lamps in homes.

Expected Savings: 45.56 GWh (energy), 24.82 MW (demand)

Action 1: Utilities should implement an incentive/rebate program to facilitate the purchase of compact fluorescent and energy-efficient fluorescent lamps, at competitive prices.

Action 2: Develop a brochure that explains the benefits of energy-efficient lighting. The program should be targeted so that compact fluorescents are installed in locations where lights are on three or more hours a day.

Action 3: Conduct an end-use research project to determine the impact on demand and energy as a result of installing energy-efficient lighting in a random sample of homes. This will be very important because this end-use can provide the greatest energy and demand savings in the residential sector.

Energy-Efficient Refrigerators

Goal 1: Replace inefficient refrigerators with efficient refrigerators.

Goal 2: Provide education, technical assistance, and financial assistance to ensure the efficient use of existing refrigerators.

Expected Savings: 29.05 GWh (energy), 3.60 MW (demand)

Action 1: Implement an energy-efficient refrigerator-rebate program to encourage the purchase of efficient refrigerators.

Action 2: Launch an appliance-labeling program to help educate customers on purchasing more efficient refrigerators.

Action 3: Establish efficiency standards that require an increase in refrigerator efficiency.

Action 4: Implement a rebate program for the replacement of door seals for refrigerators.

Action 5: Undertake discussions with local manufacturers to determine the resources and logistics required to improve the efficiency of the refrigerators they produce. The result should be a plan for improving the energy efficiency of refrigerators to be sold locally.

Energy-Efficient Cooking

Goal 1: Replace inefficient stoves with efficient stoves.

Goal 2: Provide education, technical assistance, and financial assistance to ensure the efficient use of existing stoves.

Expected Savings: 7.90 GWh (energy), 2.10 MW (demand)

Action 1: Test locally manufactured stoves to determine the difference in efficiency between these stoves and imported stoves.

Action 2: Hold discussions with local manufacturers to determine the resources and logistics required to improve the efficiency of stoves. The result should be a plan for increasing the efficiency of stoves to be sold locally.

Action 3: Implement a rebate program as an incentive for customers to purchase efficient stoves or for the manufacturer to help keep down the cost of more expensive, energy-efficient models.

Energy-Efficient Water Heater Tanks

Goal 1: Replace inefficient water-heater tanks with efficient ones.

Goal 2: Provide education, technical assistance, and financial assistance to ensure the efficient use of existing water-heater tanks.

Expected Savings: 1.16 GWh (energy), 0.13 MW (demand)

Action 1: Implement a water-heater rebate program to provide incentives for the installation of water-heater blankets, high-efficiency water heaters and heat pumps, low-flow showerheads in homes with water-heater tanks, and solar water heaters.

Smaller-Element *Termo Duchas*

Goal 1: Reduce the energy consumption and demand from *termo duchas.*

Expected Savings: 30.18 GWh (energy), 2.93 MW (demand)

Action 1: Implement efficiency standards to limit the size of the elements in *termo duchas.* This can eliminate the purchase of *termo duchas*, which are oversized for their application, and promote their replacement with more efficient models.

Action 2: Investigate the use of a power controller to control the power level to the *termo ducha.* This would provide better control of the power used by the *termo ducha* instead of increasing the water flow to achieve the proper temperature.

Action 3: Provide education, technical assistance,and financial assistance to ensure the efficient use of *termo duchas.*

Residential End-Use Monitoring

Goal: Improve the knowledge of residential end-use patterns and behavior.

Action 1: Perform end-use monitoring studies of residential customers to validate the residential load shapes projected in this study. Of particular interest are the load shapes for residential lighting, refrigeration, and electric cooking, which are the largest contributors to the residential peak. This monitoring will provide a basis for verifying reductions obtained from DSM programs, but most important, these results can be used by the Utility System Planning Department (Departmento de Planeamiento) in making projections of future load growth and load forecasting.

New Energy-Efficient Buildings

Goal: Develop energy-efficient housing designs, as for the commercial sector.

Action 1: Create an ongoing design workshop for housing designs that maximize both natural ventilation and daylighting potential. In addition, a design competition should be initiated among the professional and buildings communities to produce energy-efficient designs. Prizes should be awarded to the winners and their designs published.

Action 2: Prepare energy-efficiency information packets for developers.

Action 3: Review the institutional and financial requirements necessary to establish an energy-efficient building standard in Guatemala, including a training, technical assistance, and enforcement program. The current U.S. ASHRAE 90.1 standard may serve as a useful model. Determine the appropriateness of establishing an energy code.

Action 4: Create an ongoing design workshop for establishing a set of new housing building design and equipment guidelines for a variety of housing types. The workshop would include training for architects and builders in daylighting techniques, lighting system design, and control strategies.

Action 5: Sponsor a design competition for high energy-efficiency houses.

Action 6: Develop a data base of electrical end-uses in the residential sector. Conduct some end-use metering projects for several housing types to estimate baseline electricity use.

Public Lighting

Lighting Efficiency

Goal 1: Increase the efficiency in the public lighting sector.

Goal 2: Reduce demand at the time of system peak.

Expected Savings: 13.00 GWh (energy), 2.50 MW (demand)

Action 1: Accelerate the replacement of public-lighting fixtures in order to achieve the energy and demand savings (estimated at 13 GWh per year) and coincident peak-demand reduction (2.5 MW) for this measure as early as possible.

Exhibit S-2
Guatemala Industrial Sector:
Cost of Conserved Energy vs. GWh Savings

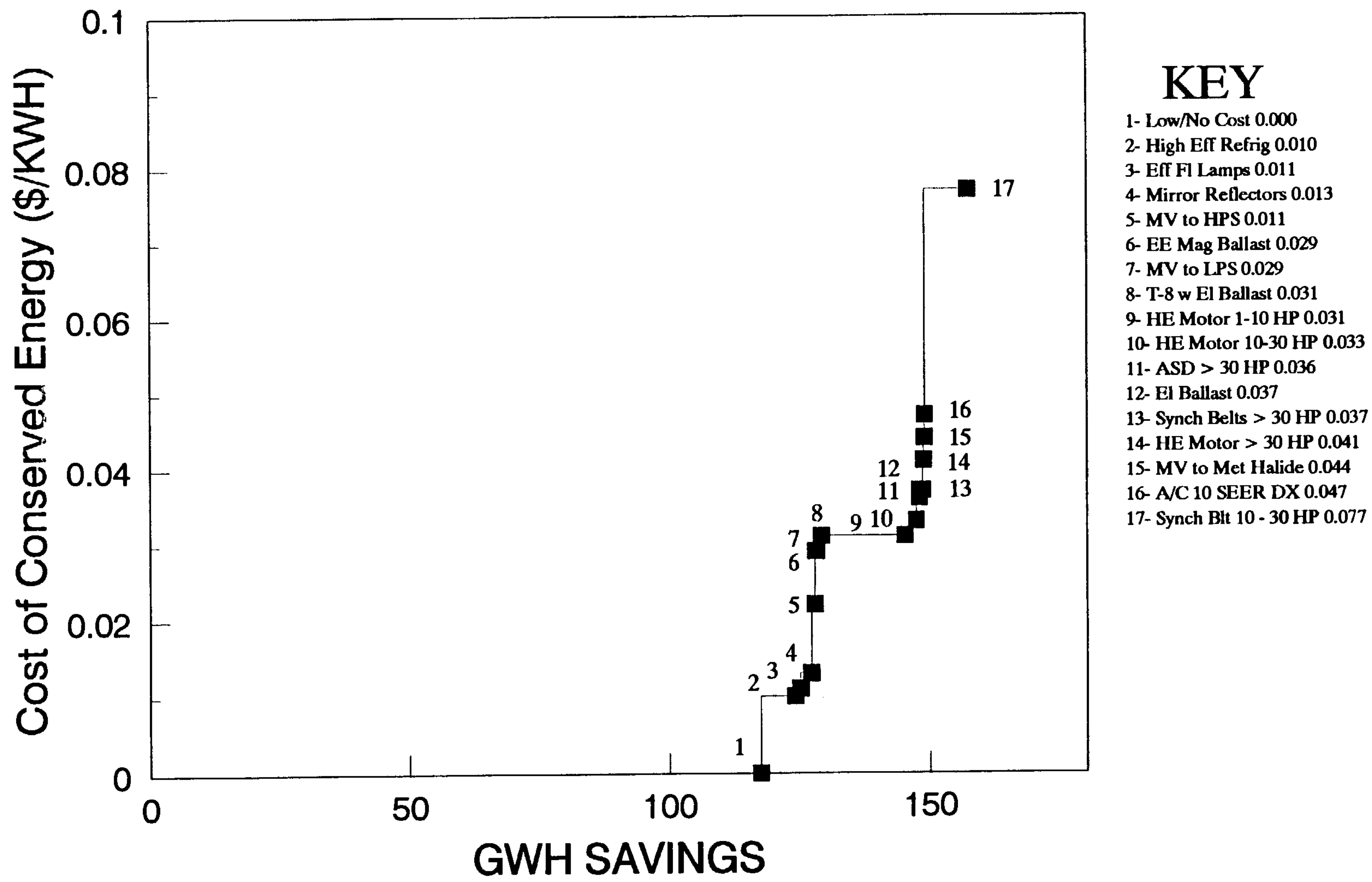


Exhibit S-3
Guatemala Commercial Sector:
Cost of Conserved Energy vs. GWh Savings

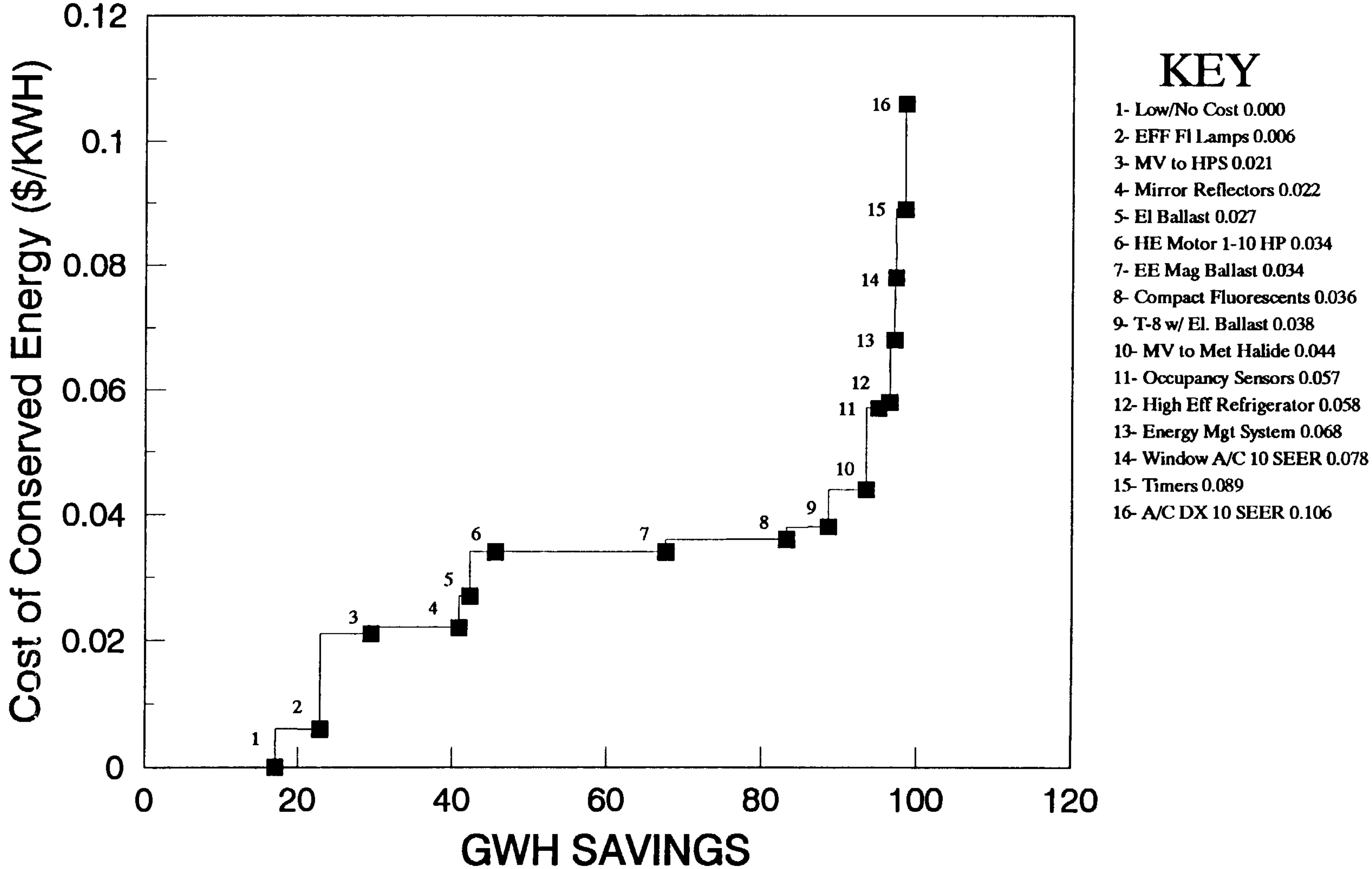
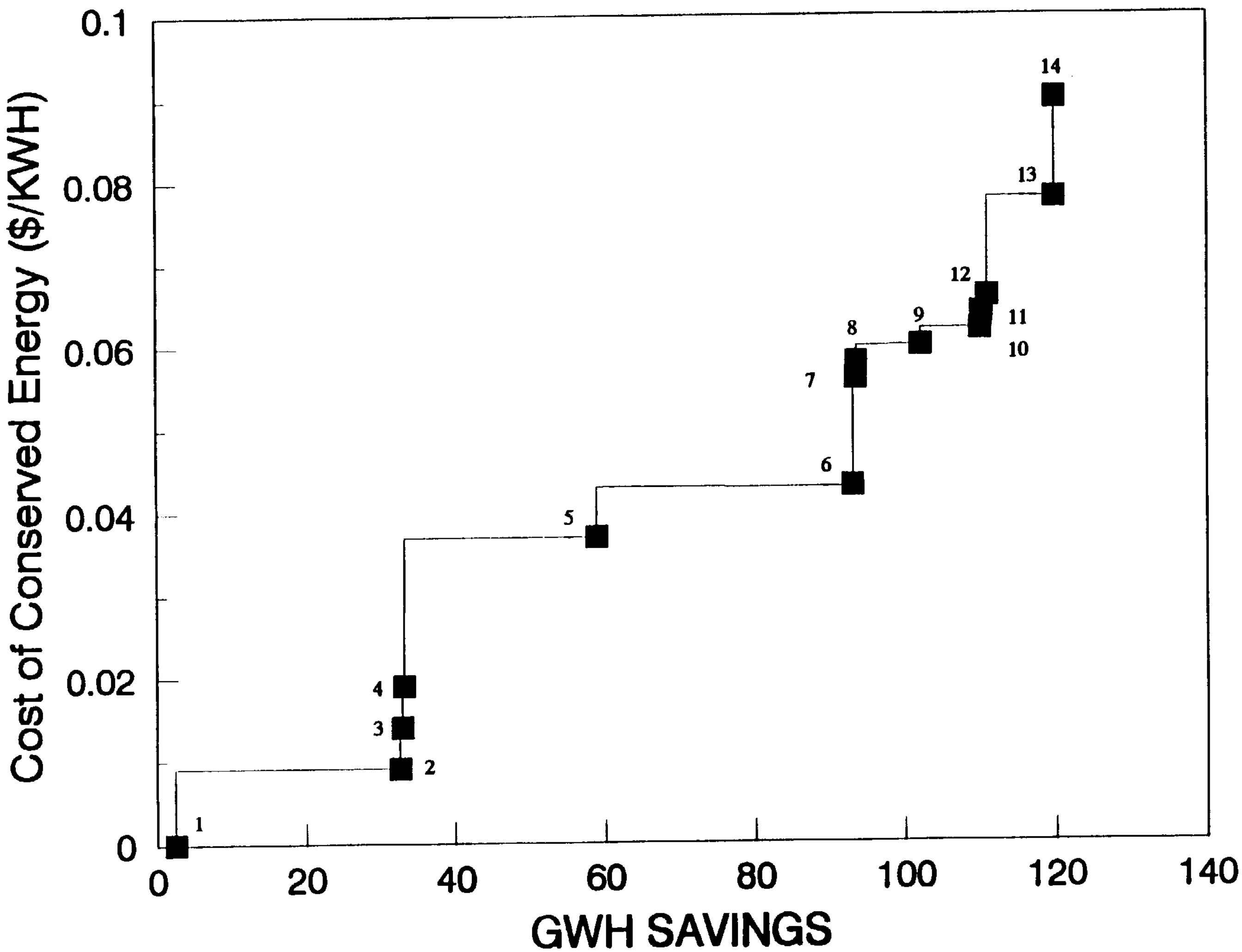


Exhibit S-4
Guatemala Residential Sector:
Cost of Conserved Energy vs. GWh Savings

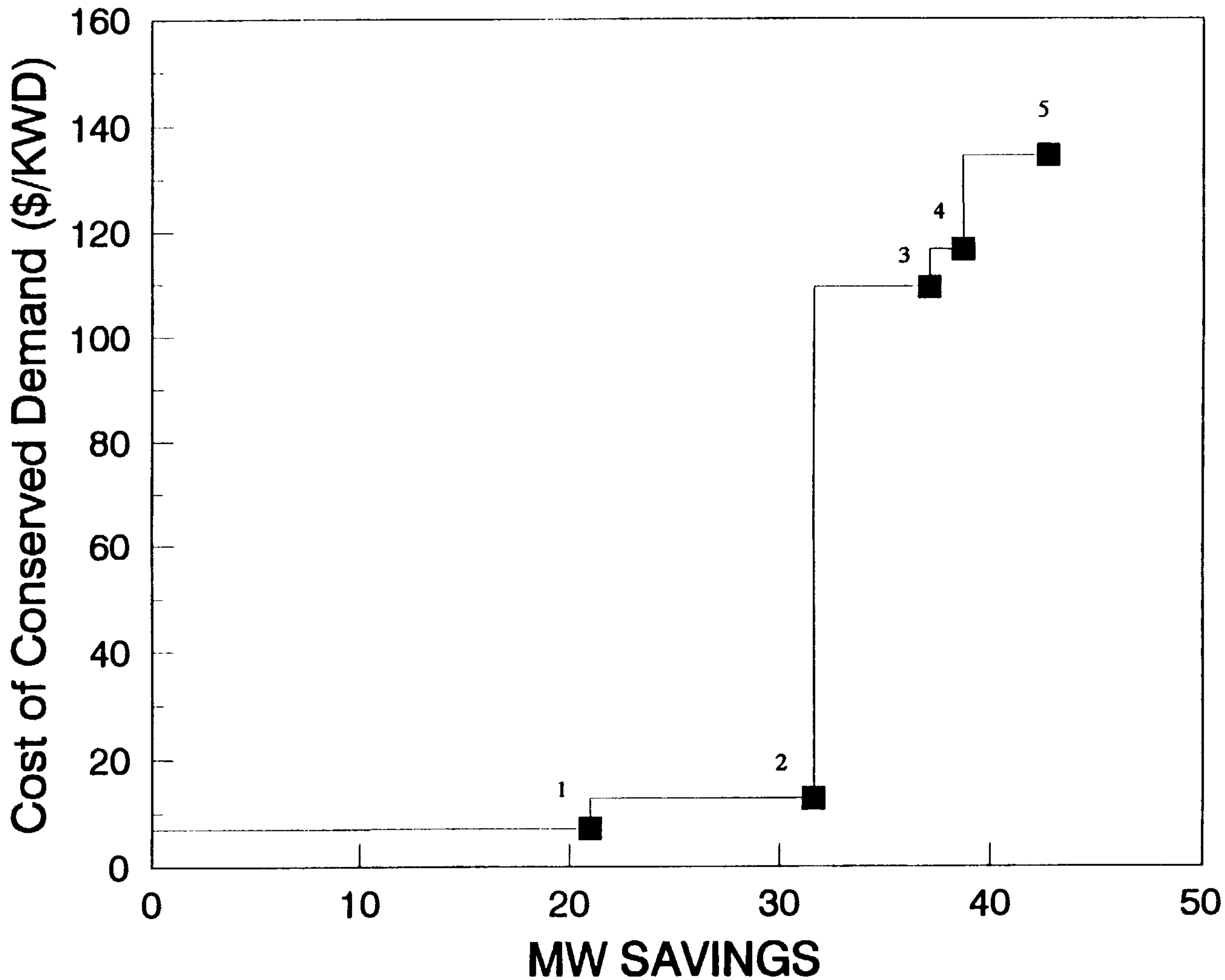


KEY

1- Ref. Behavior Mod. 0.000
2- Lower Element Termo 0.009
3- Low Flow Showerheads .014
4- Water Heater Blanket 0.019
5- HE Refrigerators 0.037
6- Compact Fluorescents 0.043
7- Efficent Water Heaters 0.056
8- Heat Pump WH 0.058
9- Red Wattage Fluorescent 0.060
10- HE Cooking 0.062
11- Water Heater Timer 0.064
12- Seals 0.066
13- HE Incandescent 0.078
14- Solar WH 0.090

Exhibit S-5

2010 Cost of Conserved Demand: Load Management Measure



KEY

1- Industrial Interruptible Rate 7.09

2- Industrial TOU 12.71

3- Commercial TOU 109.45

4- Residential Water Heater Load Control 116.51

5- Residential TOU 134.38

Exhibit S-6
Preliminary Benefit/Cost Ratios, Internal Rates of Return, and Net Present Values:[1]
All DSM Programs in Guatemala

DSM Program	Benefit/Cost Ratio	Est. Internal Rate of Return (%)	Est. Net Present Value of Program Cash Flows (US$) [2]
INDUSTRIAL			
Motors & Drives	7.3	74.28	1,780,050
Lighting	2.5	37.28	240,548
Air Conditioning	1.1	27.27	394
Low/No Cost/Other	37.3	> 100.00	13,397,275
COMMERCIAL			
Interior Lighting	6.7	> 100.00	3,015,457
Exterior Lighting	2.0	58.10	883,535
Air Conditioning	1.1	14.38	6,210
Refrigeration	1.3	27.23	147,215
Low/No Cost/Other	4.9	100.00	146,028
RESIDENTIAL			
Lighting	1.8	42.85	1,079,833
Electric Cooking	1.2	28.22	79,624
Termo Ducha	5.2	66.28	1,351,584
Tank Water Heater	1.5	36.74	36,699
Domestic Refrig.	1.4	41.85	585,947

1 These economic IRR and NPV were used solely to provide a rough assessment of the attractiveness of these measures. DSManager will be used subsequently to provide more robust estimates.

2 For these calculations, a 12% discount rate was used.

ANTECEDENTES Y OBJETIVO DEL ESTUDIO

En Guatemala se espera que el consumo de energía crezca a una tasa promedio anual de casi 6 por ciento entre 1992 y el año 2000, y por arriba del 3 por ciento entre los años 2001 y 2010, lo que representa más del doble de la capacidad del consumo nacional actual en el período 1992-2010. Para satisfacer esta demanda, las empresas de servicio público guatemaltecas han planeado construir cerca de 974 MW de capacidad de generación eléctrica adicionales, los cuales se han programado para que entren al sistema entre 1994 y el 2003, a un costo aproximado de mil 900 millones de dólares, sin considerar inversiones adicionales de transmisión y distribución.

Sin embargo, este nivel de gasto puede ocasionar montos insostenibles de endeudamiento. En 1990, la principal empresa generadora de energía eléctrica del país, el Instituto Nacional de Electrificación (INDE), retrasó el pago del servicio de su deuda externa de 321 millones de dólares, suma que representó cerca del 22 por ciento de la deuda pública externa nacional en un año.

La ausencia de un costo de recuperación y la necesidad de pagar los servicios de la deuda no solamente han impedido los esfuerzos por expandir la capacidad eléctrica en Guatemala, sino que han provocado también un constante deterioro en la confiabilidad del servicio. Las centrales eléctricas han tenido un escaso mantenimiento y los sistemas de distribución regularmente se encuentran sobrecargados, contribuyendo a incrementar las pérdidas por transmisión y distribución en cerca de 17 por ciento en 1992.

De esta forma, son necesarias diversas alternativas dentro de un enfoque convencional para la expansión de la capacidad eléctrica. Aún cuando Guatemala se encuentra ya explorando una de estas alternativas, la generación eléctrica por parte de la iniciativa privada, ha sido necesario buscar otras alternativas importantes como: la Administración de la Demanda (DSM son las siglas en inglés). El DSM consiste en aplicar medidas para incrementar la eficiencia del sector eléctrico a través de la reducción en el consumo final de electricidad. Esto puede lograrse mediante la conservación de la energía y la utilización de tecnologías energéticas más eficientes, o bien reduciendo la demanda pico del sistema mediante la administración de cargas sin sacrificar ni crecimiento económico ni bienestar social.

El DSM puede ser integrado totalmente dentro de la planeación de opciones de la oferta y en el desarrollo de un Plan Integral de Optimización de Recursos (PLIOR). El PLIOR es un plan de generación eléctrica a costos mínimos que selecciona las opciones más rentables tanto del lado de la oferta como de la demanda. Además de la obtención de importantes beneficios económicos, el DSM/PLIOR permitiría obtener beneficios ecológicos al disminuir las emisiones de las centrales eléctricas y reducir los desechos líquidos.

Para proporcionar asistencia técnica a Guatemala en la satisfacción de la creciente demanda de energía eléctrica a costos mínimos y considerando el aspecto ecológico de manera comprometida, la Agencia Internacional para el Desarrollo de los Estados Unidos (USAID), en colaboración con el INDE y la principal compañía nacional de distribución de electricidad, la Empresa Eléctrica de Guatemala (EEGSA), han promovido y patrocinado un estudio para iniciar los trabajos pertinentes en el análisis y desarrollo de la Administración de la Demanda y de un Plan Integral de Optimización de Recursos para el país.

El presente reporte constituye un importante componente dentro de un análisis más amplio en el mejoramiento de la eficiencia energética del sector eléctrico en Guatemala. Dicho análisis desarrolla estimaciones iniciales de ahorro de energía y disminuciones de la demanda en Guatemala para el período 1994-2010; un análisis detallado de costo-beneficio, utilizando un reconocido modelo de Administración de la Demanda, ampliamente utilizado en los Estados Unidos (el DSManager), será aplicado en la siguiente fase del estudio.

Paralelamente, se evaluarán las oportunidades para lograr una mayor eficiencia en la parte correspondiente al abastecimiento eléctrico; se utilizará otro modelo (LMSTM) para integrar y evaluar las opciones de costos mínimos (tanto de la oferta como de la demanda) para Guatemala. Finalmente, todos estos elementos serán considerados conjuntamente dentro de un Plan Integral de Optimización de Recursos para todo el país.

El objetivo principal de este reporte se centra en proporcionar estimaciones iniciales para conocer la factibilidad de los potenciales de ahorro de energía y disminución de la demanda en Guatemala para el período 1994-2010. En la siguiente fase de este proyecto se desarrollarán estimaciones más completas de estos potenciales para su análisis, tanto en la parte de Administración de la Demanda, como en la parte de optimización del abastecimiento eléctrico en Guatemala. Aún cuando son proporcionadas las "curvas de oferta" de la conservación de energía, y se presentan algunas indicaciones sobre el grado de competitividad de un determinado recurso dentro del análisis de la Administración de la Demanda, este reporte no intenta priorizar las medidas proporcionadas en dicho análisis, ésto se hará al integrar los estudios de oferta y demanda.

Se proporcionan también cálculos indicativos de resultados financieros contra resultados económicos.[1] Los primeros, son considerados en la elaboración de las curvas de energía ahorrada al final de este resumen ejecutivo (gráficas S-2, S-3, S-4 y S-5). Por su parte, el

[1] Los cálculos financieros son presentados a nivel de medida, mientras que los cálculos económicos se consideran a nivel de programa.

análisis económico es considerado en los cálculos de las tasas internas de retorno presentadas en los apéndices C, D y E y resumidos en el cuadro S-6 al final de esta sección.

Los ahorros potenciales son estimados a nivel de uso final de los sectores industrial, comercial y residencial de Guatemala, lo mismo que los ahorros en iluminación pública. Finalmente, el análisis centra su atención en los usos finales de cada sector que componen la mayor parte del consumo de energía eléctrica en Guatemala.

El sector industrial, por ejemplo, consume más energía eléctrica que cualquier otro sector, participando con 32.3 por ciento de las ventas totales de electricidad en Guatemala durante 1990. En este sector, es posible ahorrar montos considerables de energía eléctrica mediante la optimización del mantenimiento de equipos y la utilización de motores y mecanismos de transmisión más eficientes.

El sector comercial por su parte, representa 22.5 por ciento de las ventas, en donde la iluminación y refrigeración participan con la mitad del consumo total de este sector. Finalmente, el sector residencial consume casi la misma cantidad de energía eléctrica que el sector industrial (30.2 por ciento), representando tanto la refrigeración doméstica como la iluminación cerca de la mitad de este consumo.

Las medidas que podrían afectar favorablemente estos usos finales específicos han sido evaluados utilizando un modelo de costo-beneficio dentro del estudio de Administración de la Demanda, diseñado específicamente para este análisis (el modelo de Impacto DSM). Las medidas examinadas para el sector industrial incluyen la instalación de motores y mecanismos de transmisión altamente eficientes, iluminación de alta eficiencia y medidas de bajo o nulo costo tales como el ajuste de compresores de aire.

Por su parte, en el sector comercial las oportunidades para lograr los ahorros en iluminación se realizarían a través del reemplazo de lámparas convencionales por lámparas fluorescentes de alta eficiencia y lámparas fluorescentes compactas, entre otras medidas examinadas.

En el sector residencial, la instalación de tecnologías más eficientes en iluminación, refrigeración, cocción y calentamiento de agua, fueron examinadas además de las medidas que pueden alcanzar ahorros importantes en iluminación dentro del sector público. Algunas medidas en la administración de cargas, diseñadas para reducir las necesidades de utilizar capacidad eléctrica instalada en períodos pico fueron también exploradas en el análisis.

El presente estudio no considera aspectos institucionales o de implementación de medidas, tales como la asimilación de experiencias y cubrir las necesidades de capacitación de recursos humanos, o la consecución de posibles recursos financieros para programas de DSM.

De la misma forma, cálculos precisos de la cantidad de la capacidad eléctrica en Guatemala (que puede ser diferida a través de la Administración de la Demanda), no han sido evaluados ya que el análisis de oferta aún se está realizándose. Por lo tanto, este reporte no proporciona estimaciones sobre el impacto financiero del DSM a nivel de empresa eléctrica, ni tampoco sobre impacto macroeconómico y/o ecológico, aspectos que serán tratados con mayor detalle en el análisis integrado de oferta y demanda.

El presente resumen ejecutivo proporciona recomendaciones generales en relación a las etapas que el Gobierno de Guatemala puede tomar para iniciar la implementación de un programa de Administración de la Demanda. Las recomendaciones adicionales y la jerarquización de medidas, se presentarán en la integración del análisis tanto del lado de la oferta como de la demanda.

RESULTADOS PRELIMINARES[2]

El análisis de Administración de la Demanda normalmente presenta ahorros en términos de demanda (evitando requerimientos de capacidad instalada en períodos pico, presentados en megawatts o MW) y de energía (consumo en gigawatts/hora o GWh). Los resultados preliminares obtenidos en este estudio proponen que Guatemala puede reducir el crecimiento de la demanda de electricidad esperada en cerca de 19 por ciento para el año 2010 con un programa agresivo de Administración de la Demanda.[3]

Estos resultados finales proponen que el país puede ahorrar aproximadamente 100 MW, lo cual equivale a ahorros de 192 millones de dólares en costos evitados en el período 1994-2010.[4] Los ahorros de energía pueden llegar a representar para el año 2010 los 414 GWh; los ahorros de demanda y energía requerirían inversiones del orden de 10.4 millones de dólares en el mismo período.[5] Estas inversiones asegurarían un beneficio de

[2] Estos resultados serán reevaluados e incorporados a los análisis de: 1) el mejoramiento en la eficiencia por el lado de la oferta (v.g., reducción de pérdidas en lineas de transmisión y distribución), 2) el programa de inversión de las empresas públicas, 3) programas de Administración por Demanda seleccionados con elementos de análisis del modelo DSManager, y 4) evaluaciones de impacto utilizando el modelo LMSTM.

[3] Basado en proyecciones del INDE y la EEGSA para el periodo 1994-2010.

[4] Basado en estimaciones de las empresas eléctricas guatemaltecas con un costo promedio de la capacidad que se espera no instalar de 1,930.9 dólares/KW.

[5] Basado en el valor presente neto del programa de costos de administración y equipo, tal como se explica en el capítulo 3 dentro de la metodología.

aproximadamente 41.8 millones de dólares, resultando en una relación costo-beneficio de 4 : 1.[6]

El análisis indica que para el año 2010 es posible obtener los siguientes ahorros:

1) Disminución Total de la Demanda	**99.4 MW**
--Disminución de la Demanda por Conservación	67.8 MW
--Disminución en la Demanda por Administración de Cargas	31.6 MW
--Reducción Proyectada de la Demanda Pico en %	8.5%
--Reducción de Capacidad Adicional para 1994-2010	**18.9%**
2) Ahorros de Energía Totales	**414.2 GWh**
--Reducción Proyectada de Energía en 2010	7.1%
--Reducción de Energía Adicional Realizada para 1994-2010	**15.7%**

En lo que respecta a la reducción de la demanda pico, el sector industrial se presenta como el más importante (50.70 MW), seguido por los sectores residencial (33.57 MW) y comercial (12.67 MW). Asimismo, es posible alcanzar las reducciones en la demanda pico a través de la iluminación pública por 2.5 MW.

En el sector industrial, las medidas de bajo o nulo costo pueden reducir los requerimientos de la demanda pico en aproximadamente 4 por ciento para el año 2010; nuevas tarifas horarias de e interrumpibles pueden conjuntamente reducir los requerimientos de capacidad en períodos pico en cerca de 10 por ciento. En el sector residencial, el mejoramiento en la eficiencia de iluminación puede impactar la demanda pico de manera importante la demanda pico, reduciéndola en cerca de 5 por ciento. Por último, el sector comercial a través del programa de sustitución de la iluminación exterior, el cual puede disminuir la demanda pico en 3 por ciento para el año 2010.

Por su parte, en los ahorros de energía el sector industrial (incluyendo las medidas de administración de cargas) podría reducir el consumo en cerca de 210 GWh en el año 2010. Aproximadamente 72 por ciento de estos ahorros podrían ser conseguidos a bajo o nulo costo (v.g., éstos pueden resultar de medidas obtenidas en la realización de auditorías energéticas, incluyendo mejoras de operación y mantenimiento de equipos). Un 14 por ciento adicional

[6] Ibid.

podría obtenerse con la implementación de un programa de motores y mecanismos de transmisión de alta eficiencia.

En el sector comercial, el incremento de la eficiencia energética podría permitir un ahorro cercano a 82 GWh para el año 2010; 45 por ciento podría obtenerse de mejoras en iluminación interior únicamente. Los ahorros en el sector residencial pueden llegar a 114 Gwh para el año 2010 con mayores eficiencias en la utilización de lámparas, termoduchas y refrigeradores. Estos usos finales representan cerca del 90 por ciento de los ahorros estimados en este reporte de energía eléctrica en el sector residencial. (Estos resultados se muestran en el cuadro S-1 y en las curvas de energía ahorrada proporcionadas al final del resumen ejecutivo.)

Ninguno de estos ahorros representa una disminución en el bienestar social o en el crecimiento económico de Guatemala. Cada una de estas medidas fue diseñada para incrementar la eficiencia energética, y no para reducir el número de aplicaciones finales o los niveles de bienestar social.

Cuadro S-1
Ahorros Proyectados de DSM para Guatemala: 1994-2010

Programa Propuesto de Administración de la Demanda	Ahorros de Energía Proyectados (GWh)	Ahorros de Demanda Proyectados (MW)	Costo Promedio (US ¢ o Dls)
Sector Industrial:			
- Bajo-Nulo Costo y Medidas Adic.	150.50	13.20	0.00-0.90¢/kWh
- Motores y Mecanismos de Transmisión de Alta Eficiencia	27.81	3.42	1.4-3.4¢/kWh
- Iluminación	5.30	0.73	1.1-4.7¢/kWh
- Aire Acondicionado	4.14	0.00	4.2¢/kWh
- Corrección del Factor de Potencia	9.96	1.75	n/a
Total	**197.71**	**19.10**	
Sector Comercial:			
- Iluminación Interior	36.76	2.26	1.2-6.5¢/kWh
- Iluminación Exterior	18.17	6.91	3.4-4.8¢/kWh
- Aire Acondicionado	1.63	0.00	5.3-7.2¢/kWh
- Refrigeración	7.95	1.21	0.0-5.8¢/kWh
- Bajo-Nulo Costo y Medidas Adic.	17.64	2.28	0.0-6.8¢/kWh
Total:	**82.16**	**12.67**	
Sector Residencial:			
- Iluminación	45.56	24.82	4.3-6.0¢/kWh
- Refrigeración	29.05	3.60	0.0-6.6¢/kWh
- Cocción	7.90	2.10	1.2¢/kWh
- Calentamiento de Agua	31.34	3.06	0.0-9.0¢/kWh
Total:	**113.85**	**33.57**	
Sector de Iluminación Pública:	**13.00**	**2.50**	3.5¢/kWh
Medidas de Administración de Cargas:			
- Tarifas Interrumpibles *	6.30	21.00	$7.09/kW
- Tarifas horarias *	6.60	10.60	$12.71/kW
Total	**12.90**	**31.60**	
TOTAL	**419.62**	**99.44**	

* Se considera que no se dan incentivos para cambiar a estas tarifas.

RECOMENDACIONES Y PLAN DE ACCION

El presente estudio proporciona una serie de recomendaciones preliminares que el Gobierno de Guatemala podría considerar para el desarrollo e implementación de un plan de acción. Estas recomendaciones específicas buscan obtener beneficios técnicos e institucionales diseñando e implementando un programa efectivo de DSM/PLIOR en Guatemala.

Las recomendaciones institucionales enfocadas a Guatemala hacen posible la implementación efectiva de un Plan Integral de Optimización de Recursos. Los programas recomendados de Administración de la Demanda consisten en paquetes de medidas dirigidas a usos finales específicos.

En el sector industrial, los programas identificados son: 1) tarifas interrupción, 2) tarifas horarias, 3) medidas de bajo o nulo costo (tales como mejorar el mantenimiento), y 4) motores y mecanismos de transmisión de alta eficiencia. En el sector comercial, los programas son: 1) La iluminación de alta eficiencia, 2) medidas de bajo o nulo costo, y 3) el diseño de un programa de monitoreo de consumo final para obtener estadísticas confiables de este consumo. En el sector residencial, el programa propuesto consiste en: 1) mejorar la iluminación existente en este sector, 2) refrigeradores de alta eficiencia, 3) eficiencia energética en cocción, 4) eficiencia energética en calentadores de agua, y 5) elementos de menor capacidad en las termoduchas. Finalmente, se propone un programa para mejorar la eficiencia de la iluminación pública.

Basados en la rentabilidad de cada programa y en el interés de Guatemala por las principales áreas de estudio, los programas y medidas prioritarias, pueden definirse ahora para su alcance e implementación.

Las recomendaciones más importantes por area, sector y aplicación son las siguientes:

Institucional

Objetivo : Implementar efectivamente el Plan Integral de Optimización de Recursos.

Acción 1: El INDE y la EEGSA organizarían un departamento encargado de desarrollar un plan de Administración de la Demanda. Este departamento sería también responsable del diseño, implementación y evaluación de los programas de DSM. Algunas de sus actividades pueden ser llevadas a cabo por consultores y firmas de ingeniería bajo supervisión de las empresas eléctricas.

Acción 2: Fortalecer la experiencia técnica del INDE, la EEGSA, las agencias reguladoras gubernamentales y las compañías consultoras locales. Lo anterior implicará la transferencia de experiencias de otros países hacia Guatemala.

Acción 3: Involucrar la colaboración de los sectores público y privado a través de comités para discutir y analizar las oportunidades y necesidades en estos mismos sectores, elaborando recomendaciones para llevar a cabo acciones específicas e incluyendo la participación de compañías oferentes de servicios energéticos para su implementación.

Sector Industrial

Medidas de Bajo o Nulo Costo

Objetivo 1: Promover ampliamente las medidas que pueden ser adoptadas por la mayor parte de los consumidores industriales.

Ahorros Esperados: 150.5 GWh (en energía), 13.20 MW (en demanda)

Acción 1: Desarrollar programas financiados por las empresas eléctricas para ofrecer estudios a la industria. Esto identificará las medidas y prácticas específicas para los consumidores individuales. También, podrían realizarse seminarios de capacitación periódicamente para incrementar el conocimiento en administración de energía de los técnicos y administradores locales.

Acción 2: Un uso final que puede ser aplicado al sector industrial son los sistemas eficientes de refrigeración. Estos sistemas incluirían compresores de alta eficiencia, así como otros componentes. Las empresas eléctricas podrían desarrollar folletos y capacitar a sus representantes de servicios de energía para promover el mantenimiento regular de los sistemas de refrigeración.

Acción 3: Promover la participación de las Compañías de Servicios Energéticos, incluyendo el fortalecimiento de la experiencia técnica local.

Motores y Mecanismos de Transmisión de Alta Eficiencia

Objetivo: Mejorar la eficiencia de motores y mecanismos de transmisión.

Ahorros Esperados: 27.81 GWh (en energía), 3.42 MW (en demanda)

Acción 1: Fase I: Intentar que los consumidores que cuenten con motores en mal estado o quemados inicien su reemplazo por motores de alta eficiencia en lugar de rebobinarlos. Lo anterior puede realizarse a través del uso de incentivos al momento de la compra otorgados por normas establecidas por las empresas eléctricas y el mismo gobierno de Guatemala. La mayoría de los motores observados en las aplicaciones industriales provenían de los Estados Unidos y contaban con clasificaciones de eficiencia NEMA en la placa de diseño, lo cual ayudaría en la estimación de eficiencias actuales.

Fase II: Intentar conseguir que los consumidores del sector industrial que utilicen bandas como mecanismos de transmisión, cambien a bandas dentadas para motores menores de 10 caballos de fuerza y a bandas síncronas cuando estos sean superiores a 10 caballos de fuerza. Estas tecnologías pueden también ser promovidas a través de incentivos al momento de la compra.

Tarifas Interrumpibles

Objetivo 1: Reducir la demanda durante los períodos pico.

Objetivo 2: Promover que los requerimientos de nueva capacidad sean diferidos.

Ahorros Esperados: 6.30 GWh (en energía), 21.00 MW (en demanda)

Acción 1: Aplicar un estudio sobre consumidores ubicados tanto en el sector industrial como en el gran comercio para despertar su interés en este tipo de tarifas. Si el potencial del mercado para este programa se presenta igual al estimado dentro del presente estudio, se aplicaría un programa piloto para determinar como responden a esta tarifa los consumidores.

Acción 2: Implementar un programa de tarifas interrumpibles para obtener ventajas de los consumidores que cuenten con generadores de emergencia o que tengan la capacidad de reducir su demanda, al ser notificados por la compañía eléctrica.

Tarifas Horarias

Objetivo 1: Cambiar la carga de horas pico a horas fuera de pico.

Objetivo 2: Mejorar la eficiencia del sistema y reducir los costos de operación.

Ahorros Esperados: 6.6 GWh (en energía), 10.60 MW (en demanda).

Acción 1: Realizar un estudio sobre los consumidores del sector industrial y del gran comercio para determinar su interés en las tarifas horarias. El estudio abarcaría tanto éstas como las interrumpibles.

Acción 2: Una vez que los resultados del estudio sean obtenidos, las empresas eléctricas podrían determinar si es necesario aplicar un programa de tarifas horarias voluntario u obligatorio.

Acción 3: Una tarifa horaria podría ser aplicada a grandes consumidores en el sector industrial que normalmente tuvieran mayor respuesta a éstas tarifas que consumidores más pequeños. Mientras más alta es la relación entre el precio del período pico respecto al precio fuera del pico, es más alta la respuesta de los consumidores.

Sector Comercial

Iluminación de Alta Eficiencia

Objetivo: Implementar programas de incentivos para promover la utilización de tecnologías eficientes en iluminación para aplicaciones en interiores y exteriores.

Ahorros Esperados: 36.76 GWh (en energía), 2.26 MW (en demanda)

Acción 1: Enfocarse inicialmente en tecnologías disponibles dentro de Guatemala tales como lámparas fluorescentes compactas, lámparas fluorescentes de alta eficiencia, láminas reflectoras para incrementar la eficiencia de iluminación.

Acción 2: Una vez que los programas sean establecidos, difundirlos para incluir tecnologías emergentes tales como lámparas T-8 con balastros electrónicos.

Medidas de Bajo o Nulo Costo

Objetivo 1: Promover medidas de amplia aplicación que puedan ser adoptadas por la mayoría de los consumidores comerciales.

Objetivo 2: Promover tecnologías específicas que no representen mayores consumos al sector comercial.

Ahorros Esperados: 17.64 GWh (en energía), 2.28 MW (en demanda)

Acción 1: Desarrollar programas financiados por empresas eléctricas para ofrecer auditorías energéticas en empresas comerciales; Tales auditorías identificarían diferentes recomendaciones y medidas para consumidores individuales. Podrían ofrecerse cursos de capacitación periódicamente para incrementar el conocimiento en administración de energía de los técnicos y administradores locales.

Acción 2: Promover, a través de incentivos, la utilización de motores de alta eficiencia. Además, los motores deberían ser considerados para reemplazarse al final de su vida útil en lugar de rebobinarlos. El programa incluiría también capacitación para los consumidores del sector comercial sobre los beneficios obtenidos al contar con una alta eficiencia en los motores.

Monitoreo en el Sector Comercial sobre Usos Finales

Objetivo: Mejorar la efectividad de los programas de eficiencia energética.

Acción 1: Realizar estudios de monitoreo sobre los usos finales de los consumidores comerciales para validar los escenarios de carga proyectados dentro del mismo estudio. Resultan de particular interés los escenarios elaborados sobre iluminación interior y exterior de centros comerciales y los de refrigeración, ya que la mayor contribución a la demanda pico proviene de estos usos finales. Dicho monitoreo proporcionaría bases para verificar los logros y reducciones obtenidas dentro del programa de Administración de la Demanda.

Eficiencia Energética en Nuevos Edificios

Objetivo 1: Elevar la eficiencia eléctrica en edificios de los sectores comercial y público.

Objetivo 2: Iniciar la investigación y demonstración de técnicas y tecnologías en eficiencia energética en edificios.

Objetivo 3: Elaborar una base de datos para usos finales de electricidad en el sector comercial.

Objetivo 4: Analizar la necesidad de establecer normas mínimas de eficiencia energética en edificios.

Acción 1: Crear un taller de diseño avanzado en edificios comerciales para maximizar el potencial de ventilación natural y el de la luz del día en nuevos edificios. Además, podría establecerse un concurso de diseño de edificios energéticamente eficientes entre grupos profesionales; los premios a los ganadores podrían incluir la publicación y difusión de sus trabajos.

Acción 2: Preparar paquetes de información sobre eficiencia energética para inversionistas en construcción.

Acción 3: Examinar los requerimientos institucionales y financieros para establecer normas de eficiencia energética para edificios en Guatemala, incluyendo un programa de capacitación, de asistencia técnica y de aplicación de normas. La actual norma U.S. ASHRAE 90.1 podría servir como modelo. Determinar la necesidad de establecer una norma de eficiencia energética.

Acción 4: Crear un taller de diseño avanzado para establecer un conjunto de nuevos diseños en edificios comerciales y públicos así como lineamientos para diversos tipos de construcciones y hogares particulares.

Acción 5: Financiar un concurso sobre diseño de edificios del sector comercial y público con alta eficiencia energética.

Acción 6: Desarrollar una base de datos sobre usos finales de energía eléctrica en el sector comercial. llevar a cabo proyectos de monitoreo de consumo en diferentes tipos de edificios y desarrollar lineamientos de consumo eléctrico.

Sector Residencial

Optimizar la Iluminación Residencial

Objetivo: Instalar lámparas de alta eficiencia energética en los hogares.

Ahorros Esperados: 45.56 GWh (en energía), 24.82 MW (en demanda)

Acción 1: Implementar a través de las empresas eléctricas, un programa de incentivos y descuentos para facilitar la compra de lámparas fluorescentes compactas y de alta eficiencia a precios competitivos.

Acción 2: Desarrollar documentación de difusión como folletos que expliquen los beneficios de la iluminación de alta eficiencia. El programa debería estar enfocado a la instalación de lámparas compactas en establecimientos en donde se utiliza la luz artificial por tres o más horas al día.

Acción 3: Llevar a cabo un proyecto de investigación de usos finales para determinar el impacto a nivel de demanda y energía como resultado de la instalación de iluminación de alta eficiencia en una muestra aleatoria de hogares. Esto sería de gran importancia ya que dichos usos finales pueden proporcionar mayores ahorros tanto en demanda como en energía dentro del sector residencial.

Refrigeradores de Alta Eficiencia

Objetivo 1: Reemplazar refrigeradores ineficientes por otros más eficientes.

Objetivo 2: Proporcionar capacitación, asistencia técnica y financiera para asegurar el uso eficiente de los refrigeradores existentes.

Ahorros Esperados: 29.05 GWh (en energía), 3.60 MW (en demanda)

Acción 1: Implementar un programa de reembolsos para incentivar la compra de refrigeradores de alta eficiencia.

Acción 2: Iniciar un programa de difusión por medio de etiquetas para concientizar a los consumidores a comprar refrigeradores más eficientes.

Acción 3: Establecer normas energéticas que demanden una mayor eficiencia en el diseño de refrigeradores.

Acción 4: Implementar un programa de reembolsos para impulsar el reemplazo de sellos en las puertas de refrigeradores con mayor eficiencia.

Acción 5: Establecer reuniones con los fabricantes locales para determinar los recursos y logística requerida para mejorar la eficiencia de los refrigeradores que ellos producen. El resultado deberá ser un plan para mejorar la eficiencia de los refrigeradores que serán vendidos localmente.

Eficiencia Energética en Cocción

Objetivo 1: Reemplazar las estufas ineficientes por otras más eficientes.

Objetivo 2: Proporcionar capacitación, asistencia técnica y financiera para asegurar el uso eficiente de las estufas existentes.

Ahorros Esperados: 7.90 GWh (en energía), 2.10 MW (en demanda)

Acción 1: Realizar pruebas en estufas fabricadas en el país para determinar la diferencia de eficiencias entre las estufas nacionales e importadas.

Acción 2: Establecer reuniones con los fabricantes locales para determinar los recursos y logística requerida para mejorar la eficiencia de las estufas que ellos producen. El resultado deberá ser un plan para mejorar la eficiencia de las estufas que serán vendidas localmente.

Acción 3: Implementar un programa de reembolsos como incentivo a los consumidores para que compren estufas eficientes, y a los fabricantes para ayudarlos a disminuir los costos de producción de modelos más eficientes.

Eficiencia Energética en Calentadores de Agua

Objetivo 1: Reemplazar los calentadores ineficientes por otros más eficientes.

Objetivo 2: Proporcionar capacitación, asistencia técnica y financiera para asegurar el uso eficiente de los calentadores existentes.

Ahorros Esperados: 1.16 GWh (en energía), 0.13 MW (en demanda)

Acción 1: Implementar un programa de reembolsos que ofrezca incentivos para la instalación de aislamientos de calentadoras de agua, calentadores de alta eficiencia, bombas de calor, calentadores de agua solares y regaderas de bajo flujo en hogares que cuenten con calentadores.

Termoduchas con Capacidad Reducida de Elementos

Objetivo 1: Reducir el consumo de energía y la demanda proveniente de las *termoduchas.*

Ahorros Esperados: 30.18 GWh (en energía), 2.93 MW (en demanda)

Acción 1: Implementar normas de eficiencia para limitar el tamaño de los elementos de las termoduchas. Los anterior podría eliminar la compra de éstas, las cuales se encuentran sobredimensionadas para su aplicación y promover su reemplazo por elementos de mayor eficiencia energética.

Acción 2: Investigar la utilización de controladores de corriente para establecer parámetros más exactos y controlar los niveles de corriente de las termoduchas. Lo anterior proporcionaría un mayor control de la energía eléctrica consumida por las termoduchas, en lugar de incrementar el consumo de agua para alcanzar las temperaturas deseadas.

Acción 3: Proporcionar capacitación, asistencia técnica y financiera para asegurar el uso eficiente de las termoduchas.

Monitoreo de Usos Finales en el Sector Residencial

Objetivo: Ampliar el conocimiento de los patrones y hábitos de consumo final dentro del sector residencial.

Acción 1: Aplicar estudios de monitoreo de usos finales a consumidores del sector residencial para validar las curvas diarias de carga utilizadas en el presente estudio. De particular interés, resultan las curvas de demanda de iluminación, refrigeración y cocción eléctrica, las cuales se constituyen como los usos finales que mayor participación tienen en el pico de la demanda. Dicho monitoreo proporcionaría las bases para verificar las reducciones obtenidas de los programas de Administración de la Demanda, además de que los resultados podrían ser utilizados por los Departamentos de Planeamiento de las empresas eléctricas para elaborar proyecciones futuras del crecimiento de la demanda y la estimación de cargas.

Eficiencia Energética en Nuevos Edificios

Objetivo: Desarrollar diseños más eficientes en energía para el sector residencial como el sugerido para el sector comercial.

Acción 1: Crear un taller de diseño avanzado para viviendas que maximice tanto la ventilación natural como el potencial de la luz natural. Además, podrían iniciarse concursos entre grupos profesionales para obtener diseños de viviendas energéticamente eficientes. Los premios a los ganadores podrían incluir la publicación de sus trabajos.

Acción 2: Preparar paquetes de información sobre eficiencia energética para grupos que desarrollen y construyan viviendas.

Acción 3: Examinar los requerimientos institucionales y financieros para establecer normas de eficiencia energética para viviendas en Guatemala, incluyendo un programa de capacitación, asistencia técnica y aplicación de normas. La actual norma U.S. ASHRAE 90.1 podría servir como modelo. Determinar la necesidad de establecer una norma energética para el sector residencial.

Acción 4: Crear un taller de diseño avanzado para establecer un conjunto de nuevas normas de construcción para casas del sector residencial, así como lineamientos para diversos tipos de construcciones y hogares particulares. El taller incluiría capacitación para arquitectos, ingenieros civiles y constructores sobre técnicas de aprovechamiento de luz natural, diseño de sistemas de iluminación y estrategias de control.

Acción 5: Financiar un concurso sobre diseño de casas y edificios con alta eficiencia energética para el sector residencial.

Acción 6: Desarrollar una base de datos sobre usos finales de energía eléctrica en el sector residencial. Establecer proyectos de monitoreo de consumos para diferentes tipos de casas y desarrollar lineamientos.

Iluminación Pública

Iluminación Eficiente

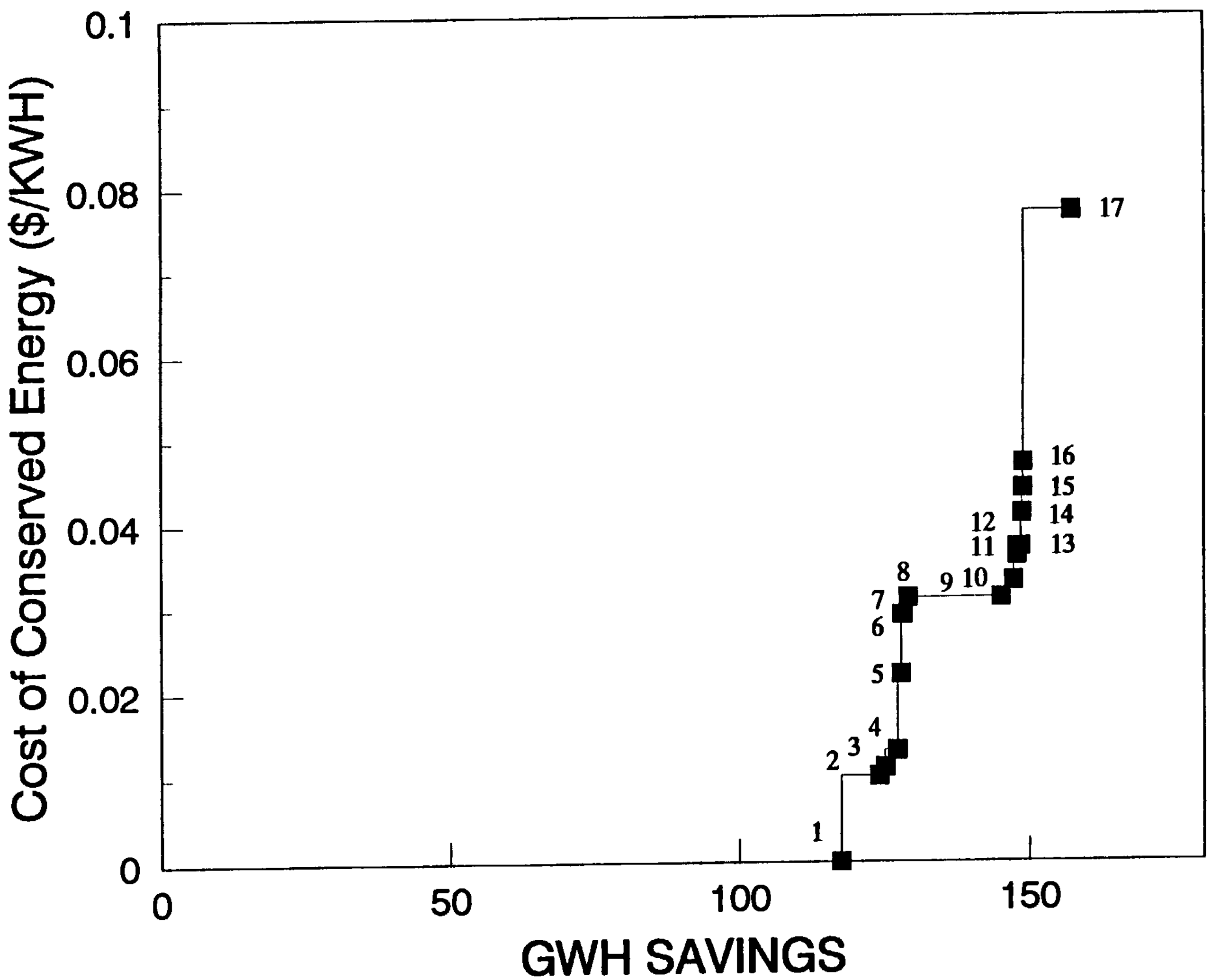
Objetivo 1: Elevar la eficiencia de iluminación del sector público.

Objetivo 2: Disminuir tanto la demanda como el pico de la demanda.

Ahorros Esperados: 13.00 GWh (en energía), 2.50 MW (en demanda)

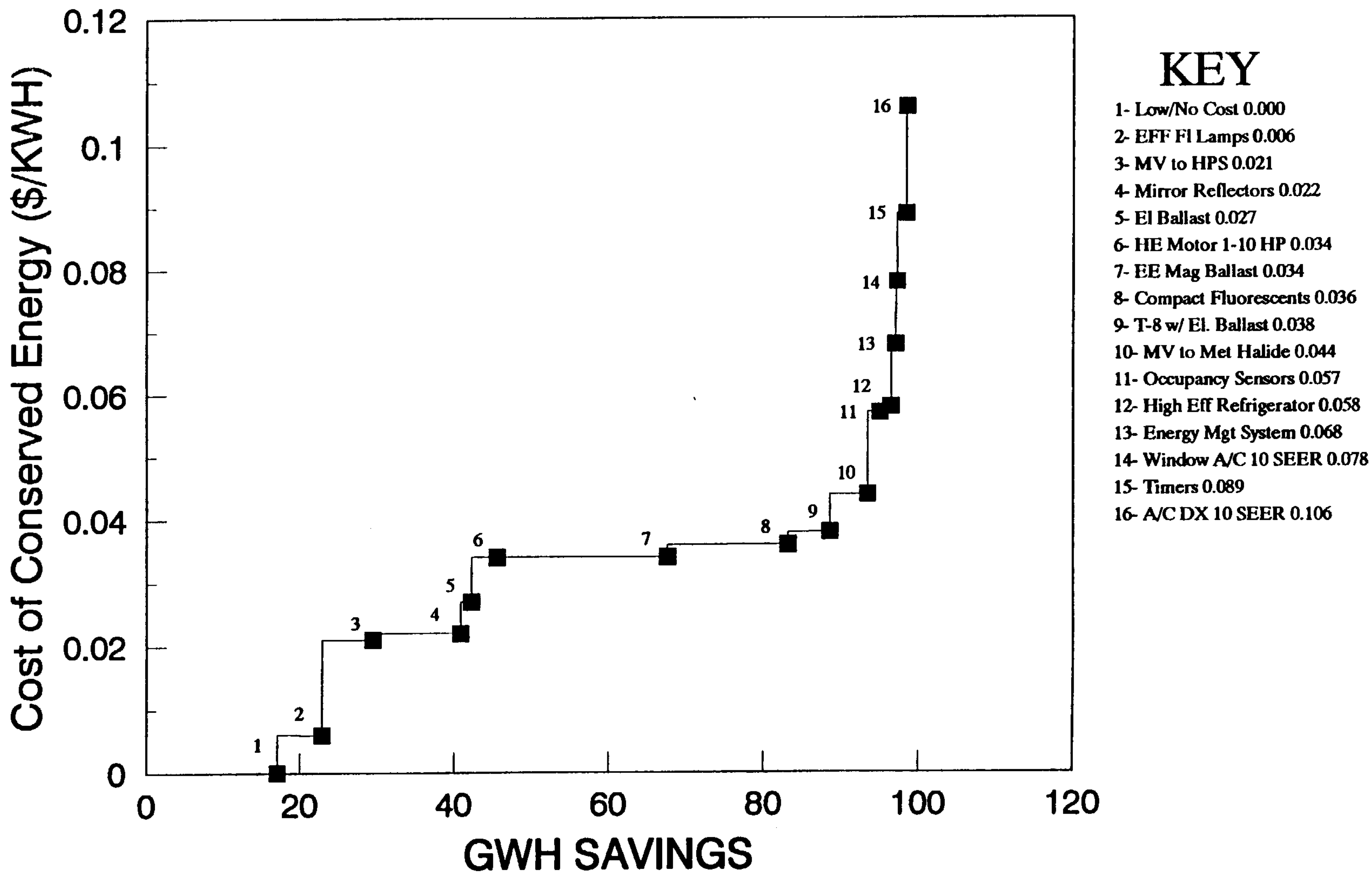
Acción 1: Acelerar el reemplazo de lámparas de iluminación pública para poder lograr los ahorros tanto de energía y demanda (estimados en 13 GWh por año), como los del pico de la demanda (calculados en 2.5 MW), lo más pronto posible.

Gráfica S-2
Sector Industrial de Guatemala:
Costo de Energía Ahorrada vs. GWh Ahorrados

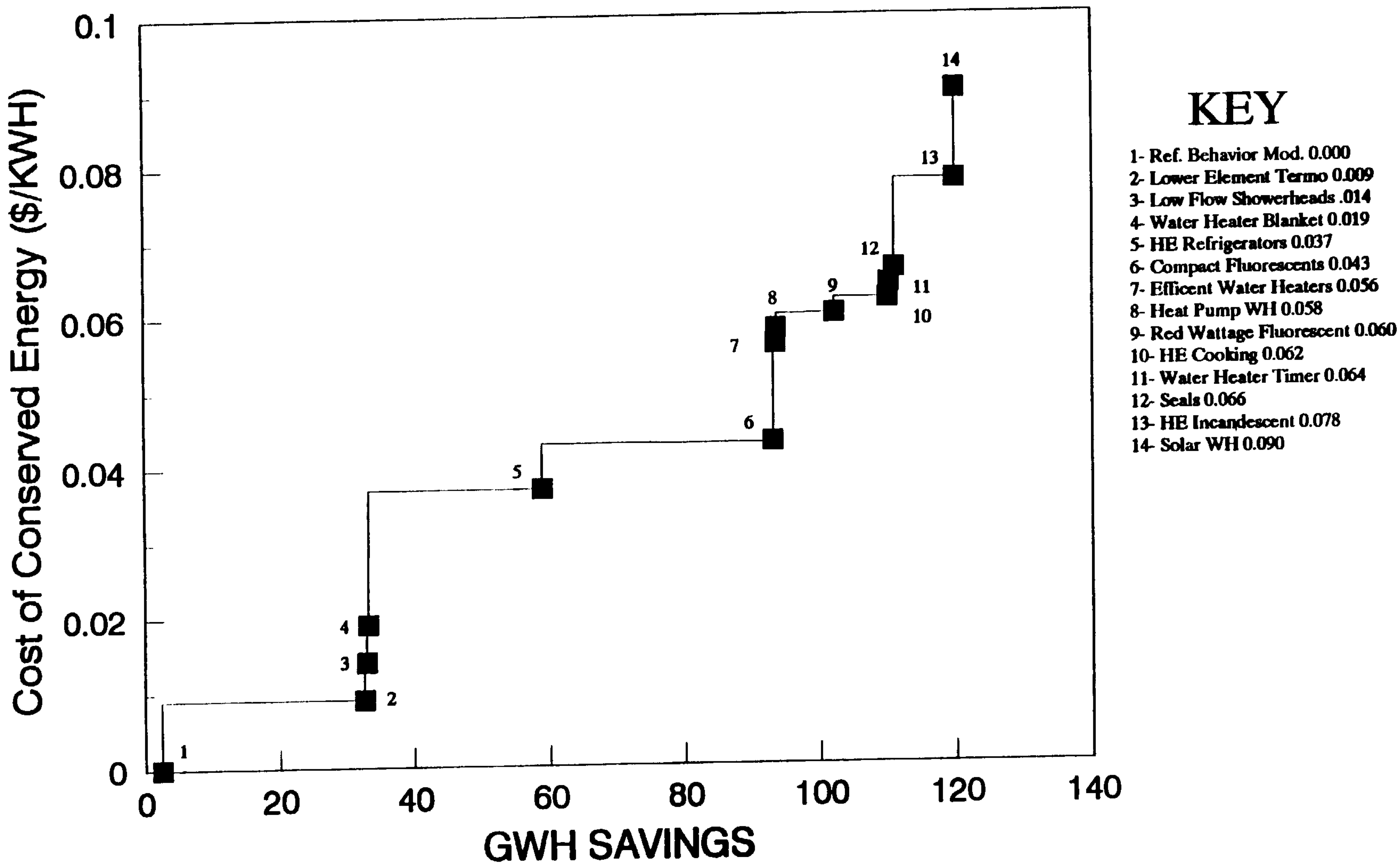


KEY
1- Low/No Cost 0.000
2- High Eff Refrig 0.010
3- Eff Fl Lamps 0.011
4- Mirror Reflectors 0.013
5- MV to HPS 0.011
6- EE Mag Ballast 0.029
7- MV to LPS 0.029
8- T-8 w El Ballast 0.031
9- HE Motor 1-10 HP 0.031
10- HE Motor 10-30 HP 0.033
11- ASD > 30 HP 0.036
12- El Ballast 0.037
13- Synch Belts > 30 HP 0.037
14- HE Motor > 30 HP 0.041
15- MV to Met Halide 0.044
16- A/C 10 SEER DX 0.047
17- Synch Blt 10 - 30 HP 0.077

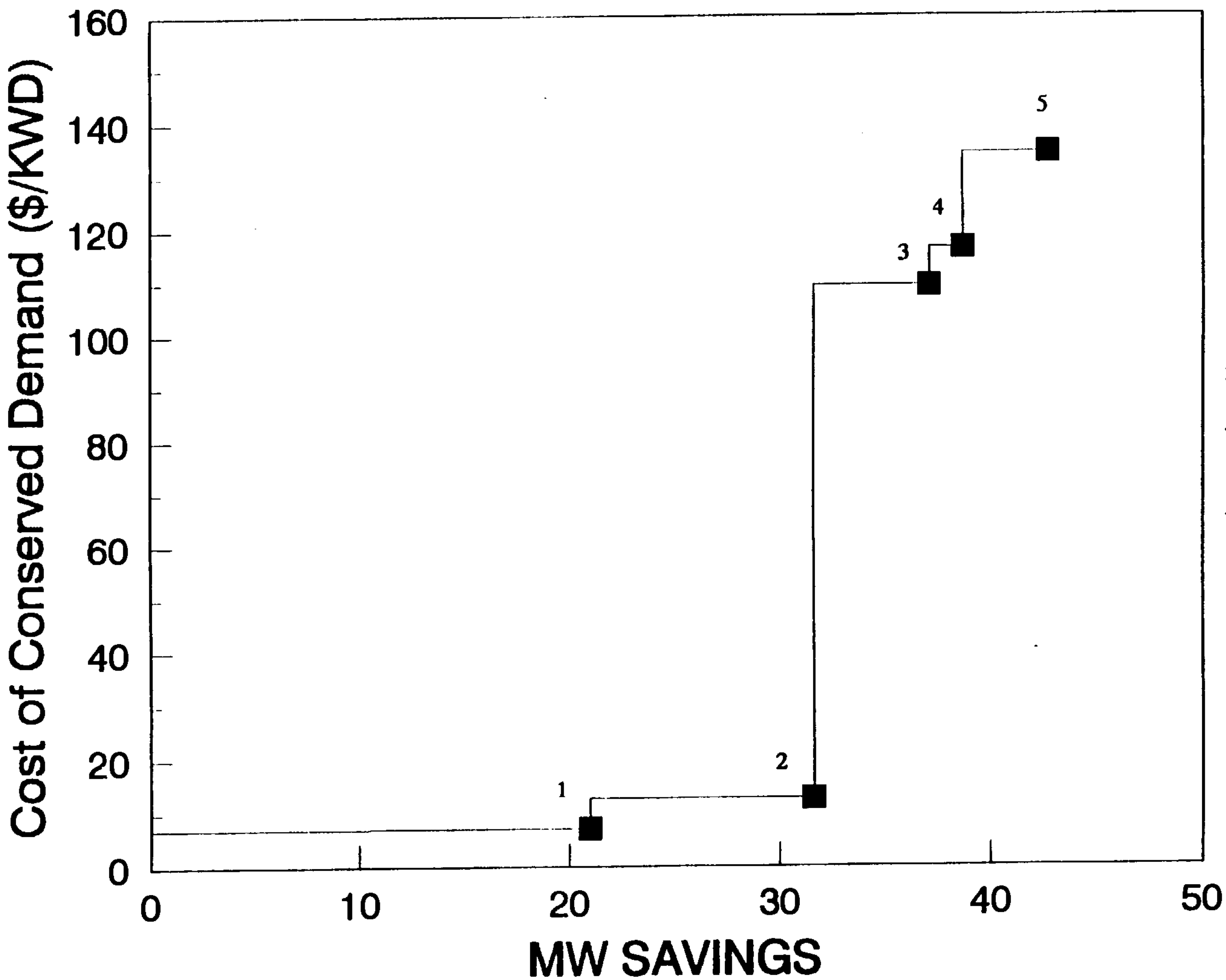
Gráfica S-3
Sector Comercial de Guatemala:
Costo de Energía Ahorrada vs. GWh Ahorrados



Gráfica S-4
Sector Residencial de Guatemala:
Costo de Energía Ahorrada vs. GWh Ahorrados



Gráfica S-5
Costo de la Demanda Ahorrada en el año 2010: Medidas de Administración de Cargas



KEY

1- Industrial Interruptible Rate 7.09

2- Industrial TOU 12.71

3- Commercial TOU 109.45

4- Residential Water Heater Load Control 116.51

5- Residential TOU 134.38

Cuadro S-6
Tasas Preliminares de Costo/Beneficio, Tasas Internas de Retorno y Valor Presente Neto: [1]
Conjunto de Programas de Administración de la Demanda en Guatemala

Programa DSM	Relación Costo/Beneficio	Tasa Interna de Retorno (%)	Valor Presente Neto del Programa de Flujo de Efectivo (US Dls) [2]
SECTOR INDUSTRIAL			
-Motores y Mec. de Transmisión	7.3	74.28	1,780,050
-Iluminación	2.5	37.28	240,548
-Aire Acondicionado	1.1	27.27	394
-Bajo-Nulo Costo/Otro	37.3	>100.00	13,397,275
SECTOR COMERCIAL			
-Iluminación Interior	6.7	>100.00	3,015,457
-Iluminación Exterior	2.0	58.10	883,535
-Aire Acondicionado	1.1	14.38	6,210
-Refrigeración	1.3	27.23	147,215
-Bajo-Nulo Costo/Otro	NA	NA	146,028
SECTOR RESIDENCIAL			
-Iluminación	1.8	42.85	1,079,833
-Cocción Eléctrica	1.2	28.22	79,624
-Termoduchas	5.2	66.28	1,351,584
-Calentadores de Agua	1.5	36.74	36,699
-Refrigeración Doméstica	1.4	41.85	585,947

1 Las tasas TIR y VPN fueron aplicadas únicamente para fortalecer el análisis de estas medidas. El DSManager será utilizado posteriormente para proporcionar cálculos más sólidos.

2 Se utilizó una tasa de descuento del 12% para estos cálculos.

CHAPTER 1: INTRODUCTION

1.1 BACKGROUND AND STUDY PURPOSE

Economic recovery and subsidized power tariffs have helped spur the demand for electricity in Guatemala, which is projected to grow at an average rate of 4.3 percent per year between 1991 and 2010. To satisfy medium-term growth in demand, Guatemala plans to bring 974 MW of new capacity on line between 1994 and 2003. While sufficient supplies of electricity will help assure continued economic growth, the cost of meeting needed capacity requirements will be high.

If present trends continue, Guatemala will be investing on the order of $190 million per year to meet growth in electricity demand.[1] This comes to a grand total of some $3.23 billion between 1994 and 2010.[2] Multilateral banks can lend Guatemala some of the resources needed to finance this large investment, but the added accumulation of debt will be a heavy burden. Guatemala's principal generation utility, INDE, has already had difficulty servicing its existing $321 million of external debt in 1990. Even if Guatemala could carry more power-sector debt (which accounted for 21.8 percent of the Government's total external debt in 1990[3]), it is increasingly apparent that multilateral banks will not have sufficient funds to finance all the planned expansion required in the developing world.

This is why alternatives are needed to the conventional approach to capacity expansion. These alternatives can include: 1) private sector participation, where an influx of private capital can help reduce the heavy power-sector debt burden on public financing, and 2) the development of conservation and efficiency programs to make more effective use of electric power conversion, transmission, and utilization.

Guatemala is successfully pursuing the first alternative, private-sector investment in the power sector. The U.S. Agency for International Development (USAID) has assisted the country in opening this new avenue for mobilizing external resources to finance power expansion.

[1] This figure is very approximate and until more reliable figures can be obtained, it is based on the weighted average cost of generation multiplied by the level of capacity expansion called for in the country's most recent expansion plan, and divided by the number of years in the plan (10).

[2] This estimate assumes that current levels of investment per year are continued after 2003 and through 2010. Other assumptions are as in footnote 1, above.

[3] This includes INDE's debt only.

This study investigates the second alternative: the savings that can be achieved through demand-side management in the power sector. Demand-side management (DSM) refers to a package of measures to conserve energy and/or reduce or shift peak demand (load management). DSM broadens the range of options available to a utility in meeting projected demand by ensuring that cost-effective demand-side options are included in any least-cost plan. The experience with DSM in the U.S., which has some of the lowest power tariffs in the world, provides an excellent example of the gains that can be achieved from exploiting cost-effective opportunities on the demand side.

In an effort to assist Guatemala in managing its power resource requirements, the USAID Office of Energy and Infrastructure, Guatemala Mission, and Regional Office for Central American Programs (ROCAP), together with the Guatemalan Instituto Nacional de Electrificación (INDE) and Empresa Eléctrica de Energía de Guatemala, S.A. (EEGSA), initiated a U.S.-Guatemalan effort to identify the potential benefits of appropriate DSM programs in the residential, commercial, and industrial end-use sectors.[4] Both consumer conservation programs and load management are evaluated in this assessment.

In studying the potential for DSM in Guatemala, this report examines both electricity conservation/efficiency programs *and* the impact of high-efficiency technologies on projected Guatemalan growth in electricity demand. The cost of saving capacity (kW) and energy (kWh) is used to determine which measures are cost-effective against the existing INDE expansion plan. This plan utilizes an average marginal cost for new power supply (generation, transmission, and distribution) of about 8 U.S. cents per kilowatt hour, as provided by INDE and EEGSA. This preliminary analysis identifies which DSM measures can save Guatemala energy for less than the cost of building new supplies and estimates the magnitude of these savings.

1.2 THE ECONOMY AND THE POWER SECTOR OF GUATEMALA

Guatemala is continuing to recover from a deep recession that affected most of the region in the first half of the 1980s, a time when growth in electricity demand was flat. The country's growth in GNP dropped dramatically from an annual average of 5.9 percent in the last half of the 1970s to an annual average of -1.4 percent for the first half of the 1980s. In the late 1980s, the economy recovered to an average annual 2.3 percent (1985 to 1989) growth rate, which reached 3 percent in 1990.

[4] In this study, industrial use includes municipalities and the commercial sector includes consumption in government facilities. The agricultural sector is not included because it accounts for a very small percentage of electricity consumption in Guatemala.

Renewed economic growth is in part the result of some important policy reforms in Guatemala. In response to the protracted recession in the early 1980s, the Government undertook a comprehensive adjustment program in the mid-1980s, reducing the government deficit, bringing down inflation, reforming the exchange rate system, liberalizing trade, and promoting private-sector development.

The burden of debt is nevertheless heavy. Like other nations in the region, Guatemala has financed large public-sector deficits with loans from abroad. The public-sector debt[5] reached 5.4 percent of GDP in the 1980-82 period, and after having fallen in the mid-1980s, crept back up to an estimated 4.4 percent in 1990.

The country's principal utility, INDE, contributes substantially to the debt problem, with costs greatly exceeding revenues. Consequently, the utility has required large infusions of capital from the central government, amounting to some $188 million over the 1980 to 1990 period. Tariffs have dropped from an average of 13.2¢/kWh in 1982 to 4.9¢/kWh in 1990: an estimated 54 percent of long-run marginal costs in that year. Bulk sales are even more highly subsidized, representing only 34 percent of generation and distribution costs. However, these low rates have failed to temper increases in demand. ⇐ ?

With low revenues, the utility has had to struggle to pay its external debt. In December 1990, its accumulated debt service arrears reached $55 million. As a consequence, INDE has had to slash borrowing from abroad from 76 percent of the utility's investment resources (1985) to 5 percent (1989). This suggests that it is unlikely that INDE can carry the substantial increases in debt that its expansion plan would appear to require.

The utility's constrained income and debt burden not only hamper its ability to finance future capacity expansion but have also led to a steady deterioration in reliability of service. Power plants have been poorly maintained and distribution systems are regularly overloaded, contributing to a rise in electricity losses. These losses are currently estimated at 17 percent.

Another difficulty is that power generation is not sufficiently diversified in Guatemala, leading to serious technical and fuel-supply risks. In a drive to reduce dependence on imported oil, Guatemala completed the Chixoy Hydro Power Plant in 1986, carving out a 40 percent (300 MW) share of the country's total power capacity in that year. This installation is threatened with potential failure due to local geological conditions. Droughts in recent years have exacerbated the situation in a country that depends on hydropower for 65.6 percent (see Exhibit 2-2) of its reliable capacity (1990). Severe electricity rationing was in effect as recently as 1991.

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[5] Corrected for interest payments.

1.3 THE NEED FOR INTEGRATED RESOURCE PLANNING

Integrated resource planning (IRP) is an innovative approach to meeting new power requirements like those in Guatemala. Unlike supply planning, in integrated resource planning, both supply and demand alternatives are considered formally in the utility's planning and resource acquisition processes. Because IRP recognizes the need to combine supply- and demand-side resources, integrated resource planning is actually least-cost utility planning. This approach can save Guatemala billions of dollars in avoided costs over the decades ahead, keeping power-sector indebtedness to an absolute minimum.

Conventional utility planning has traditionally been associated with the lowest-cost mix of generation resources for a given power system. However, the lowest cost cannot be achieved without full consideration of demand-side resources. Some of these resources cost very little and they can be quite substantial in size. In IRP, conservation or energy efficiency is viewed as a resource for the electric power system, a resource that can be estimated, forecast, scheduled, and purchased to help meet future growth requirements for an entire country.

Although IRP is innovative, it is not entirely new. In the U.S., IRP has already become routine in the planning processes of many public and private utilities throughout the country. European countries are now beginning to adopt IRP as well. But it is the developing countries that stand to gain the most from IRP. These are the countries that are having the most difficulty in managing growth in electricity demand, the same countries where the opportunity cost for every dollar invested in the power sector is extremely high.

In addition to reducing INDE's (and EEGSA's) investment requirements, there are several benefits of IRP for Guatemala's utilities. These include:

- lower operating costs
- less uncertainty in projecting future demand
- reduced risk of overbuilding.

For the country as a whole, IRP offers:

- lower customer bills (both a welfare gain and a boost to industrial competitiveness)
- reduced oil imports (hence decreased balance of payments pressures)
- reduced environmental impacts of power plant construction and operation.

1.4 THE GUATEMALA POWER-SECTOR EFFICIENCY ASSESSMENT

This report is only one component of a larger assessment of Guatemalan power-sector efficiency. It develops initial estimates for energy and demand savings in Guatemala between 1994 and 2010. A detailed cost-benefit analysis using a standard utility DSM model used widely in the United States (DSManager) will follow. In addition, opportunities for greater efficiency on the supply side will also be evaluated. Another standard model (LMSTM) will be used to evaluate least-cost supply side options for Guatemala. Finally, these various elements will be integrated into an integrated resource plan for the country.

Following this introduction, Chapter 2 outlines the supply-demand situation and load shapes of Guatemala's power sector. Chapter 3 discusses the methodology used to estimate the potential for energy savings in Guatemala between 1994 and 2010. Chapters 4, 5, and 6 present preliminary results on the size and cost of possible savings in energy and demand for the industrial, commercial and residential end-use sectors. Load management measures, which are applied in this study only to the industrial sector, are treated separately in Chapter 7. Their impact is confined in this analysis to demand savings. Chapter 8 explores the possibility of energy and demand savings in public lighting. Chapter 9 discusses some of the institutional issues in implementing DSM and IRP based on the U.S. experience. Finally, Chapter 10 issues a series of detailed recommendations that are the basis for developing a demand-side efficiency action plan.

CHAPTER 2: THE ELECTRIC POWER SECTOR IN GUATEMALA

The development of the power sector in Guatemala has played a pivotal role in facilitating the economic development of the country and in increasing comfort and convenience in Guatemalan homes. Despite some major challenges in maintaining a reliable power supply, the country's two power utilities, both government-owned, have succeeded in providing affordable power to a significant share of the Guatemalan population. The first, the Instituto Nacional de Electrificación (INDE), generates most of the electricity in the country. The second is the Empresa Eléctrica de Guatemala, S.A. (EEGSA), which is responsible for most of the distribution in the country. The country also has ten small municipal electric utilities, but these are not discussed in this report.

INDE was established at its inception as a government-owned enterprise reporting to the Minister of Energy and Mines. The utility was formed in 1959 to develop an integrated power grid for the country. By 1990, INDE accounted for 95.3 percent of the power generated in Guatemala and distributed electricity to about 250,000 customers in villages and rural areas.

EEGSA was once a foreign-owned utility, but is now controlled by INDE, which owns over 90 percent of EEGSA's stock. EEGSA is primarily a distribution company responsible for the distribution and sale of 72.6 percent of Guatemala's electrical energy. In 1990, the utility serviced 320,000 customers in metropolitan Guatemala City. EEGSA also owns and operates a limited number of generating plants, accounting for 4.7 percent of national electricity generation in 1990.

Transmission and distribution assets from both utilities comprise an integrated national grid: the Sistema Nacional Integrado (SNI). Today, most of Guatemala is interconnected through high-voltage transmission lines (69 kV 138 kV, and 230 kV). The INDE transmission system consists of approximately 337 km of 230 kV lines, 45 km of 138 kV lines, and 975 km of 69 kV lines. EEGSA's transmission system consists of 500 km of 69 kV lines.

2.1 SUPPLY AND DEMAND

Guatemala has a modest level of installed generating capacity and sales. In 1990, nameplate capacity reached 817 MW and output reached 2,334 GWh, a figure that drops to 1,989 GWh in sales as a result of losses in transmission and distribution.[1,2] As a share of net

[1] *INDE Informe Estadístico 1990*, Instituto Nacional de Electrificación, División de Operación, 1990.

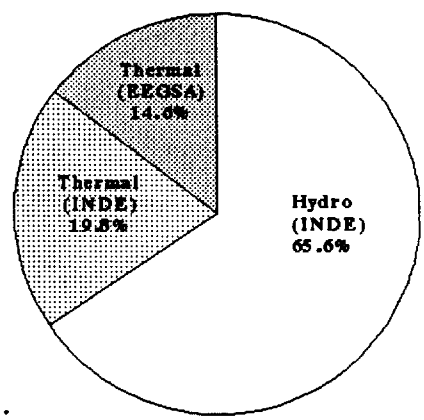
generation, these losses amounted to a significant 15 percent, although this figure probably reached 17 percent in 1992, according to Guatemalan utility officials. It appears that about 40 percent of losses in 1990 were non-technical (i.e., users are illegally tapping into the grid).

2.1.1 Reliable Capacity

Of the total 817 MW of installed capacity in Guatemala in 1990, approximately 664 MW -- or 78.8 percent -- is considered reliable, dispatchable capacity.[3] Of this, 65.6 percent is hydroelectric (INDE) and 34.4 percent is thermal (split 58 to 42 percent between INDE and EEGSA, respectively). The reliable installed capacity is shown in Exhibit 2-1. Exhibit 2-2 shows the generation capacity of the entire country.

It is important to note that Guatemala, heavily dependent on hydropower resources, has suffered profound effects of droughts, most recently in 1991, causing power shortages of up to six hours per day. These droughts drastically reduced the availability of power from virtually all hydropower resources. The reliability figures in the following exhibits do not account for the uncertainty that droughts have introduced into Guatemala's electricity planning process and the subsequent interest in exploring efficiency opportunities on the demand side.

Exhibit 2-1: Reliable Installed Capacity (1990)



Source: INDE, 1991.

Total: 664.1 MW

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2 *Reporte Estadístico de EEGSA*, 1990, Gerencia de Planificación, Departamento de Planeamiento, Mayo 1990.

3 *INDE Informe Estadístico 1990*, op. cit.

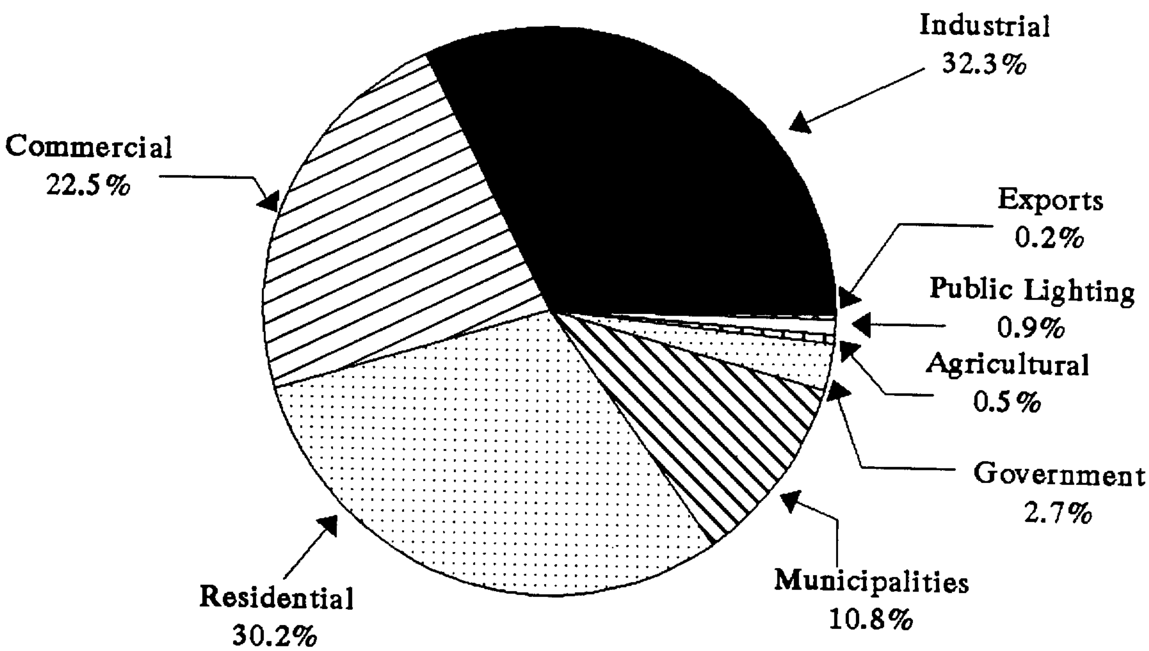
Exhibit 2-2
Generation Capacity in Guatemala, 1990

INDE Hydropower	Reliable Capacity (MW)	Energy (MWh)
Chixoy	275.00	1,544,922.570
Aguacapa	75.00	290,871.000
Marinala	60.00	175,890.000
Esclavos	13.00	54,678.700
San Luis	0.00	0.000
El Salto	1.00	5,134.000
Palin	1.30	7,599.600
Rio Hondo	2.00	17,166.600
Sta. Maria	6.00	31,765.781
El Porvenir	2.00	16,278.100
Chichaic	0.60	3,388.900
Subtotal	**435.9**	**2,147,695.1**
INDE Thermal		
Esc Vapor 1	22.00	0.000
Esc Vapor 2	45.00	67,443.000
Esc Gas 1	10.00	664.500
Esc Gas 2	10.00	1,063.700
Esc Gas 3	20.00	6,356.400
Esc Gas 4	20.00	1,387.300
Esc Gas 5	0.00	0.000
Pto Barrios	3.00	615.000
San Felipe	1.20	76.370
Subtotal	**131.2**	**77,606.27**
EEGSA Thermal		
Laguna Vapor	33.00	23,353.840
Laguna Gas 2	16.00	14,473.000
Laguna Gas 3	16.00	38,108.000
Laguna Gas 4	32.00	33,389.000
Subtotal	**97.00**	**109,323.84**
GRAND TOTAL	**664.10**	**2,334,425.22**

2.1.2 Electricity Consumption by Sector

Industry is the biggest consumer of electricity in Guatemala, although the residential sector is not far behind. By sector, 32.3 percent of INDE and EEGSA's combined sales were to the industrial, 30.2 percent to the residential, 22.5 percent to the commercial, 10.8 percent to the municipal, 2.7 percent to the governmental, and 0.5 percent to the agricultural sector. Public lighting consumed about 0.9 percent and 0.2 percent was exported. Exhibit 2-3 shows this end-use break down. Appendix A provides a table describing the breakdown of sales for INDE and EEGSA.

Exhibit 2-3
INDE and EEGSA Energy Sales by Sector, 1990



Electricity consumption reached approximately 221 kWh per capita in Guatemala in 1990,[4] the lowest level of per-capita consumption in Central America. For the period 1972 to 1980, consumption in Guatemala grew at a very high annual rate of 9.6 percent (Exhibit 2-4). Although between 1980 and 1985, there was little growth in electrical consumption because of a deep recession at that time, growth resumed between 1986 and 1990, averaging 8.5 percent per year.

[4] Assuming a consumption (after losses) of 1,989,369 MWh and a 1990 estimated population of approximately 9 million.

Exhibit 2-4
Annual Energy and Demand Growth Rates

	Energy (%)	Maximum Demand (%)
1972-1980	9.6	9.2
1980-1985	1.4	2.0
1986-1990	8.5	8.5
1992-2010	4.3	4.0

Source: INDE and EEGSA.

Over the last 30 years, growth in electricity consumption has declined only once: in 1982 during the region-wide deep recession of the early 1980s. Exhibit 2-5 shows the fairly consistent growth in energy (*energía*) and demand (*potencia*) in Guatemala for the 1961 to 1990 period.

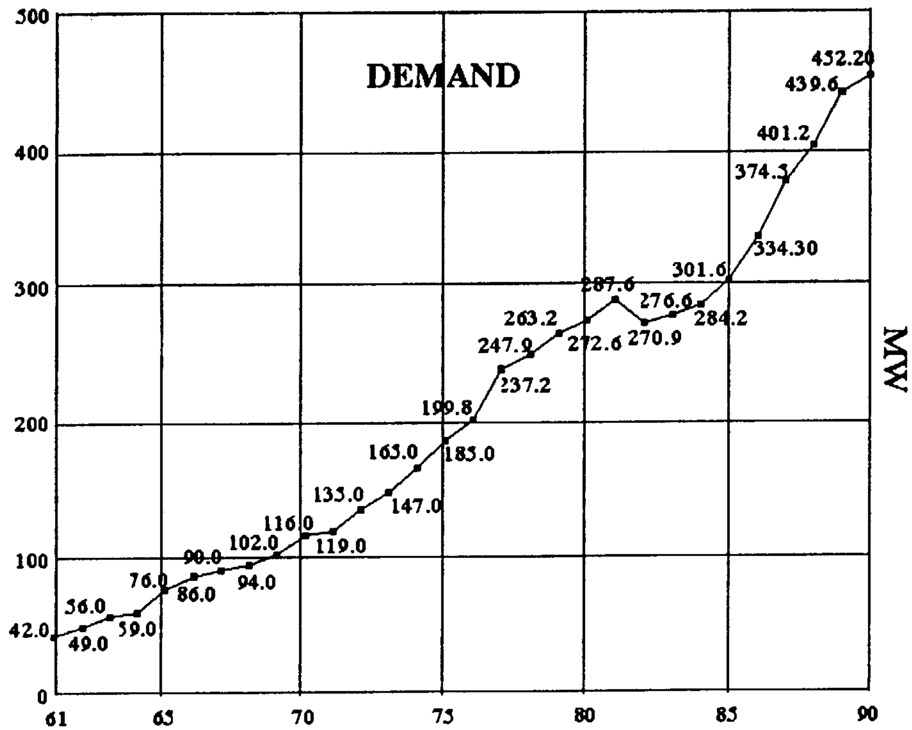
While residential service has grown rapidly in recent years, significant portions of the countryside remain unelectrified. From 1980 to 1990, the number of residential customers in Guatemala increased 6.9 percent per year. Electric power coverage of the population was nevertheless estimated at only 40 percent in 1990, according to the World Bank.

The Guatemalan economy appears to be poised for substantial growth in electricity consumption in the years ahead. Demand projections prepared by INDE and EEGSA forecast a growth rate in maximum demand (MW) of over 6 percent in 1992, tapering off to nearly 3 percent by the year 2010 (see Exhibit 2-6). The growth in energy consumed during the same period is projected to fall from nearly 12 percent in 1992 to nearly 3 percent in 2010. These figures are based on the most recent revision of the Guatemalan expansion plan.

2.2 LOAD SHAPES FOR THE SYSTEM AND SECTORS

The Guatemalan utility system peaks in the early part of the evening. On the day of maximum annual system peak, the load curve reveals a marked spike between the hours of 6:00 p.m. and 9:00 p.m. As Exhibit 2-7 shows, the load increases by approximately 110 MW between the hours of 6 p.m. and 7 p.m. These patterns of consumption in Guatemala do not vary greatly between the dry and rainy seasons.

Exhibit 2-5
Annual Growth in Energy and Demand



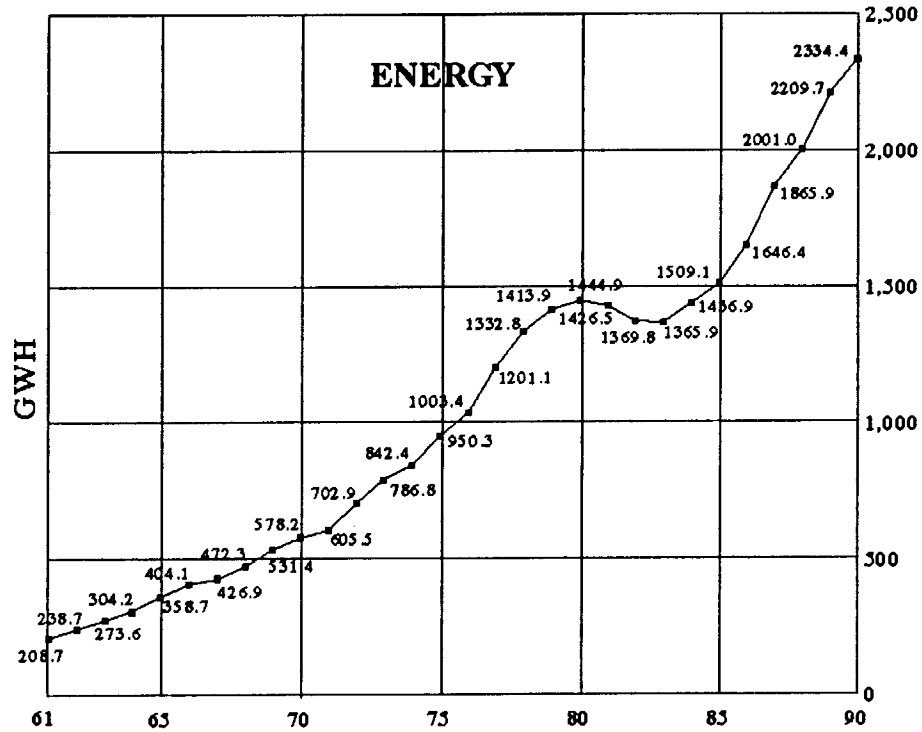


Exhibit 2-6
Projected Electricity Requirements, 1992-2010

	Energy GWh	Demand MW
1992	2,726.79	575.83
1993	3,048.44	610.48
1994	3,212.84	643.40
1995	3,377.14	676.31
1996	3,541.54	709.23
1997	3,705.94	742.15
1998	3,870.24	775.05
1999	4,034.64	807.98
2000	4,199.04	840.90
2001	4,363.34	873.80
2002	4,527.74	906.72
2003	4,692.14	939.65
2004	4,856.44	972.55
2005	5,020.84	1,005.47
2006	5,185.24	1,038.40
2007	5,349.54	1,071.30
2008	5,513.94	1,104.22
2009	5,678.34	1,137.14
2010	5,843.04	1,170.13

Source: INDE and EEGSA.

The primary contributors to the peak are residential loads, primarily lighting and other residential end uses. Other contributors to the evening peak are public lighting and exterior lighting in the commercial and industrial sectors. The industrial and commercial peaks tend to coincide, while residential loads tend to peak towards the early evening. Exhibit 2-8 shows the typical load profiles for the industrial, commercial and residential sectors. It also shows the load shape for INDE, which provides a significant contribution to the peak. Some explanations for INDE's pronounced evening peak are that the utility has a high percentage of rural residential customers whose primary load is evening lighting, and that INDE provides much of the public lighting in rural areas.

Exhibit 2-7
Load Curve on the Day of Maximum Demand 1990

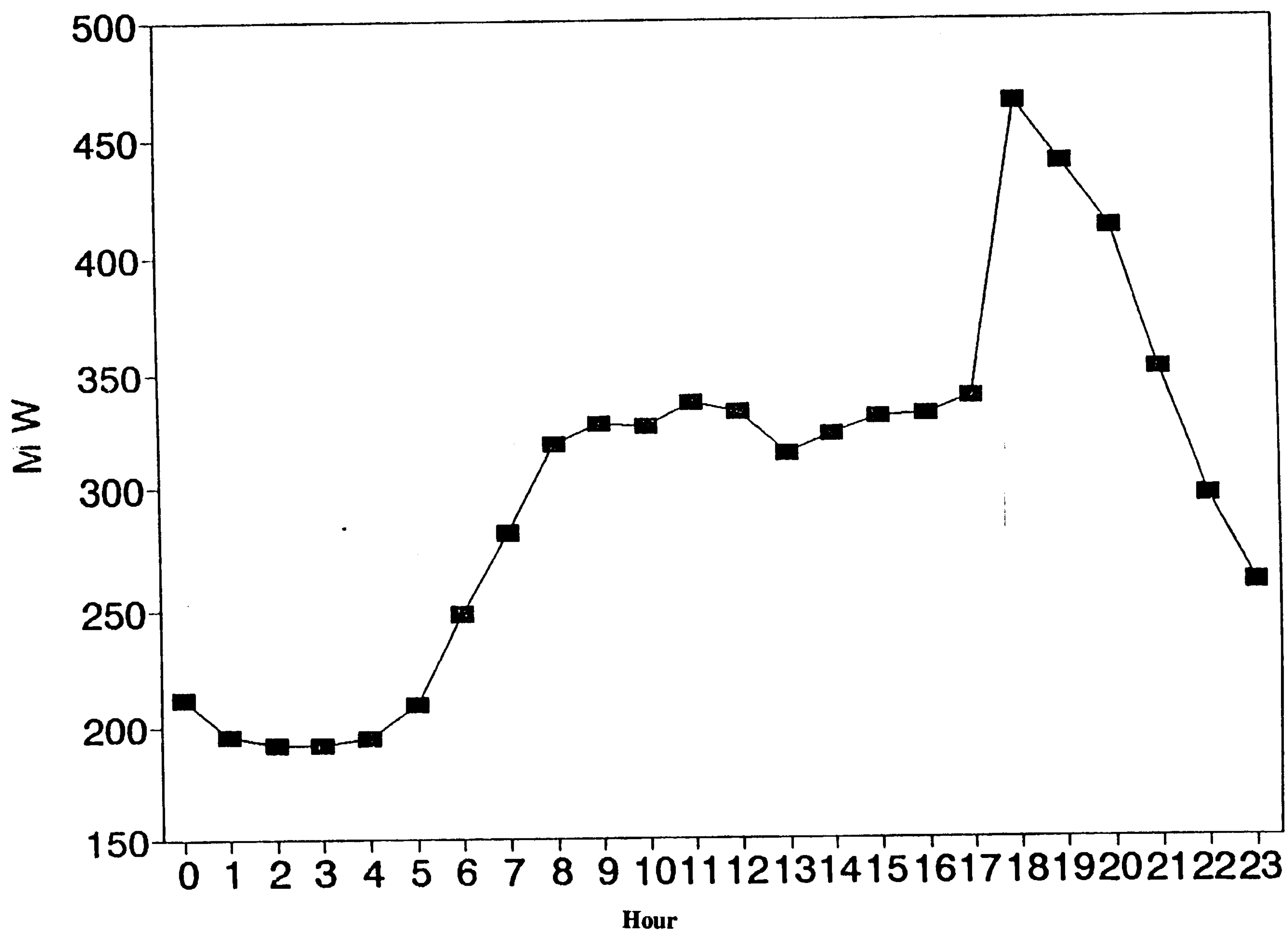
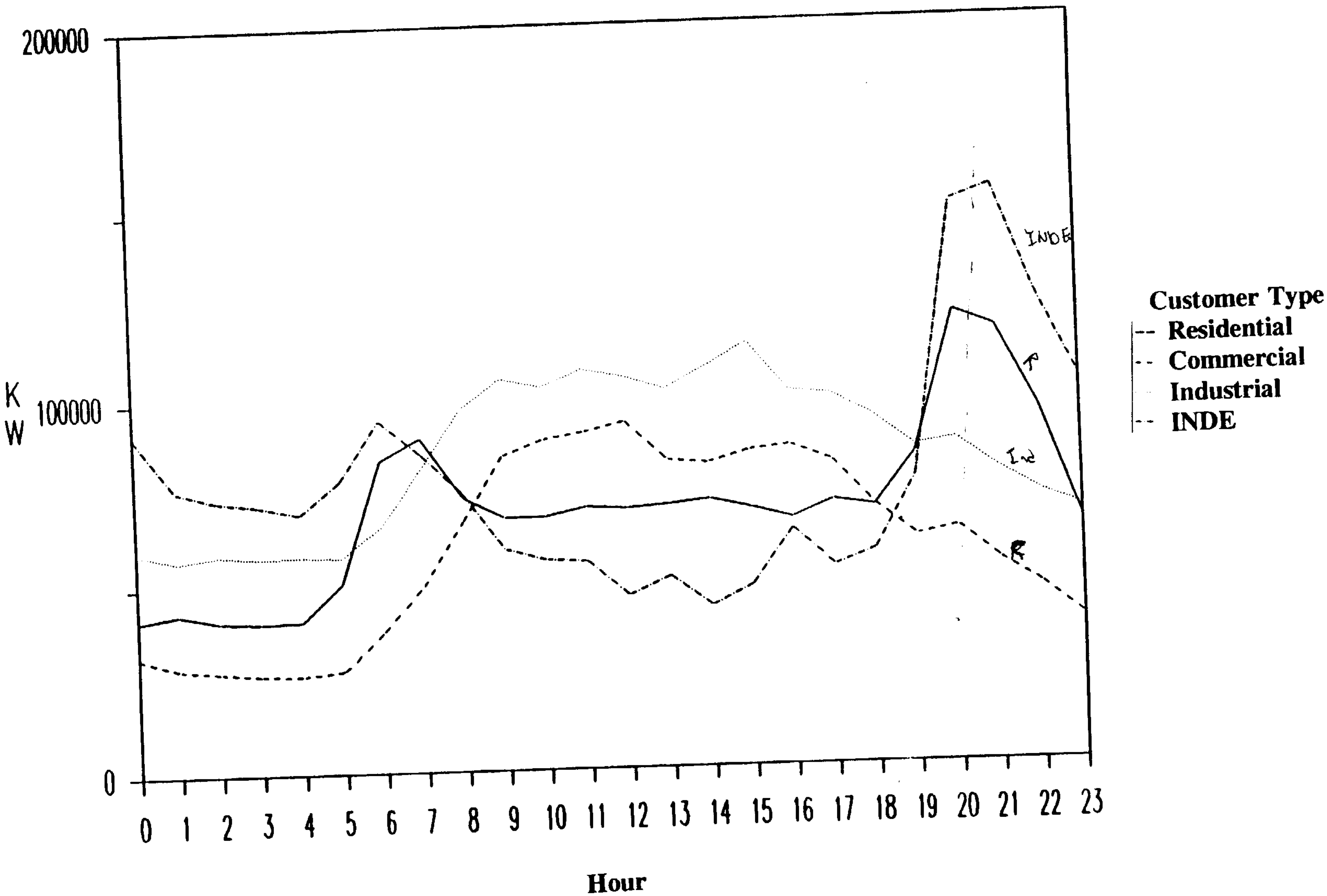


Exhibit 2-8
Load Profiles by Type of Consumer



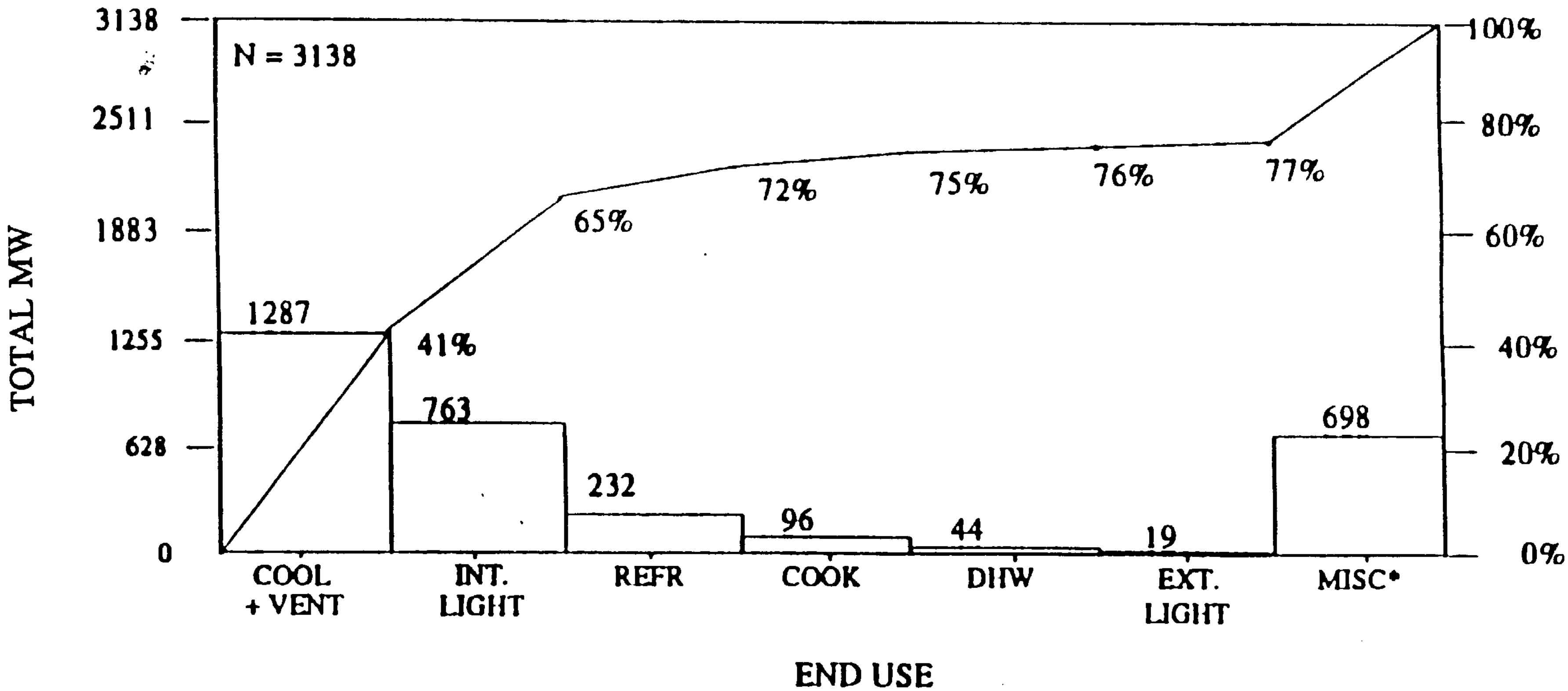
These data are sufficient to draw a few tentative, general conclusions in performing a DSM analysis. The pronounced peak in the early evening typically can best be reduced with direct load-control programs, interruptible rates, time-of-use rates, and other peak-reduction programs. Strategic conservation programs targeted at those end-uses which are responsible for the peak can also play an important role.

But these load data alone are insufficient to estimate Guatemala's DSM potential in any detail. These load curves are only estimates obtained from "typical feeders" in the system. To conduct a detailed demand-side analysis, a breakdown of the coincident peak demands by specific end-use application is necessary in order to isolate those major end-use applications that contribute most to the system peak.

Ideally, a utility will have data available on end-use contributions to the peak. Exhibit 2-9 provides an example of the type of information that is needed to analyze in detail the impact of the various sectors on the system peak. This exhibit shows the contribution of specific commercial end-use applications to the summer peak in Florida.

The next chapter discusses how these specific load shapes can be modelled in order to conduct a preliminary DSM analysis for Guatemala.

Exhibit 2-9
Commercial End-Use Summer Contribution to System Peak Days



* Misc End Use: small appliances, computers, office equipment, coffee makers, water fountains, fixtures (other than lighting), receptacles (other than lighting or space conditioning), TV's, stereos

** GS & GSD rate classes

Source: FPL Research, Economics & Forecasting Dept., *FPL Demand Side Management Plan for the 90's.* Feb. 12, 1990.

CHAPTER 3: DEMAND-SIDE MANAGEMENT STUDY METHODOLOGY

Conducting a demand-side management (DSM) assessment can be a complex exercise requiring both computer modeling and expert judgment. One of the challenges in developing countries is the lack of data on end-use consumption, but careful computer simulation can substitute for these data. Expert judgment and knowledge of past utility DSM experience and local conditions are also required. Experts must estimate some critical variables that cannot be computed and must establish sound assumptions.

3.1 OVERVIEW

We first chose a planning horizon that would allow for the design, initiation and maturation of DSM programs in Guatemala. We also wanted to cover a period that would relate to INDE's own supply-side planning horizon. The period chosen was 1994 to 2010.

After reviewing overall sectoral shares of electricity consumption, we identified those sectors of strategic importance in achieving substantial energy savings in Guatemala. Because representative sectoral load curves were unavailable, we developed "typical" load shapes for three strategic sectors -- residential, commercial, and industrial -- using a sampling technique. These load shapes were developed in conjunction with local utilities.

Next, using these sectoral load shapes, we estimated end-use load shapes for all major end-uses within the targeted sectors (such as industrial motors, commercial lighting, or residential cooking). These estimates were achieved using a computer spreadsheet especially designed for this study, the DSM Impact Spreadsheet. This spreadsheet calculates the end-use load shapes using data on overall sectoral load shapes, annual energy consumption by end-use, annual energy usage in each sector, and patterns of customer end-use consumption.

Based on the end-use load shapes and characteristics, we chose energy-efficient technologies and measures and load management measures (collectively called demand-side management or DSM measures) which would achieve the utilities' load shape objectives. These measures were chosen in close collaboration with Guatemalan utility representatives on the basis of technical characteristics (applicability) and cost. The measures included such things as replacing incandescent lamps with high-efficiency lamps and performing regular maintenance on industrial refrigerators.

The measures were then grouped into programs. Every program, with the exception of low/no-cost programs, targeted savings in a specific end-use such as residential hot water heating. Expert judgment combined with extensive field research were used to determine the likely participation in each measure within each program for Guatemala. This variable is called the "likely measure participation percent" (LMPP) and it has an important bearing on the magnitude of reductions for a particular measure -- and, ultimately, of a particular program -- on consumption for a given end-use.

Conservation supply curves were then constructed showing how much energy (or demand) can be saved per measure in Guatemala and at what cost per kWh. These curves, which are a central feature of this analysis, plot the cost of conserved energy (CCE) for the DSM measures and the cost of conserved demand (CCD) for the load management measures as a function of the amount of energy saved. In the conservation supply curves, the CCE and CCD are ranked from least to most costly, and considering the achievable market potential.

The impacts in this study were quantified in terms of:

- *the Maximum Technical Potential (MTP)*: the maximum reduction in energy use and demand that could be achieved if all inefficient equipment existing today were replaced with the most efficient commercially available technologies

- *the Maximum Economic Potential (EP)*: the maximum reduction in energy use and demand given specific economic assumptions

- *the Achievable Market Potential (MP)*: the expected reduction in energy use and demand that would occur as a result of utility DSM programs.

These impacts were aggregated to determine the overall potential savings in energy and demand for Guatemala in the year 2010. These impacts assume that the DSM programs modelled in this study are launched in 1994.

3.2 SIMULATING LOAD SHAPES

One major obstacle encountered in this study was the lack of sectoral load curves for the residential, commercial and industrial sectors. These were required to analyze the achievable DSM impact by the year 2010. Some load curves for large industrial users were available, but of limited use because very few industries or selected feeders were represented in the small sample. Because the DSManager computer model was to be used later as a screening tool to evaluate the feasibility of the various measures and programs, more detailed load curves were necessary in this stage of the analysis.

In order to obtain typical sectoral load shapes, EEGSA and INDE selected circuits that were typical of the residential, commercial and industrial sectors. To obtain load shapes by end-use, a computer spreadsheet was developed that simulates the end-use load shapes based on Guatemalan consumer behavior for all major end-uses. Data on these patterns of behavior in Guatemala were based on in-country research.

The spreadsheet, called the DSM Impact Spreadsheet,[1] then adjusted the total sector load curve based on the annual energy consumption by end-use and total annual energy usage for each sector. Exhibit 3-1 shows some of the input parameters used for the residential sector. The input and output tables for the industrial, commercial and residential spreadsheets are found in Appendices C, D, and E.

The **spreadsheet inputs** are as follows:

1) annual energy consumption by sector
2) load shapes for each sector
3) appliance monthly energy consumption
4) percent energy consumption by end-use
5) number of customers by sector.

The spreadsheet contains an input table for the end-use related parameters required from each utility. If values for the entire country are available, these may also be used as input. Individual utility parameters were used for the residential spreadsheet and country-wide parameters were used for the commercial and industrial spreadsheets.

The **spreadsheet end-use outputs** are as follows:

1) number of appliances for each end-use
2) appliance saturation by end-use
3) hourly load shape by end-use (without DSM impact) in kW
4) end-use percent contribution to hourly demand
5) hourly diversified demand per customer by end-use.

3.3 ESTIMATING IMPACTS

Once the load shape output data were available, we estimated the impact of DSM measures on end-use load shapes in Guatemala. The proposed DSM measure parameters were input into "End-Use DSM Impact Tables." The DSM measure input parameters were: 1) percent energy savings for each measure, 2) demand reduction for measure (in % for conservation and efficiency measures and hourly demand impact for other measures), 3) equipment cost per participant, and 4) likely percent participation rate.

---

[1] The DSM Impact Spreadsheet is proprietary software developed by Strategic Energy Efficiency Associates, Inc.

Exhibit 3-1
EEGSA Residential Sector End-Use Breakdown

		(MWH)	

Total SNI 1990 Residential Consumption:		599,972	MWH
Total 1990 EEGSA Residential Consumption:		473,567	MWH
Total 1990 EEGSA Residential Consumption as % of SNI:		78.93%	
Average Daily 1990 EEGSA Residential Consumption:		1,297	MWH
Number of EEGSA Residential Customers in 1990:	(INPUT)	272,716	Residential Customers (1)

CONSUMPTION BY END-USE	% of Total Sector kWh	Annual Usage (MWh)	Appliance	(INPUTS) Avg. Monthly kWh/end-use	No. of Appli-ances	Estimated Appliance Saturation
Cooking Energy Consumption: (EEGSA)	18.64%	88,256	Stove	180.0	40,859	15.0%
Water Heating Energy Consumption(EEGSA)	12.83%	60,757	Termodu	50.0	101,261	37.1%
(Termoducha + WH Tank) = 16.29%	3.46%	16,379	WH Tank	100.0	13,636	5.0%
Lighting Energy Consumption: (EEGSA)	13.70%	64,871	Lighting	20.0	270,296	99.1%
Refrigeration Energy Consumption(EEGSA):	31.06%	147,091	efrigerator	72.0	170,244	62.4%
Other End-Use Energy Consumption(EEGSA)	20.32%	96,213	Other	29.4	272,626	
	100.00%					

	ELECTRIC COOKING	TERMO-DUCHA	WH TANK	LIGHTING	REFRI-ERATION	OTHER ND-USES
Annual kWh	88,256	60,757	16,379	64,871	147,091	96,213
# Cust w/Appl	40,859	101,261	13,636	270,296	170,244	272,626
# of Days	365	365	365	365	365	365
Avg kWh/Cust/Day	5.92	1.64	3.29	0.66	2.37	0.97

1) Source: Reporte Estadistico de EEGSA 1990, Cuadro No. 1.

The impacts of each of the DSM measures on end-use load shapes were determined for each energy technology and/or each DSM program. The impacts were quantified in terms of: 1) maximum technical potential, 2) maximum economic potential, and 3) achievable market potential.

The results were finally aggregated in summary tables of energy savings. These tables show the achievable market potential energy reduction by end-use by year from 1994 through 2010 for the various programs. Similarly, a summary table of demand savings shows the achievable market potential coincident demand reductions by end-use by year for the same period. These tables can be found in Appendices C, D, and E.

3.3.1 Methodology

The percent energy savings and demand reduction for each measure were calculated based on the technical aspects of the given measure and end-use technology in Guatemala. The equipment costs represent costs in Guatemala derived from extensive field research in the country and data provided by the national utilities.

The spreadsheet used to estimate the energy savings from DSM measures assumes that for a specified end-use, various technologies can be offered as a "program" to residential customers. Customers will participate in the program in different proportions. To model the participation in the program for different technologies, the concept of "likely measure participation percent" was used.

The likely measure participation rate (LMPP) is defined as the number of participants that are projected to participate in a specific measure divided by the total participants for that program. For example, for the residential program, suppose that ten customers implement ten lighting measures: eight are compact fluorescents and two are energy-efficient fluorescent lamps. Then, the LMPP = 80% for compact fluorescents and LMPP= 20% for energy-efficient fluorescents. The LMPP should not be confused with the market penetration rate, which refers to the total number of customers that could participate in the DSM program.

Another example of the use of LMPP is for the measures that can be applied to water heater tanks. For example, suppose that solar water heating would provide the greatest savings (thus, theoretically, it should be used in the calculation of MTP). However, because the payback for this measure is over 11 years, it is assumed that a variety of measures are implemented as a "program" and the MTP for this program is then calculated (see Chapter 6: The Residential Sector).

For example, the measures assumed for the Guatemala water heater tank program are given in Exhibit 3-2:

Exhibit 3-2
Measures Assumed for Water Heater Tank Program

DSM Measure	Likely Measure Participation Percent
Energy-Efficient Water Heaters	50%
Heat Pump Water Heaters	5%
Solar Water Heaters	2%
Water Heater Blankets	20%
Water Heater Timers	10%
Low-Flow Showerheads	50%
Total	**137%**

Note that the total LMPP is greater than 100 percent in this example. This means that each participant will implement 1.37 measures, on average, for this program, since multiple measures can be implemented by each participant.

3.3.2 Interpreting the DSM Impact Tables

Exhibit 3-3, a sample from the spreadsheet, helps to illustrate the kinds of output available at this stage of the analysis.

Each column in the end-use impact tables shows the impact on the end-use load shape as a result of the specific DSM measure identified in that column. The column to the far right entitled "Total Program Impact w/DSM" shows the resulting impact on the load shape for the particular DSM program in question (here the program targets residential water-heater electricity consumption). The results from this portion of the spreadsheet are the new end-use load shapes with and without DSM. These data, in both tabular and graphic form, are found in Appendices D, E and F for the industrial, commercial and residential sectors, respectively.

Exhibit 3-3
Sample End-Use DSM Impact Table

TABLE 7T(4)

1992 RESIDENTIAL WATER HEATER TANKS
SNI RESIDENTIAL SECTOR HOURLY DSM
IMPACT BY END-USE PER AVERAGE PARTICIPANT

TIME	WH TANK (kW)	WH TANK (kW)	WH TANK (kW)	WH TANK (kW)	WH TANK (kW)	WH TANK (kW)	TOTAL PROGRAM IMPACT W/DSM (kW)
Technology:	WH Blanket	Eff WH	Ht Pmp	WH Timer	Solar WH	L.F.Shwr.Hd.	
Energy Savings:	12.0%	20.0%	72.3%	10.0%	92.0%	20.0%	28.9%
Demand Reductions:	12.0%	20.0%	72.3%	50.0%	92.0%	20.0%	32.9%
Equip. Cost/ Part.	$10	$100	$345	$35	$745	$12	$93.65
Likely Meas Part %	20.0%	50.0%	5.0%	10.0%	2.0%	50.0%	1.37
0	0.029	0.026	0.009	0.030	0.003	0.026	0.026
1	0.012	0.011	0.004	0.012	0.001	0.011	0.010
2	0.020	0.018	0.006	0.021	0.002	0.018	0.018
3	0.087	0.079	0.027	0.089	0.008	0.079	0.078
4	0.226	0.205	0.071	0.231	0.021	0.205	0.203
5	0.405	0.369	0.128	0.185	0.037	0.369	0.347
6	0.434	0.395	0.137	0.334	0.039	0.395	0.382
7	0.269	0.245	0.085	0.356	0.024	0.245	0.247
8	0.203	0.184	0.064	0.207	0.018	0.184	0.182
9	0.151	0.137	0.047	0.154	0.014	0.137	0.135
10	0.087	0.079	0.027	0.089	0.008	0.079	0.078
11	0.064	0.058	0.020	0.065	0.006	0.058	0.057
12	0.055	0.050	0.017	0.056	0.005	0.050	0.049
13	0.058	0.053	0.018	0.059	0.005	0.053	0.052
14	0.080	0.072	0.025	0.081	0.007	0.072	0.071
15	0.072	0.066	0.023	0.074	0.007	0.066	0.065
16	0.075	0.068	0.024	0.077	0.007	0.068	0.068
17	0.081	0.074	0.026	0.083	0.007	0.074	0.073
18	0.101	0.092	0.032	0.104	0.009	0.092	0.091
19	0.104	0.095	0.033	0.107	0.009	0.095	0.094
20	0.104	0.095	0.033	0.107	0.009	0.095	0.094
21	0.090	0.082	0.028	0.092	0.008	0.082	0.081
22	0.046	0.042	0.015	0.047	0.004	0.042	0.042
23	0.041	0.037	0.013	0.041	0.004	0.037	0.036

The next steps were to calculate the maximum technical potential (MTP), the maximum economic potential, and the achievable DSM market potential. Other important variables like annual estimated participants by DSM program were also calculated to help determine the magnitude of the overall DSM program impact on patterns of consumption.

3.3.3 Maximum Technical Potential (MTP)

MTP is defined as the maximum reduction in energy use and demand that could be achieved if all inefficient equipment existing today is replaced with the most efficient, commercially available technologies. The MTP for the year 2010 is calculated assuming an increase (or decrease) in appliance saturation over time (as provided by utility projections), the energy consumption by sector and end-use, the estimated coincident peak demand reduction by end-use, and the energy and demand reductions by technology/measure.

MTP is the energy savings achieved by the most efficient measure for a specified end-use, irrespective of cost. However, for this analysis, we included the "likely measure participation percent" (LMPP) in the calculation of MTP.

The MTP is calculated as follows:

$$MTP = BC * ES * AF * IA$$

where:
- MTP = maximum technical potential
- BC = end-use base consumption
- ES = percent energy savings for measure
- AF = applicability factor (the percent of the total end-use to which the specific technology/measure can be applied)
- IA = interaction adjustment (an estimate of the interaction between measures applied to the same end-use, mutually compatible technologies and competing technologies).

Notation on MTP-related terms. Note that in this study, the "applicability factor" (AF) and the "end use technical saturation" are used interchangeably. Both refer to the percentage of the end-use to which the proposed measure can be applied. "MTP participation," a term used sometimes used in this report, refers to the number of customers who can participate in DSM technology if current inefficient appliances could be replaced with the proposed DSM technology or measure. "MTP energy reduction" refers to the maximum energy reduction that can be achieved on the basis of technical considerations alone.

3.3.4 Maximum Economic Potential (EP)

The EP is defined as the maximum reduction in energy use and demand based on specified economic assumptions. The assumptions include the economic attractiveness of the measure and the replacement factor of the specified appliances or measures. The EP is a percent of the MTP based on the economic parameters selected for the analysis.

The EP is calculated as follows:

EP = BC * ES * AF * IA * RF * EA

EP = MTP * RF * EA

where:
- EP = economic potential
- BC = end-use base consumption
- ES = percent energy savings
- AF = applicability factor (defined above)
- IA = interaction adjustment (defined above)
- RF = replacement factor (the percent of the appliances or measures that are replaced as a result of normal equipment failure, which is based on the life of the equipment)
- EA = economic attractiveness (estimated percent of the population for whom it would be economically feasible to implement a DSM technology or measure based on the cost-effectiveness or payback period required for the customer to recover the investment in the DSM measure).

Notation on EP-related terms. The "maximum economic potential impact" can be given in both energy (MWh) and demand (MW).

3.3.5 Achievable Market Potential (MP)

MP is defined as the expected reduction in energy use and demand that would occur as a result of utility DSM programs. The MP for the year 2010 is calculated utilizing the market penetration rate and the market diffusion factor.

The MP is calculated as follows:

MP = BC * ES * AF * IA * RF * EA * MPR * MDF

MP = EP * MPR * MDF

where: MP = achievable market potential
BC = end-use base consumption
ES = percent energy savings
AF = applicability factor (defined above)
IA = interaction adjustment (defined above)
RF = replacement factor (defined above)
EA = economic attractiveness (defined above)
MPR = market penetration rate (the rate at which customers will adopt a specific measure)
MDF = market diffusion factor (this models the rate of adoption of a measure over time).

Notation on MP-related terms. "DSM impact" is given in energy (MWh) or demand (MW) and is the energy savings associated with the implementation of a proposed DSM program. The "market penetration rates" in this study were based on the penetration rate curves developed by the Electric Power Research Institute (EPRI) in the United States. These rates for new energy conservation technologies are widely accepted in the U.S. Typically the rate of penetration of a new technology is very slow at first because of the lack of confidence in the technology. As it gains acceptance, the rate increases substantially. At about 70 percent of maximum penetration, according to EPRI, the rate slows until maximum penetration is reached. The curve used by EPRI, shown in Exhibit 3-4, can be modeled using the following formula:

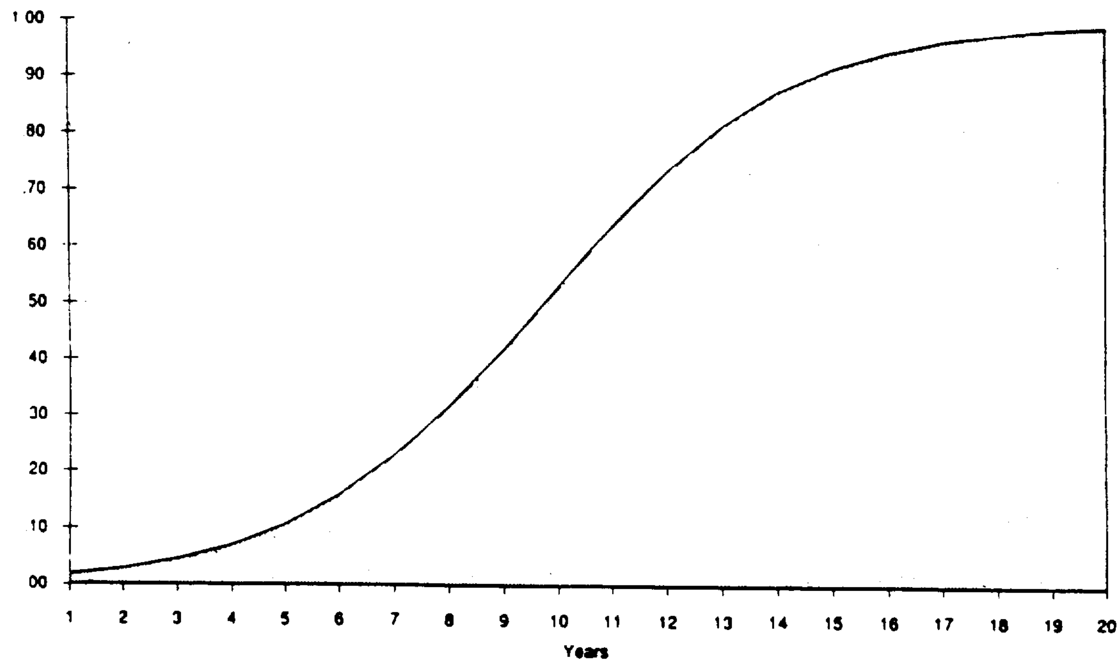
$$Rate\ of\ Penetration = \frac{1}{1 + e^{A+Bt}}$$

$$A = Ln\left[\frac{1-P_1}{P_1} - (Bt_1)\right]$$

$$B = \frac{Ln\left(\frac{1-P_1}{P_1}\right) - Ln\left(\frac{1-P_2}{P_2}\right)}{t_1 - t_2}$$

P_1 = Assumed penetration at time t_1
P_2 = Assumed penetration at time t_2

Exhibit 3-4
EPRI Penetration Rate Curve



Source: Electric Power Research Institute.

The market penetration rates in this study all assume some kind of incentive or the establishment of standards in order to accelerate market penetration. The rates were adjusted not on the basis of any specific formula, but on the basis of U.S. utility experience: some programs usually require a greater "push" than others. We did not attempt at this stage, however, to precisely quantify the magnitude of incentives (or rebates) that could be offered by the Guatemalan utilities. In the next phase of this assessment, with the use of DSManager software, these issues will be explored in more detail and incentives will be quantified.

3.4 CALCULATING THE COSTS OF CONSERVED ENERGY OR DEMAND

Demand-side management measures (DSMM) vary widely in terms of cost. To rank the demand-side management measures and obtain a first approximation of the economic viability of each, we used an annualized factor called the cost of conserved energy/demand (CCE or CCD). The CCE or CCD can be determined using the following formula:

$$\text{CCE or CCD} = \frac{\text{Incremental DSMM Cost x CRF}}{\text{Amount of Energy or Demand Conserved Annually}}$$

where

DSMM = The demand-side management measure

CRF = The capital recovery factor

$$= \frac{r}{1 - (1+r)\text{-}n}$$

Here, r is the discount rate and n is the number of years over which the investment is amortized.

The incremental cost of the DSMM is the difference between the net present value (NPV) of the DSMM and the NPV of the alternative (the currently used technology or procedure). The NPV calculations consider the change in operation and maintenance costs related to that measure. For measures that will require full replacement to achieve a significant penetration rate (e.g., stove burners with a life over 10 years), then only the full replacement cost was considered. For DSMMs with lives that are not equal to a multiple of the present technology life, the NPV was taken over two or more DSMM lifetimes so that a multiple was reached.

The capital recovery factor (CRF) spreads the incremental cost of the DSMM over the life of the measure, giving an annualized or levelized cost. Any changes, including changes in related labor costs, are included in the NPV calculations. The amount of energy or demand conserved annually is the energy saved in kWh or kW per year by one unit of the DSMM. The CCE or CCD is given in US cents per kWh.

3.5 COMPARING DSM COSTS TO BENEFITS

In principle, any measure whose cost is below the utility's avoided cost is attractive and should be evaluated in greater detail. Using the simplistic cost of conserved energy (demand) approach set forth in the previous section, the levelized cost per kWh for each of the DSM measures was compared directly to the estimated long-run marginal cost for power in Guatemala. Note that the conservation supply curves presented in this report, which show the estimated levelized costs for all the measures, are preliminary. The next step in this study will be to conduct a much more detailed cost/benefit analysis with additional data such as proper voltage-level, LRMC per customer class, and more refined end-use data and cost estimates. Also note also that these calculations are financial (i.e., import duties and local taxes are included). (The economic analysis was conducted at the program level and is discussed below.)

INDE and EEGSA have estimated the average overall long-run marginal cost (LRMC) (generation, transmission, distribution) of the SNI system at about US 8¢/kWh. (At times of system peak, the avoided cost has been estimated at up to US 10¢/kWh.) In this study, energy conservation measures that could meet or beat about one-half (to allow a margin for administrative, risk-related expenses and assured profitability) of the LRMC (US 8¢/kWh) were included into DSM programs and recommended for implementation. Note that the CCEs illustrated in the conservation supply curves do not include program implementation and administrative costs and therefore, the extra margin needs to be considered.

For the purposes of evaluating the benefits of the load management programs, as a proxy, we used a recent figure, provided by EEGSA, representing the kW cost of the most recent plant addition in Guatemala -- the privately owned ENRON generating units floating on barges. The kW/year cost for this project is estimated to be US $204/kW/year. In this study, load management measures that were less than half the $204/kW figure ($102) were included at this point into DSM programs recommended for implementation. This 50% of the avoided cost methodology is only preliminary and is simply designed to roughly reflect the additional risks that DSM programs can present over the supply options with which Guatemalan utilities are more familiar.

Unlike the CCEs, some of the associated administrative costs of CCDs (such as program implementations costs) were included in the conservation supply curves because these costs are sometimes significant for load management measures. The reason is that programs such as interruptible tariffs are more institutional than technology-driven and can be large in scope. These factors can create significant administrative costs for the utility.

In conducting the overall cost/benefit of the programs, an economic analysis was performed correcting for equipment import duties and local taxes. However, additional (economic) costs were factored in such as administrative expenses. The assumptions underlying these expenses differed depending on the nature of the program. For some programs, such as industrial motors, the level of expenditure throughout the life of the program is assumed to be steady based on the assumption that such a program would require utility promotion over the long term. In the case of industrial motors, this is in part attributed to the relatively high incremental costs of energy-efficient over standard motors and the limited opportunities for replacing burned-out motors with energy-efficient models in any particular year. For other programs, such as low/no-cost measures in the industrial sector, the level of administrative expenses increases as the number of program participants increase as a result of an accelerating market penetration of industrial energy audits. Other programs require a steady level of effort in the beginning but only a reduced level of effort thereafter --or none at all -- once the technology (or measure) is accepted and fully demonstrated and customers begin to implement the DSM measure based on market incentives and availability of information on the benefits of doing so. These assumptions are based on U.S. utility experience and will be re-examined in greater detail in the follow-up assessment using DSManager software.

Although this report currently evaluates the programs to the best degree possible within the current limitations of data availability, the following sequential steps need to be considered in the program evaluation.

1. The utility designates a proposed "avoided unit" which the DSM and load management programs will avoid or defer. This unit should represent the type of unit that would have been built according to the expansion plan.

2. The utility planner then determines the impact to the avoided unit, based on the change in load, resulting from the DSM program(s).

3. The net present value (capacity and operating cost) for the avoided unit is then determined.

4. Next, the fuel impact (fuel saving or fuel penalty) resulting from the delay in the unit's construction, and other savings if any, are calculated.

5. The NPV benefit plus NPV fuel impact for the avoided capacity is calculated and compared to the total NPV of the DSM program cost. For approval to proceed, the NPV benefit plus NPV fuel impact resulting from the avoided capacity should exceed the NPV DSM program cost. Ideally, the benefit should be double the cost of the program to provide a margin of safety in the engineering estimates for the program.

6. The NPV benefit plus NPV fuel impact of the avoided capacity can be divided by the total number of DSM program MW and total number of months in the life of the program to develop the benefit in dollars per kW per month. The fuel impact is usually estimated using a production cost simulation model.

3.6 CALCULATIONS INCLUDED IN DSM PROGRAM COSTS

Industrial Sector: In the industrial sector, the program costs included in the economic analysis were:

- equipment costs (excluding taxes and import duties on equipment)
- administrative expenses
- equipment installation costs.

Depending on the measure, either the full or the incremental cost of the measure was considered. For the following measures, the full cost of the measure was included, and for all other measures in the industrial sector, the incremental cost of the measure was included in calculating the weighted average cost of the program:

- cogged V-belts
- synchronous belts
- refrigeration unit maintenance/adjustment (low-cost measure)
- air compressor maintenance/adjustment (low-cost measure)
- energy audits (low-cost measure)
- fluorescent mirror reflectors.

For each program, the entire cost of the measures or a percent of the cost of the measures was then utilized to determine the cost-effectiveness of the program. For some programs such as industrial air conditioning, only 50 percent of the cost of the measure was included to maintain the program benefit:cost ratio of greater than 1:0.[2]

Commercial Sector: In the commercial sector, the program costs include the same items as in the industrial sector. For the following measures, the full cost of the measure was included, and for all other measures in the commercial sector, the incremental cost of the measure was considered:

---

[2] One of the deficiencies of the economic analysis is that it does not capture the savings for measures over the life of the measure. For example, measures installed in 2010 only provide energy savings in 2010, so that savings over the remaining life of the measure are not captured. This tends to make the measures less cost-effective in the economic analysis as compared to the financial analysis.

- T-8 lighting system
- fluorescent mirrored reflectors
- lighting timers
- occupancy sensors
- energy management systems
- refrigeration unit maintenance/adjustment.

For two programs in the commercial sector, only a percent of the cost of the program was included in the equipment cost per participant. These two programs are air conditioning, for which 30 percent of the program costs were included, and refrigeration, for which 75 percent of the program costs were included in the equipment costs per participant.

Residential Sector: In the residential sector, the program costs included in the economic analysis were:

- equipment costs (excluding taxes and import duties on equipment)
- administrative expenses for the program.

For the following measures, the full cost of the measure was included in the economic analysis:

- water heating insulation blankets
- low-flow showerheads
- water heater timers
- refrigerator seals.

The equipment cost for the residential water heater tank program consists of the incremental cost of a measure implemented for that program. The cost of the measure is the weighted average cost of all the measures for that program.

For all other residential sector measures, the incremental cost of the measure was considered, except for the refrigeration program, for which 75 percent of the incremental cost was considered in order to make the program cost-effective.

CHAPTER 4: THE INDUSTRIAL SECTOR

Guatemalan industry consumes more electricity than any other sector of the economy. In 1990, the industrial sector accounted for 32.3 percent of the country's electricity sales.

Guatemala has no heavy industry. Most of its manufacturing has traditionally been light assembly and food processing, although the sector has diversified somewhat in recent years. Since its initial moves towards trade liberalization in 1986, the country has seen exports in textiles and apparel boom, especially to industrialized countries. These newly dynamic export industries -- along with growth in traditional manufacturing in Guatemala -- are contributing toward an increase in demand for electricity.

In this study, industrial and municipal loads are combined because they behave similarly in Guatemala. These loads, referred to in this report as "industrial," accounted for 43.1 percent of Guatemala's electricity use in 1990 (856 GWh). Over 5,300 industrial facilities were receiving electric service from the grid at the end of 1990, with monthly energy consumption as shown below:

		kWh/month
EEGSA	industrial customers	22,460
EEGSA	municipal customers	858
INDE	industrial customers	1,629
INDE	municipal customers	615
INDE	very large customers	76,810

Within the industrial sector, motors and drives account for the single-largest share of electricity consumption -- nearly 95 percent of all electricity used in Guatemalan industry. Exhibit 4-1 shows the break out of major end-uses in the industrial sector and the share of motors and drives.

The important role that motors and drives play as an industrial end-use is not unique to Guatemala. In the U.S., for example, motors and drives are also the principal electricity end use; however, consumption is somewhat more evenly distributed over other end-uses such as process heating and lighting. Exhibit 4-2 compares the end-use energy breakdown in Guatemala with that of the United States.[1]

[1] This comparison is based on a United Nations study and inputs from the planning departments of both EEGSA (*Reporte Estadístico de EEGSA, 1990*, May 1991) and INDE (*Informe Estadístico 1990*, February 1991).

Exhibit 4-1
Guatemala Industrial Electricity End-Uses (MWh)

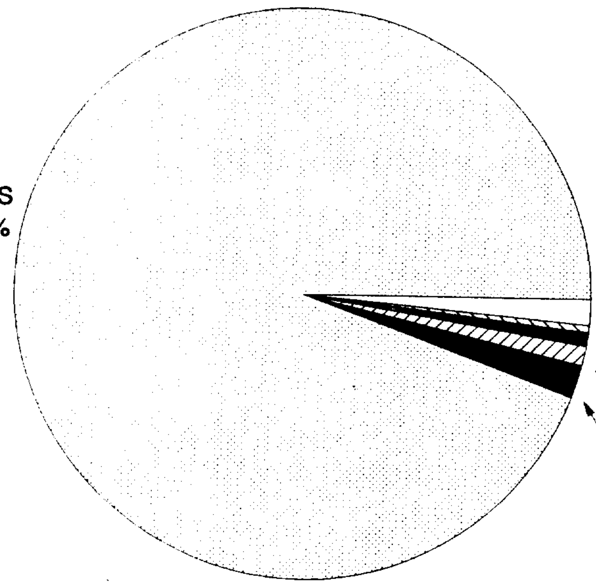


Exhibit 4-2
Guatemala Industrial End-Use Consumption

End-Use	Guatemala[1] Perc. Usage	1990 MWh	United States[2] Perc. Usage	1990 GWh
Motors and Drives	94.3%	605,297	67.0%	661,738
Process Heating	0.8%	5,135	10.8%	106,223
Electrolytic	0.4%	2,568	11.6%	114,553
Lighting[3]	1.9%	12,196	10.6%	104,607
Air Conditioning	1.1%	7,061		
Other[4]	1.5%	9,628		
Total	**100.0%**	**641,884**	**100.0**	**987,121**

[1]UNDP/MEN Study

[2]1990 Base Case Forecast, *Impact of Demand Side Management on Future Electricity Demand*, Barakat & Chamberlain, Inc., Sept. 1990.

[3]Figures for U.S. include lighting and other uses.

includes refrigeration and forklifts.

4.1 INDUSTRIAL SECTOR LOAD SHAPES

Detailed data on industrial-sector load shapes were required for this DSM assessment. As discussed in the previous chapter on methodology, these detailed end-use data were unavailable. Several types of end-use data, such as annual energy consumption, overall usage patterns, and average consumption by equipment type, were used to develop simulated load shapes using the DSM Impact Model.

The data that were available indicate that industrial electricity use contributes substantially to Guatemala's system peak. Motors and drives contribute an estimated 122.8 MW of demand at the system peak, as shown in Exhibit 4-3. Exhibit 4-4 shows the load curve for the Guatemalan industrial sector in terms of hourly diversified demand by end-use.

Exhibit 4-3
Industrial End-Use Contribution at Time of System Peak

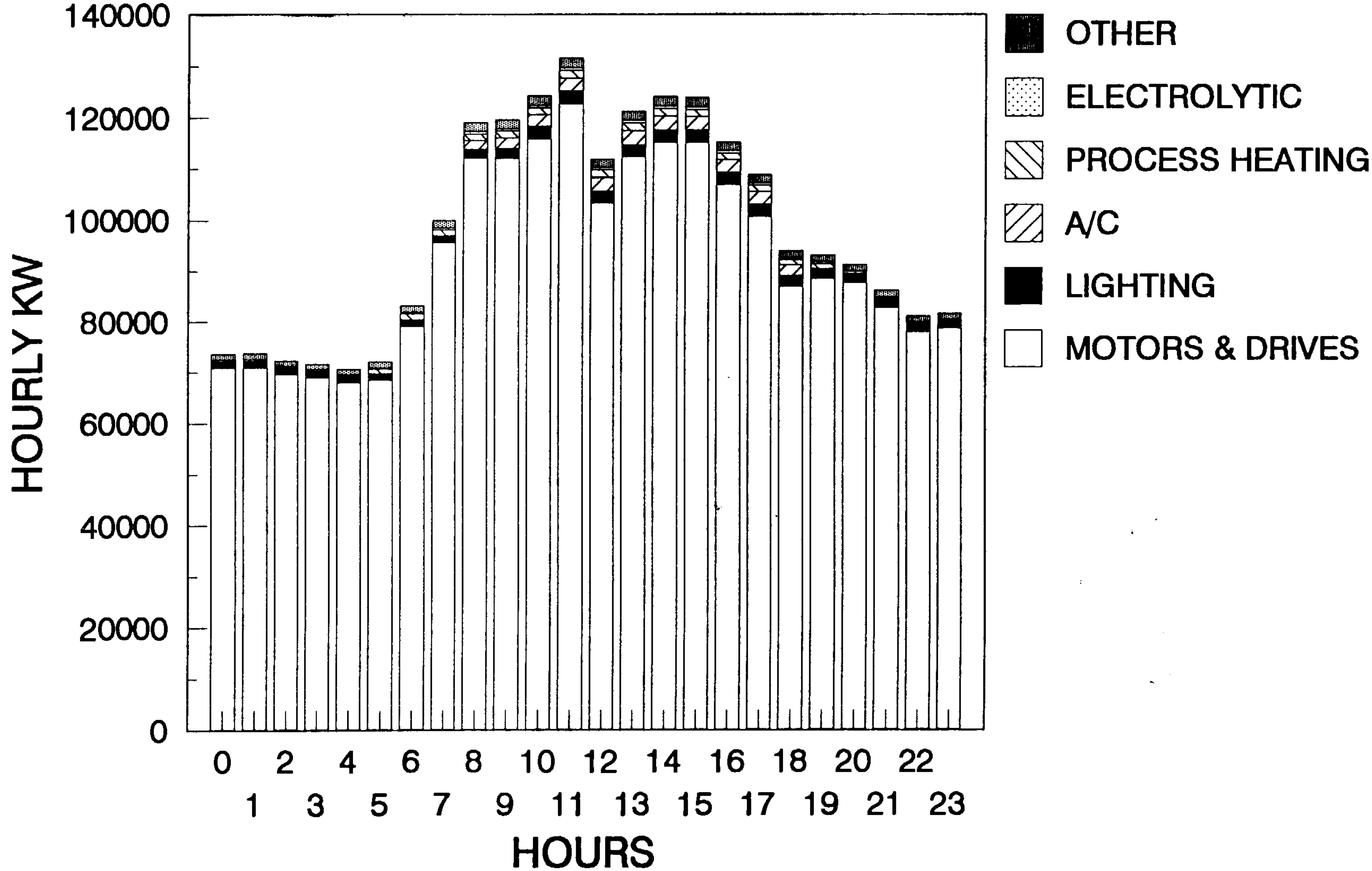
End-Uses	Contribution to Industrial Peak (%)	Contribution to System Peak (MW)
Motors & Drives	95.99%	122.8 MW
Lighting	2.11%	2.7 MW
Air Conditioning	0.00%	0.00 MW
Process Heat	0.00%	0.00 MW
Electrolytic	0.40%	0.51 MW
Other End Uses	1.50%	1.92 MW

4.2 DSM MEASURES FOR THE INDUSTRIAL SECTOR

DSM measures for the industrial sector can achieve both energy (GWh) and demand (MW) savings. A number of new technologies and low- and no-cost measures could save considerable amounts of energy in the industrial sector, often at a reasonable cost. Measures designed principally for energy conservation can also favorably affect peak-demand. Load management measures specifically designed to achieve peak demand savings in the industrial sector are discussed in Chapter 7.

As Exhibits 4-2 and 4-3 have shown, motors and drives, lighting, air conditioning, and "other" end-uses would appear to be the focal points for an industrial DSM program.

Exhibit 4-4
Guatemala Industrial Sector:
Hourly End-Use Profile



Together, these four categories represent 98.8 percent of industrial-sector energy consumption.

We grouped all of the applicable DSM measures for this sector into programs. The DSM programs for industry target the following end-uses:

1. end uses amenable to low-cost, no-cost, and other measures
2. energy-efficient motors and drives
3. energy-efficient lighting
4. energy-efficient air conditioning.

4.2.1 Low/No-Cost and Other Measures

Low-cost and no-cost measures are energy conservation measures that typically involve operation and maintenance improvements, and greater energy awareness for turning off lights and equipment when not needed. The costs of these "low-tech" measures are minimal. They include such things as:

- turning off lights when not needed
- turning off equipment when not needed
- using equipment only when fully loaded (e.g., heat treat furnaces)
- keeping doors to refrigerated space closed
- repairing damaged or missing insulation
- using the most efficient equipment when more than one model can be used
- reducing compressed air pressure
- repairing compressed air leaks
- repairing water leaks (to reduce lost pump energy)
- installing compressed air intakes in the coolest location
- lubricating equipment on schedule
- keeping equipment clean and cool (especially motors)
- using natural light as much as possible

Low/No-Cost and Other Measures Program

The measures and technologies we considered for this program included low- and no-cost measures that can be implemented in conjunction with energy audits, air compressor adjustment and maintenance, refrigeration adjustment and maintenance, and high-efficiency refrigeration. This last measure is included because, although high-efficiency refrigeration in the industrial sector in Guatemala would not achieve great savings, the technology can be cost-effective. To determine whether or not that is the case, we evaluated it together with the low/no-cost measures using the DSM Impact Model.

Energy Audit Measures. These energy savings are based on energy audits and the implementation of maintenance and operating strategies for existing equipment. The U.S. experience suggests that a 10 to 15 percent savings can be achieved by implementing and following up on energy audits in the industrial sector. Preliminary evidence from developing countries suggest that much larger savings can be achieved. We used a figure of 15 percent, a conservative estimate for Guatemala. The specific assumptions underlying the modeling of this measure are:

- The installed load is assumed to be 200 kW with a base energy consumption of 1,248,000 kWh. The annual energy savings are 187,200 kWh and a demand reduction of 30 kW, or a 15.0 percent overall energy and demand reduction for all the participants in the program.

Air Compressor Adjustment and Maintenance. This measure achieves energy savings based on the adjustment, repair of leaks, and maintenance of existing 20 horsepower air compressors including distribution components. The estimated savings in the U.S. are about 10 percent per air compressor. This figure, which comes from U.S. industry, is appropriate for Guatemala, too, because the end-use technologies and their applications do not differ substantially between the two countries.

The following specific assumptions were made:

- The air compressor is assumed to operate 3,640 hours per year. The annual energy savings are 4,105 kWh, or a 10.0 percent reduction for all participants in the program.

Refrigeration-Unit Adjustment and Maintenance. Other end-use energy savings are based on the adjustment and maintenance of the refrigeration-equipment components of a 15 horsepower system. We estimate that this measure will achieve a 10 percent savings per unit, an estimate from the U.S. air-conditioning and refrigeration industry. Like air compressors, these measures and end-use technologies do not differ greatly between the U.S. and Guatemala, and we used the U.S. 10 percent estimate in the DSM Impact Model. Specific assumptions were:

- Refrigeration equipment is assumed to operate 6,132 hours per year. The annual energy savings are 5,745 kWh, or a 10.0 percent reduction for each program participant.

High-Efficiency Refrigeration. Other end-use energy savings are based on the replacement of a 15 horsepower refrigerator compressor with a higher-efficiency compressor. We estimated that a 9.9 percent reduction could be achieved per participant per refrigerator based on the increase in efficiency between a standard and a high-efficiency 15 horsepower motor. The 9.9 percent figure is based on manufacturer data. The specific assumptions were:

- Refrigeration equipment is assumed to operate 6,132 hours per year. The annual energy savings are 5,959 kWh and 1.2 kW, or a 9.9 percent reduction in electricity consumption for this measure per participant.

Designing a Low/No-Cost and Other Measures Program

The program primarily focuses on low/no cost measures. Air-compressor adjustment and maintenance and refrigeration maintenance are sufficiently important to be treated separately. In fact, these measures could be undertaken outside a comprehensive energy audit program because of the large potential savings they typically offer.

Some additional measures are included in the overall low/no-cost and other measures program because, while they could be worthwhile to pursue, the likely savings in Guatemala would not be large. This is why high-efficiency refrigeration is grouped with low/no-cost measures.

Of all the measures included, the low/no-cost measures are particularly attractive because of their fast payback. We reflect this assumption in the high estimated-participation rate for the these measures in the overall program. The applicable DSM measures in this program are listed in Exhibit 4-5 with the corresponding "likely measure participation percentage":

Exhibit 4-5
Likely Participation Percentage for Low/No Cost and Miscellaneous Measures

DSM Measure	Likely Measure Participation Percent
Low-Cost/No-Cost Measures	60%
--Air Compressor Adjustment and Maintenance	20%
--Refrigeration Maintenance	14%
High-Efficiency Refrigeration	6%

The other end-use energy savings and paybacks for each of the measures in the program are shown in Exhibit 4-6:

Exhibit 4-6
End-Use Energy Savings and Paybacks for Program Measures

DSM Measure	Measure Energy Savings	Measure Payback (yrs)
Low-Cost/No-Cost Measures	15.0%	Immediate
--Air Compressor Adjustment and Maintenance	10.0%	Immediate
--Refrigeration Maintenance	10.0%	Immediate
High-Efficiency Refrigeration	9.9%	1.0

Estimated Program Savings

For this Guatemalan program, the weighted average of the estimated achievable savings per program participant is 13.1 percent or 1,261 kWh/year. The estimated cost of conserved energy for these programs is between 0 and 0.9 cents/kWh and the simple payback of these measures is between 0 and 1.0 year.

The savings estimated for this program are among the largest of any DSM program evaluated in this study. In the year 2010, the estimated maximum technical potential for the program is an estimated 262 GWh with a peak-demand reduction of 23 MW. The achievable market potential in the year 2010 for the program is estimated to be 57 percent of the maximum technical potential or 150.5 GWh and 13.20 MW in peak-demand reduction. These figures assume a 68 percent market penetration rate for this program in 2010.

4.2.2 Energy-Efficient Motors and Drives Program

Because motors and drives account for such a large share of Guatemalan industrial electricity consumption (94.3 percent), we designed a program that could better manage consumption for this end use. In Guatemala, motors between 1 and 10 horsepower consume 76 percent of motor energy usage; those between 10 and 30 horsepower consume 21 percent; and motors greater than 30 horsepower consume 3 percent of the electricity used for motors.

A number of technologies exist today that can significantly lower motor and drive electricity consumption. Depending on their applicability in Guatemala, we incorporated these technologies into a DSM program based on expected energy savings, cost and other factors. To calculate future savings, we made explicit assumptions regarding the average efficiency for each technology and average annual usage in typical installations. We also used estimates of rates of market penetration based on EPRI studies of market-penetration curves for energy-efficient technologies (discussed earlier in Chapter 3), as well as our own estimates of the likely measure participation rate for each measure. Finally, we estimated the payback per measure and overall savings for the program in terms of both energy and coincident peak demand.

Efficient Motor and Drive Technologies

Numerous proven technologies exist that could be beneficial in Guatemalan industrial applications. These include energy-efficient motors, adjustable speed drives, cogged V-belts and synchronous belt drives.

Energy-Efficient Motors. Energy-efficient motors are made with higher quality materials, improved bearings and fans, and superior windings. Energy savings with such motors vary from 2 to 10 percent, with the larger savings being in the smaller horsepower ranges. Energy-efficient motors can be retrofit to all but specialty motors. This study assumes that standard motors are replaced by energy-efficient models as the standard motors burn out. This study makes a number of assumptions regarding the efficiency and annual usage of motors in Guatemala:

- ***High-Efficiency 1 - 10 hp Motors:*** Motor and drive energy savings are based on the replacement of a 3 hp standard efficiency motor (Eff=80 percent) with a 3 hp high-efficiency motor (Eff=87 percent). The motor is assumed to operate 3,640 hours per year. The annual energy savings are 614 kWh and a demand reduction of 169 W, or an 8.0 percent energy and demand reduction.

- ***High-Efficiency 10 - 30 hp Motors:*** Motor and drive energy savings are based on the replacement of a 15 hp standard efficiency motor (Eff=86 percent) with a 15 hp high-efficiency motor (Eff=91 percent). The motor is assumed to operate 3,640 hours per year. The annual energy savings are 1,952 kWh and a demand reduction of 536 W, or a 5.5 percent energy and demand reduction.

- ***High-Efficiency >30 hp Motors:*** Motor and drive energy savings are based on the replacement of a 50 hp standard efficiency motor (Eff=90.4 percent) with a 50 hp high-efficiency motor (Eff=94.1 percent). The motor is assumed to operate 3,640 hours per year. The annual energy savings are 4,429 kWh and a demand reduction of 1.2 kW, or a 3.9 percent energy and demand reduction.

Energy-Efficient Belts. Energy-efficient belts can improve efficiency. Cogged V-belts have notches formed into the face of the belt. This allows greater flexibility and heat dissipation, resulting in an efficiency improvement of approximately 2 percent. Cogged V-belts do not require sheave changes and can replace a standard V-belt when it wears out or breaks. The life and price of cogged V-belts are estimated to be twice those of standard V-belts.

Synchronous belts also improve efficiency. These belts, sometimes called high-torque drive (HTD) belts, are flat with rounded teeth. They resemble timing belts, but can run at higher velocities with less noise. Synchronous belts transmit drive power 4 to 10 percent more efficiently than standard V-belts because they have greater flexibility and less slip. They can be applied to any V-belt application except those requiring slip for shock loadings and those used with belt clutches. Synchronous belts require that the sheaves be replaced along with the belt and, therefore, they cannot be installed whenever a V-belt breaks. They are generally cost-effective for drives above 7.5 horsepower.

The assumptions we made governing efficient belts, their use, and the applicable motor-size ranges in Guatemala were the following:

- ***Cogged V-Belts for 1 - 10 hp Motors:*** Motor and drive energy savings are based on the replacement of the standard V-belt drive on a 3 hp standard efficiency motor (Eff=80 percent) with cogged V-belts. The motor is assumed to operate 3,640 hours per year. The annual energy savings are 153 kWh and a demand reduction of 42 W, or a 2 percent energy and demand reduction.

- ***Synchronous Belt Drives 10 - 30 hp Motors:*** Motor and drive energy savings are based on the replacement of the standard V-belt drive of a 15 hp standard efficiency motor (Eff=86 percent) with a synchronous belt drive. The motor is assumed to operate 3,640 hours per year. The annual energy savings are 1,776 kWh and a demand reduction of 0.5 kW, or a 5 percent energy and demand reduction.

- ***Synchronous Belt Drives > 30 hp Motors:*** Motor and drive energy savings are based on the replacement of the belt drive of a 50 hp standard efficiency motor (Eff=90.4 percent) with synchronous belt drives. The motor is assumed to operate 3,640 hours per year. The annual energy savings are 5,632 kWh and a demand reduction of 1.5 kW, or a 5 percent energy reduction.

Energy-Efficient Drives. Energy-efficient drives principally include adjustable or variable-speed drives. These drives modulate the speed of driven equipment. Reducing the speed of a fan by 50 percent, for example, can reduce power consumption by 97.5 percent.

Older AC variable-speed drives used clutches and other mechanical means that were frequently unwieldy, costly, and hard to maintain. Early variable-frequency drives also proved troublesome and costly. The current generation of electronic variable-speed drives is significantly more reliable and less expensive. We made the following assumptions about energy-efficient belts and which size ranges made the most sense to target:

- ***Adjustable-Speed Drive >30 hp Motors:*** Motor and drive energy savings are based on the replacement of a 50 hp standard efficiency fan motor (Eff=90.4 percent) with a 50 hp adjustable-speed drive. The motor is assumed to operate 3,640 hours per year. The annual energy savings are 28,161 kWh and a demand reduction of 3.1 kW, or a 30 percent energy reduction and a 10 percent demand reduction.

Designing an Efficient-Motors and Drives Program

Based on the assumptions of energy use for each measure, its applicability and availability in Guatemala, and other factors, we designed an energy-efficient motors and drives program suitable for Guatemala. The program matches new, efficient technologies to the motor-size ranges in which they are best suited.

We estimated that cogged-V belts for motors in the 1 to 10 horsepower range and high-efficiency motors also in the 1 to 10 horsepower range would likely attract the highest participation in this program (Exhibit 4-7). This is because of a combination of factors such as low initial cost, attractive payback, and the importance of small motors as a share of the total market in Guatemala.

Exhibit 4-7
Likely Participation Percentage for Motors and Drives

DSM Measure	Likely Measure Participation Percent
High-Efficiency 1 - 10 hp Motors	36.0%
High-Efficiency 10 - 30 hp Motors	7.3%
High-Efficiency > 30 hp Motors	1.0%
Adjustable-Speed Drives > 30 hp motors	0.5%
Cogged V-Belts 1- 10 hp Motors	40.0%
Synchronous Belt Drives 10 - 30 hp Motors	13.7%
Synchronous Belt Drives > 30 hp Motors	1.5%

Based on the assumptions we made governing annual use and average efficiency per measure, we calculated the expected paybacks for the various measures included in the program. Cogged V-belts and synchronous belt drives for large motors (greater than 30 horsepower) emerge as the measures with the fastest payback. Adjustable-speed drives for large motors, on the other hand, offer some of the greatest energy savings of any single measure (per installation). These results are shown in Exhibit 4-8:

Exhibit 4-8
Energy Saving and Paybacks for DSM Measures

DSM Measure	Measure Energy Savings	Measure Payback (yrs)
High-Efficiency 1 - 10 hp Motors	8.0%	3.1
High-Efficiency 10 - 30 hp Motors	5.5%	3.3
High-Efficiency > 30 hp Motors	3.9%	4.1
Adjustable-Speed Drives > 30 hp Motors	30.0%	3.7
Cogged V-Belts 1- 10 hp Motors	13.3%	1.3
Synchronous Belt Drives 10 - 30 hp Motors	5.0%	2.7
Synchronous Belt Drives > 30 hp Motors	5.0%	1.3

Estimated Program Savings

The model suggests that in Guatemala, significant energy savings in motors and drives could be achieved at reasonable cost. The program could save an estimated 4.9 percent of energy consumption per participant with energy savings on the order of 7,640 kWh/year per customer. The estimated cost of conserved energy for these measures is between 1.4 and 3.4 cents/kWh -- less than the estimated long-run marginal cost of about 8.0 cents/kWh in Guatemala.

In the year 2010, we estimate the maximum technical potential for the motors and drives program as 103.5 GWh with a demand reduction of 12.7 MW in peak-demand savings. Of these savings, the actual achievable market potential in the year 2010 is 27.81 GWh with a 3.42 MW peak-demand reduction. These actual savings are about 27 percent of the maximum technical potential and represent the gains that can be achieved at an economically attractive marginal cost. These figures assume a 60 percent penetration rate for this program by the year 2010.

4.2.3 Energy-Efficient Lighting Program

Because industrial lighting is the second-largest end use in Guatemala's industrial sector (consuming 1.9 percent of electricity requirements), lighting is an attractive candidate for a possible DSM program. The program proposed here relies on the promotion and/or substitution of more efficient lamps for conventional lamps, more efficient ballasts, and the installation of fluorescent-mirrored reflectors.

This is not to say that there are no measures which do not rely on high-efficiency technology. For example, increased use of daylighting in manufacturing plants can be a very inexpensive and effective measure. However, we treat low- and no-cost measures as a separate program cutting across many end-uses. These were discussed in Section 4.2.1.

The technologies included in the proposed industrial-lighting program are energy-efficient fluorescent lamps, fluorescent mirrored reflectors, efficient magnetic ballasts, electronic ballasts, T-8 lamps with electronic ballasts, high-pressure sodium lamps, low-pressure sodium lamps and metal halide lamps.

Efficient Lighting Technologies

Numerous types of energy-efficient lighting technologies are well demonstrated, convenient to install, and available in Guatemala. These technologies are typically more suitable for some applications than others. The assumptions we made regarding usage and efficiency are all based on a typical installation.

Energy-Efficient Fluorescent Lamps. Energy-efficient (or reduced-wattage) fluorescent lamps are constructed using a mixture of rare elements and gases to give energy savings while minimizing the reduction in light output. Savings are typically in the 15 percent range while lighting levels drop approximately 10 percent. Because of the low lighting levels evidenced in some countries, the applicability of energy-efficient fluorescents may be reduced. We made the following assumptions regarding the savings that can be achieved and usage of these lamps in Guatemala:

- Lighting energy savings are based on the replacement of a 40 watt fluorescent lamp with a 34 watt reduced-wattage fluorescent lamp. The lamps are assumed to operate an average of 6,240 hours per year. The annual energy savings per lamp are 37 kWh and a demand reduction of 6 W, or an energy and demand reduction of 15 percent.

Fluorescent Mirrored Reflectors. Fluorescent mirrored reflectors are polished or reflectorized metal inserts that are placed in an existing fixture. The reflectors direct more light out of the fixture and toward the work surface, sometimes permitting half of the lamps in a room to be removed. On the average, installing reflectors and removing half of the lamps and ballasts will result in lighting levels of 25 to 40 percent of the design light level. Current reflector technology uses clips to secure the reflector to the fixture. Current reflectors also serve as the ballast cover in lay-in fixtures. We made the following assumptions in the model:

- Lighting energy savings are based on the reduction of a standard 4-40 watt fluorescent lamp and two standard magnetic ballasts fixture to a 2-40 watt fluorescent lamp with one standard magnetic ballast and a mirrored reflector. The lamps are assumed to operate an average of 6,240 hours per year. The annual energy savings per fixture are 543 kWh and a demand reduction of 87 W, or an energy and demand reduction of 49.7 percent.

Efficient Magnetic Ballasts. Efficient magnetic ballasts use copper wire and improved core materials to achieve greater savings as compared to standard electro-magnetic ballasts. The efficiency improvement is between 8 and 10 percent of the energy consumed by a ballast operating two standard F 40 lamps. We assumed in the DSM Impact Model for Guatemala that:

- Lighting energy savings are based on the replacement of a standard 4-40 watt fluorescent lamp and two standard magnetic ballasts fixture with a 4-40 watt fluorescent lamp and two efficient magnetic ballasts.[2] The lamps are assumed to operate an average of 6,240 hours per year. The annual energy savings per fixture are 87 kWh and a demand reduction of 14 W, or an energy and demand reduction of 8 percent.

Electronic Ballasts. Electronic ballasts use electronic circuitry to regulate the energy coming into lamps. These ballasts typically operate at 20 to 25 kiloherz, while standard electro-mechanical ballasts operate at line frequency (60 herz). They apply to both 48- and 96-inch lamps. Energy savings from these ballasts are 15 to 25 percent. Because of their solid-state electronic components and lower operating temperatures, electronic ballasts are said to operate for 25 years or more. Their failure rate is now equal to or below the rate of electro-mechanical ballasts. We assumed that:

- Lighting energy savings are based on the replacement of a standard 4-40 watt fluorescent lamp and two standard magnetic ballasts fixture with a 4-40 watt fluorescent lamp and two electronic ballasts. The lamps are assumed to operate an average of 6,240 hours per year. The annual energy savings per fixture are 256 kWh

[2] Energy-efficient ballasts are a viable DSM measure alone or in combination with lamp replacements.

and a demand reduction of 41 W, or an energy and demand reduction of 23.4 percent.

T-8 Lamps With Electronic Ballasts. T-8 lamps with electronic ballasts are a variation on *electronic ballasts combining the benefits of T-8 lamps with electronic ballasts.* T-8 lamps have a smaller diameter than standard lamps (1 inch versus the standard 1.5 inches) and have three phosphor layers deposited on the inside of the tube. These features increase the probability that the ultraviolet energy emitted will strike the phosphor instead of being reabsorbed. Also, the smaller diameter lamp tends to have less lumen depreciation over its useful life. When used in conjunction with electronic ballasts, these lamps' lighting systems can provide savings of approximately 35 percent when compared to standard lamps and ballasts. We made the following assumptions governing these lamps:

- Lighting energy savings are based on the replacement of a standard 4-40 watt fluorescent lamp and two standard magnetic ballasts fixture with a 4-T-8, 32 watt fluorescent lamp with one electronic ballast. The lamps are assumed to operate an average of 6,240 hours per year. The annual energy savings per fixture are 381 kWh and a demand reduction of 61 W, or an energy and demand reduction of 34.9 percent.

High-Pressure Sodium Lamps. High-pressure sodium (HPS) lamps provide high efficiency and long life. The efficacy or lumens of output per watt of electricity is high: 58 to 126 lumens per watt compared with 15 to 24 for a conventional incandescent lamp. This high efficacy, combined with their good color rendition, makes these lamps attractive for some applications, especially outdoor lighting such as street lighting. These lamps are also finding application in industrial bays where coloration is not as important. We made the following assumptions regarding HPS lamps in Guatemala:

- Lighting energy savings are based on the replacement of a 250 watt mercury vapor fixture with a 150 watt high-pressure sodium fixture. The lamps are assumed to operate an average of 4,380 hours per year. The annual energy savings are 438 kWh and 100 W, or a 40 percent energy and demand reduction.

Low-Pressure Sodium Lamps. Low-pressure sodium (LPS) lamps are the most efficient lamps available (with an efficacy rating of between 75 and 150 lumens per watt). While they also benefit by being commonly available, low-pressure sodium lamps have some limits on their application. This is due to the poor color rendition from these lamps. Applications include tunnels, parking lots, garages, and street lighting. We assumed the following for LPS lamps:

- Lighting energy savings are based on the replacement of a 250 watt mercury vapor fixture with a 100 watt low-pressure sodium fixture. The lamps are assumed to operate an average of 4,380 hours per year. The annual energy savings are 657 kWh and 150 W, or a 60 percent energy and demand reduction.

Metal Halide Lamps. Metal halide lamps use are energy-efficient lamps that provide the best color rendition of all high-intensity discharge lamps. These lamps can last as long as mercury vapor lamps and be twice as efficient. These lamps are used in sports stadiums, warehouses, bay lighting and in general where color rendition is important. These lamps are available in wattages as low as 70 plus a 35 Watt ballast, making them applicable in grocery stores and some department stores. We made the following assumptions in the model:

- Lighting energy savings are based on the replacement of a 250 watt mercury vapor fixture with a 175 watt metal halide fixture. The lamps are assumed to operate an average of 4,380 hours per year. The annual energy savings are 329 kWh and 75 W, or a 30 percent energy and demand reduction.

Designing an Energy-Efficient Lighting Program

We designed a program that includes various industrial lighting technologies based on what is available in Guatemala, the types of lighting applications that exist in the industrial sector, U.S. utility experience, the suggestions of U.S. and Guatemalan utility consultants, and the estimated payback for each measure. Compact fluorescent lamps were not included because of their limited application in the industrial sector. The various high-efficiency lighting technologies included in the program have all been fully tested and commercialized. Metal halide fixtures were not a cost-effective replacement for mercury vapor fixtures and were thus not included in this program.

The program matches new, efficient-lighting technologies to a broad spectrum of industrial-lighting applications in Guatemala from large-area shop-floor illumination to lighting for exterior security and parking. We estimate that measures like the installation of energy-efficient (reduced-wattage) fluorescent lamps and fluorescent-mirrored reflectors would likely attract some of the highest participation rates in this package of measures. In part, these estimates are based on the fast payback of these measures and their availability in Guatemala. The applicable DSM measures for lighting are combined into a program set out in Exhibit 4-9 with the corresponding estimate of the "likely measure participation percentage":

Exhibit 4-9
Likely Participation Percentage for Lighting Measures

DSM Measure	Likely Measure Participation Percent
Energy-Efficient Fluorescent Lamps	38.7%
T-8 Lamps with Electronic Ballasts	15.5%
Fluorescent Mirrored Reflectors	23.2%
Efficient Magnetic Ballasts	6.0%
Electronic Ballasts	2.6%
High-Pressure Sodium Lamps	9.8%
Low-Pressure Sodium Lamps	1.4%

Energy-efficient fluorescent lamps, low-pressure sodium lamps, and fluorescent-mirrored reflectors are the industrial-lighting measures with the fastest payback. The latter two also rate at the top in terms of energy savings per measure. The lighting energy savings and payback for each of the measures in the program are shown in Exhibit 4-10.

Exhibit 4-10
Energy Savings and Paybacks for Lighting Measures

DSM Measure	Measure Energy Savings	Measure Payback (yrs)
Energy-Efficient Fluorescent Lamps	5.0%	0.4
T-8 Lamps with Electronic Ballasts	34.9%	3.4
Fluorescent Mirrored Reflectors	49.7%	1.5
Efficient Magnetic Ballasts	8.0%	2.8
Electronic Ballasts	23.4%	4.0
High-Pressure Sodium Lamps	40.0%	2.5
Low-Pressure Sodium Lamps	50.0%	3.2

Estimated Program Savings

For Guatemala, the savings estimated to result from the industrial lighting program is 29.5 percent of the lighting-energy consumption per participant. Energy savings are 903 kWh/year per participant and the estimated cost of conserved energy for these measures is between 1.1 and 4.7 cents/kWh, with most of these measures below the estimated long-run marginal cost of approximately 8.0 cents/kWh for Guatemala's utilities. The simple payback of these measures is between 0.4 years and 4.0 years.

In the year 2010, the estimated maximum technical potential for the lighting program is 11.3 GWh and a 1.6 MW peak demand reduction. Out of this figure, the achievable market potential is estimated to be 5.30 GWh with a peak-demand reduction of 0.73 MW. These achievable savings represent nearly half (47 percent) of the maximum technical potential, and assume a 70 percent penetration rate for this program in 2010.

4.2.4 Energy-Efficient Air Conditioning Program

Air conditioning is the third-most significant electricity end-use (1.1 percent of total consumption) in Guatemalan industry. Air conditioning appears to be primarily used for cooling general office areas. Units are generally conventional, although the exact percentage of industrial accounts with installed air conditioning equipment is not currently available.

We estimated that energy reductions would be achieved for this end-use, but with little or no coincident-demand reductions. This is because of the limited average use of air conditioners during the peak periods in Guatemala.

Energy-Efficient Air Conditioners

There are not very many alternative technologies to choose from in trying to reduce the energy used for air conditioning in Guatemala.

High-Efficiency Direct-Expansion (DX) Units. The only realistic option is to replace the direct expansion units now used in Guatemalan industry with high-efficiency direct-expansion units. DX units cool air by passing it directly over the evaporation coil. Increased efficiency is achieved with improved compressor designs, increased coil area, more efficient motors in the air handlers, and with better insulation. These units are not especially sophisticated or complex to use, repair or maintain. In the industrial air-conditioning program proposed here, we made the following assumptions:

- Air conditioning energy savings are based on the replacement of a 90,000 Btu/h DX unit with an estimated efficiency of 6.0 EER with a 90,000 Btu/h DX unit with an average efficiency of 10.0 EER. The air conditioning equipment is assumed to operate 1,558 hours per year. The annual energy savings are 7,478 kWh and 4.8 kW, or a 40.0 percent energy and demand reduction.

Designing an Efficient Air Conditioning Program

The program proposed here includes only one measure --the installation of high-efficiency, direct-expansion units. Other air conditioning technologies would not have widespread application in Guatemala, would be too expensive, and/or would not be available. Because only one measure is included in this program, the likely measure participation percent shown in Exhibit 4-11 is 100 (there are no other measures in which to participate in the program):

Exhibit 4-11
Likely Participation Percentage for Air Conditioning Measure

DSM Measure	Likely Measure Participation Percent
High-Efficiency DX Units	100%

Air conditioning energy savings are high, but not with an especially fast payback (Exhibit 4-12):

Exhibit 4-12
Energy Savings and Paybacks for Air Conditioning Measures

DSM Measure	Measure Energy Savings	Measure Payback (yrs)
High-Efficiency DX Units	40.0%	5.1

The extended payback is due to the limited average yearly use in the industrial sector, resulting in limited kWh potential savings (7478 kWh/year per participant).

Estimated Program Savings

The estimated cost of conserved energy for this program is 4.2 cents/kWh, which is less than the estimated long-run marginal cost of approximately 8.0 cents/kWh for Guatemala's utilities.

In the year 2010, we estimate the maximum technical potential for the air conditioning program at 15.5 GWh with 0 MW of peak demand savings. Of this, the achievable market potential is estimated to be 4.1 GWh, again with no peak reduction. These achievable energy savings represent about 26 percent of the maximum technical potential. These results assume that the market penetration rate of this program is 50 percent in 2010.

4.2.5 Industrial Power-Factor Correction Program

Large customers can require more power than they actually use through losses due to low power factor. Although Guatemala now penalizes these customers for failing to compensate for low power factor, additional capacity savings appear to be possible if the power factor in the distribution lines is corrected to 98 percent.

Power factor is the relationship (phase) of current and voltage in AC electrical distribution systems. Under ideal conditions, current and voltage are "in phase" and the power factor is 1.0. If inductive loads (such as motors, transformers, and other coil-wound equipment) are present, current lags behind the voltage, and the power factor is reduced to less than 1.0. The power factor is the cosine of the phase angle of lag between the current and the voltage. Low power factor causes higher current to flow in power distribution lines in order to deliver a given number of kilowatts to an electrical load. The effects are:

- Power distribution systems in facilities with low power factor may be limited in capacity (see below) since high current flows result from low power factor.
- Electricity costs can be increased if an electric utility charges a penalty for low power factor.
- higher current flow increases resistance heating losses in the transmission and distribution system, adding slightly (less than 1 percent) to the electricity consumption.

Power demand and consumption are measured in kW and kWh. Power generation distribution and transformation systems have their capacity measured in kVA (kilovolt amperes).

$$KVA = \frac{V \times A \times 1.73 \text{ (three-phase system)}}{1000}$$

V = Volts

A = Amps

1.73 = square root of 3 (for three-phase systems)

The power factor of a system is defined as:

$$pf = \cos\theta = kW/kVA$$

where θ is the phase angle between voltage and current.

For example, with unity power factor (1.0), it would take 2,000 kVA of generating and distribution network capacity to deliver 2,000 kW. If the power factor dropped to 0.85, however, 2,353 kVA of capacity would be needed. Thus, low power factor has an adverse effect on generating and distribution capacity: if the power factor is low, the electric utility must have additional capacity available to meet electricity demands.

Electric utilities attempt to improve their system power factor by installing capacitors in their distribution systems, and by imposing a penalty for users with low power factor. Usually, however, this applies to only the large users: most residential and commercial facilities do not have meters that can measure power factor.

Most electrical loads on a utility system are inherently inductive due to the wide-spread use of transformers, conductors and motors. This inductive component (lagging power factor) causes an increase in the current required to deliver a given amount of power to the system. At high load levels, the lagging power factor may result in excessive losses and, in the extreme case, may limit the power transfer capability to the load.

The benefits to be achieved from power factor correction can be large. Exhibit 4-13 shows the power factor for a group of industrial customers in Guatemala. The power factor for Group 1 ranges between 42.6 percent and 84.8 percent, with the average being 70 percent. The power factor for Group 2 ranges between 68.1 percent and 80.5 percent, with the average being 77.3 percent.

Exhibit 4-13
Power Factors for a Group of Industrial Customers

Company	Bill	Consump .kWh	D.Fac 1 kW	Fact.Pot. (%)	D.Fac 2 (kW)	Quota 1 (Q)	Quota Fin (Q)	Dif. (Q)	Increment (%)
1) Users with Power Factor Correction Equipment									
Extrudoplast	13,617,075	158,200	660	69.30	810	63,898.77	67,023.77	3,125.00	4.66
Ina S.A	14,104,188	307,412	582	69.60	711	109,087.11	111,864.16	2,777.05	2.48
Aceros Suarez	12,856,338	210,000	1,943	42.60	3,877	109,137.77	146,374.39	37,236.62	25.44
Hornos S.A.	12,503,143	1,601,250	7,098	68.20	8,846	655,754.82	655,754.06	33,028.24	4.80
Ginsa	13,116,339	782,250	2,667	64.30	3,526	314,592.73	314,592.56	20,445.83	6.10
Ind. Acricasa	12,503,130	220,550	536	71.20	640	83,101.23	85,792.17	2,690.94	3.14
Cia. Ind. Listex	12,704,166	2,535,750	4,358	84.80	4,368	909,067.90	909,067.90	249.72	0.03
Listex S.A.	14,865,001	1,065,750	1,706	70.20	2066	378,818.87	378,818.87	9,304.18	2.40
Fagrigas	12,503,169	95,200	581	79.30	623	43,695.91	43,695.91	812.00	1.82
Cervecia C.A.	12,502,976	1,407,000	3,856	80.40	4,077	547,079.01	547,079.01	6,032.01	1.09
Total				**69.99**		**3,214,234.12**	**3,329,935.71**	**115,701.59**	**3.47**
2) Users without Power Factor Correction Equipment									
Kellog's de C.A.	12,142,565	246,960	676	77.80	739	92,122.73	93,478.96	1,356.23	1.45
Fabrica la Luz	11,813,770	180,600	560	78.40	607	68,781.86	69,793.65	1,011.79	1.45
Alimentos S.A.	12,355,357	322,700	980	68.10	1,223	122,457.02	127,688.20	5,231.18	4.10
Ind. Tubos y Perfiles	10,980,263	177,240	554	80.40	586	67,597.61	68,264.67	667.35	0.98
Texsesa	13,969,644	166,288	420	76.00	470	61,272.61	62,348.99	1,076	1.73
Texto S.A.	15,745,766	307,720	627	80.50	662	110,152.59	110,906.06	753.47	0.68
Ind. Avicola del Sur	15,643,641	195,300	454	78.30	493	71,117.22	71,956.79	839.57	1.17
Olefinas S.A.	13,105,601	521,220	938	78.30	1,018	183,908.00	185,630.20	1,722.20	0.93
Verdufrex S.A.	14,885,713	171,500	602	79.5075.80	644	66,827.71	67,731.86	904.15	1.33
Ind. Oleaginosas	12,503,197	988,400	2,814		3,156	371,034.83	378,397.23	7,362.40	1.95
Total				**77.31**		**1,215,271.89**	**1,236,196.61**	**20,924.72**	**1.69**
Grand Total						**4,429,506.01**	**4,566,132.32**	**13,6,626.31**	**2.99**

Nota: Inf. Del F.P. Dada por Depto. de Contadores Memo. DTC-024-92
La Lista Incluye Contadores Diferentes al Quantum.

Power-Factor Correction Technologies

The most practical and economical power-factor correction device is the capacitor. It improves the power factor because the effects of capacitance are exactly opposite those of inductance. Capacitors supply reactive current required by an inductive load, rather than taking it from the grid. Capacitors are sized in kVAr, which is the reactive power corresponding to the reactive current. Capacitors can be installed at any point in the electrical system and will improve the power factor between the point of application and the power source. However, the power factor between the load and the capacitor will remain unchanged. Capacitors are usually added either at each piece of offending equipment (individual compensation), ahead of groups of motors or motor control centers or distribution panels (group compensation), or at main services (central compensation).

Designing a Power-Factor Correction Program

A number of complex considerations bear on the design of a power-factor correction program. From a technical point of view, it may be best to promote individual compensation on every motor to provide the maximum power-factor correction. However, except for large motors, this is not usually preferable because deploying central groups or banks of capacitors with a single control system can maintain constant power-factor correction regardless of the load variations on the system. Individual capacitors simply cannot follow load variation. Central compensation also offers added benefits in terms of enhanced reliability and more streamlined maintenance regimes.

Utilities often install capacitors on their own lines where it is not practical to measure power factor, or to assess charges to owners. The addition of shunt capacitor banks to distribution feeders compensates the lagging power factor in the same way as the end-use applications discussed above. Power-factor correction on distribution feeders is usually implemented by utilities in order to accomplish one or more of the following objectives:

- eliminate excessive voltage drop
- reduce losses
- optimize available generation
- help maintain the system within desired operating standards.

Power-factor correction for the purposes of reducing losses requires that losses be evaluated considering the daily load cycle for a given capacitor application. The performance of typical feeders reveals a few common operating characteristics applicable to most feeders:

- Losses vary as a square of the kVA load level. These losses are significant mainly at peak load levels.

- The loss reduction factor (reduction in kW loss per kVar capacitance added) at a given point is proportional to the magnitude of the load kVAr and is independent of the kW magnitude.

- Voltage drop on a utility system is a function of the reactance to resistive ratio (electrical parameters determined by the design of the system). This ratio is influenced by conductor type and size, geometry of line, and length of line. Normally, voltage drop will be more sensitive to kVAr levels than kW. This suggests the implementation of a suitable power factor correction program to maintain a quality voltage profile in the distribution feeders at all times.

- In order to maintain a stable system, power factors in excess of 0.98 in the distribution system should be prevented (without considering the effects of transmission line capacitance) during light load levels. The additional capacitance introduced by the transmission lines can over-compensate the system reactance, thus resulting in a leading power factor. This can be prevented with the installation of a remote control system to switch capacitors as needed or based on system parameters.

- Power factor correction is essential during peaks in order to prevent excessive voltage drop.

By improving the power factor at industrial facilities, the Guatemalan utilities will be able to reduce losses in transmission and distribution lines. By correcting the power factor from 85 to 90 percent, the utility can reduce line losses by approximately 11 percent, thus achieving both energy and peak- demand savings.

Estimated Program Savings

In Guatemala, line losses are approximately 17 percent of net generation, of which an estimated 40 percent is non-technical. According to INDE and EEGSA, the power factor in the transmission lines is high; the distribution system, however, has a lower power factor.

Under the assumption that power factor improvement will directly affect 50 percent of the technical line losses, the improvement in system power factor from .85 to 0.9 could have the following effect on the energy consumption attributable to the industrial sector:

- 880,753 MWh x 0.11 x .16 x (1 - 0.4) x 0.5 = 4,650 MWh (in 1992)

- 1,887,418 MWh x 0.11 x .16 x (1 - 0.4) x 0.5 = 9,964 MWh (in 2010).

Assuming a coincident peak load factor of 0.65, the peak-demand reduction potential can be estimated as:

- 4,650 MWh / (8760 x 0.65) = 0.8 MW (in 1992)
- 9,964 MWh / (8760 x 0.65) = 1.75 MW (in 2010).

A demand-side management program could be implemented to provide incentives to customers to increase their power factor. An assessment of the savings associated with such a program would quantify the savings that could be achieved. Based on these savings, an incentive could be designed to achieve these savings.

We estimate that the achievable market potential in the year 2010 for power factor correction is 9.96 GWh/yr with a peak-demand reduction of 1.75 MW.

4.4 SUMMARY OF INDUSTRIAL SECTOR DSM IMPACTS

The analysis of potential demand-side management measures that can be implemented in Guatemala revealed that the greatest impact can be achieved from implementing low- and no-cost measures. Savings from high-efficiency motors and drives are also significant. And while load management measures *per se* are discussed separately in Chapter 7, significant peak-demand savings can also be achieved through the programs discussed here, including power-factor correction.

The DSM measures for the applicable end-uses in the industrial sector can provide an estimated energy conservation savings potential of 210.5 GWh/yr with a coincident peak-demand reduction of 50.7 MW. These estimates are for the year 2010.

We developed a conservation supply curve to rank the various DSM measures across all DSM programs in the industrial sector in Guatemala (Exhibit 4-14). This curve shows the magnitude of GWh savings and the levelized cost per kWh for each measure proposed here. The exhibit illustrates the following preliminary results:

- low/no-cost measures could provide the greatest energy savings at very low cost
- savings from high-efficiency refrigeration are significant at a cost of conserved energy of less than one cent per kWh

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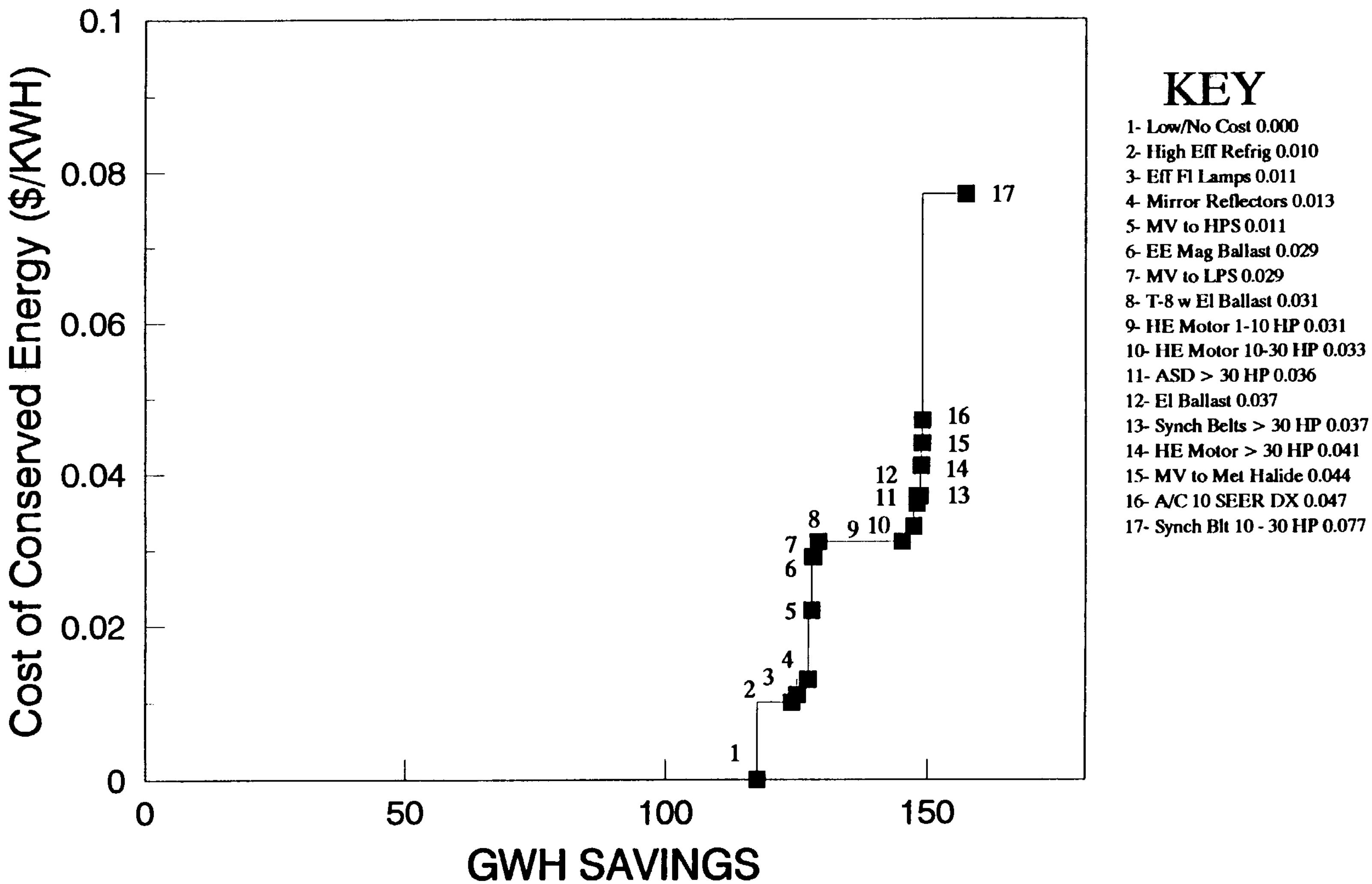
Exhibit 4-14
Guatemala Industrial Sector:
Cost of Conserved Energy vs. GWh Savings



- after low/no cost savings, energy-efficient motors in the 1 to 10 horsepower range could achieve the second-largest savings of any single measure, at a cost of approximately 2.6 cents per kWh

- at 16.7 cents per kWh, the conversion from mercury vapor to metal halide lamps does not appear to be a cost-effective energy-saving technology for Guatemala.

As discussed in Chapter 3 on methodology, note that an additional margin must be allowed for the administrative costs of running these programs. These costs will vary depending on the program, and will be examined in greater detail in the next phase of this Guatemalan power sector efficiency assessment.

Also note that power-factor correction is not included in the curve. This is because of the difficulty in making key assumptions required for calculating program costs.[3]

A summary of the estimated industrial DSM program impacts is found in Exhibit 4-15. These results show the impact in 2010 of programs begun in 1994, but these results are not cumulative. They show that the market penetration of the various energy-saving technologies and measures proposed for the industrial sector will achieve 210.6 GWh in energy savings and 50.7 MW of demand savings in the year 2010 *if the programs are launched in 1994*. If they are not initiated at that time, the savings we projected for 2010 would be achieved in later years.

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[3] For example, industrial power-factor requirements could simply be increased to 90 percent, placing costs directly on the customer. These costs would be offset, however, by some benefits to the utility in improved performance of the distribution system. Decreases in customer tariff rates could return these benefits to the customer who is bearing all the costs under this approach. But tariff rate adjustment is beyond the scope of this assessment. Another approach would be to provide program participants with rebates. The magnitude of these rebates and their total cost is also beyond the scope of this initial assessment.

Exhibit 4-15
Guatemala -- Total DSM Energy and Demand Savings in the Industrial Sector - 2010

	Guat. Mkt. Pen.	MWh Usage	% Savings /Inst.	Overall GWh Saved	Overall % Savings	Maximum MW	Peak Coinc. Factor	Peak Coinc. MW	% Savings /Inst.	Peak MW Saved	Peak % Savings
Industrial Sector (1)		2,358,750				436	0.76	332			
Motors & Drives		2,224,301						319			
Motors & DSM Program	49.9%		4.4%	27.81	1.18%				4.5%	3.42	1.0%
Lighting		44,816						6.9			
High-Efficiency Lighting	70.0%		29.5%	5.30	0.22%				29.5%	0.73	0.22%
Other		25,946						0			
High-Efficiency A/C	40.0%		40.0%	4.1	0.18%				40.0%	0.00	0.00%
Low Cost/No Cost	68.0%		13.0%	150.5	6.38%				9.6%	13.20	3.98%
Power Factor Correction				9.96	0.42%					1.75	5.27%
Innovative Rates*											
Time of Use	15.0%			6.60	0.28%					10.60	3.2%
Interruptible	22.0%			6.30	0.27%					21.00	6.3%
Total				210.57	8.9%					50.7	15.3%

(1) Cogeneration from Ingenios is not included in the industrial maximum MW.

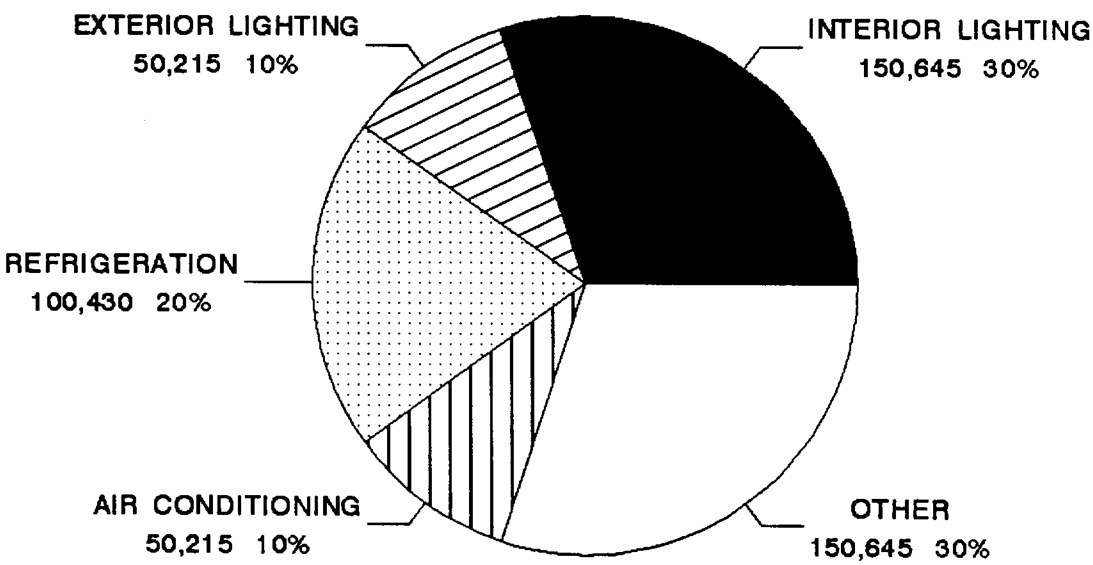
* See Chapter 7 for a discussion of load management rates.

CHAPTER 5: THE COMMERCIAL SECTOR

The commercial sector in Guatemala accounts for a significant share of the country's electricity consumption. Nearly 100,000 commercial customers consumed 25.2 percent of Guatemala's electricity in 1990 (502 GWh out of a total of 1,989 GWh),[1] and customers had an average monthly electricity consumption of 420.6 kWh. These usage patterns did not differ greatly between commercial consumers of EEGSA and INDE.

Interior lighting is the largest single end use in Guatemala's commercial sector, accounting for 30 percent of consumption. Refrigeration is also an important end use, accounting for about 20 percent of consumption. Air conditioning (10 percent) and exterior lighting (10 percent) are other significant end uses. Exhibit 5-1 depicts the shares of total end-use consumption for various end uses in the commercial sector.

Exhibit 5-1
Guatemala Commercial Electricity End-Uses
(MWh)



[1] The commercial and governmental sectors were combined into the commercial sector because of their similarities in end-use patterns.

The importance of lighting as a commercial sector end use is not unique to Guatemala. As Exhibit 5-2 shows, lighting is the single largest commercial end use in Guatemala, Costa Rica and the United States.

Exhibit 5-2
Primary Commercial End-Uses in Guatemala, Costa Rica, and the U.S.

	United States[1]		Costa Rica[2]		Guatemala[3]	
End-Use	1990 GWh	% Usage	1990 GWh	% Usage	1990 GWh	% Usage
Lighting	278,885	32%	180	26%	150.6[4]	30%
Ext Lighting					50.2	10%
Heating	90,329	10%	70	10%		
Cooling	180,435	20%			50.2	10%
Ventilation	89,995	10%				
Motors			100	14%		
Refrigeration	71,195	8%	70	10%	100.4	20%
Water Heating	28,144	3%				
Cooking	18,911	2%				
Other	126,816	14%	280	40%	150.6	30%
Total	**884,710**	**100%**	**700**	**100%**	**502**	**100%**

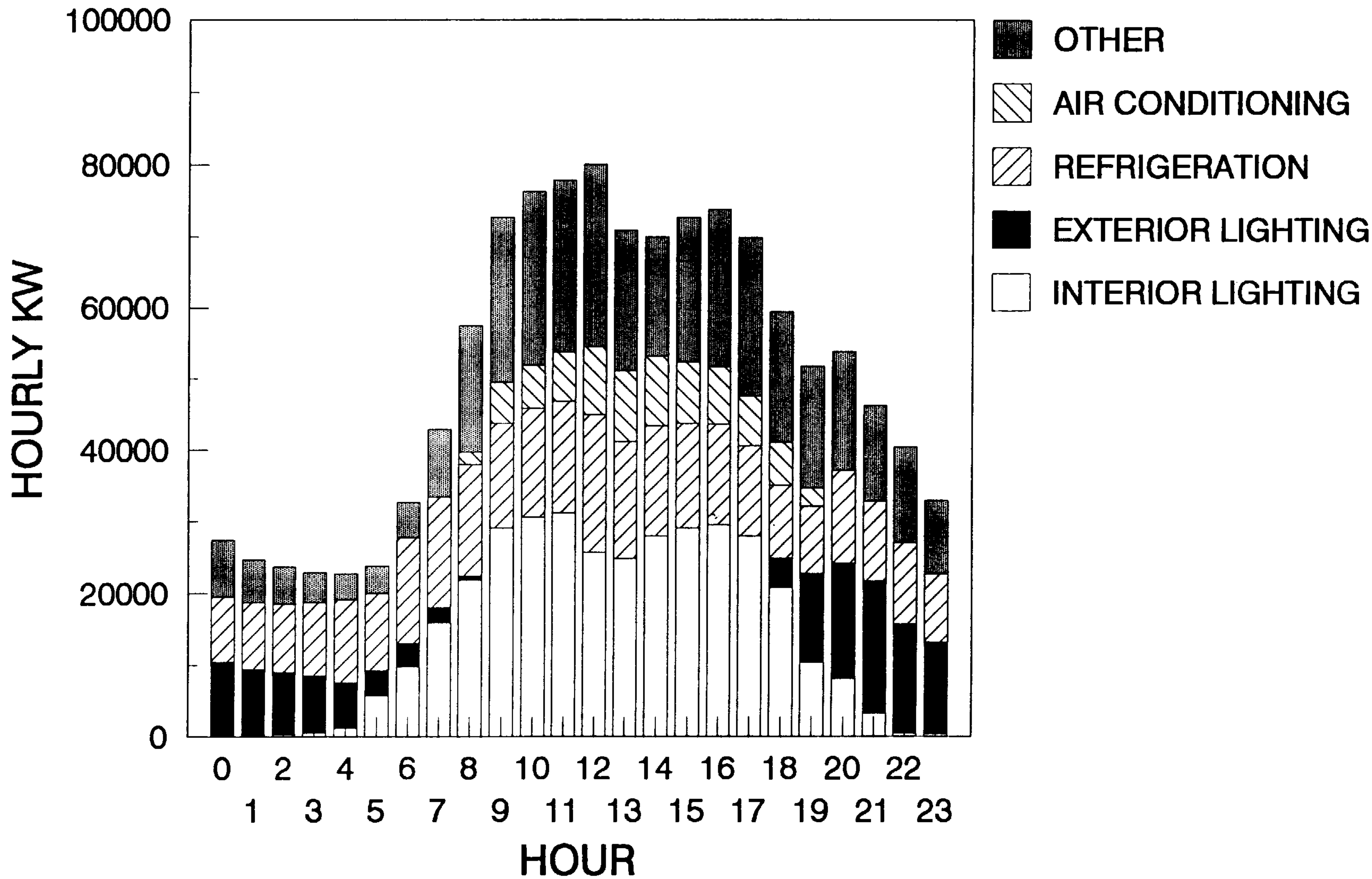
1 1990 Base case forecast, *Impact of Demand-Side Management on Future Electricity Demand.* Bakarat & Chamberlain, Inc., Sept. 1990.
2 *Commercial and End-Use Breakout, Costa Rica: Power Sector Efficiency Assessment,* RCG/Hagler, Bailly, Inc., June 1991.
3 Estimates provided by Departamento de Planeación, EEGSA and INDE.
4 Interior lighting only.

5.1 COMMERCIAL SECTOR LOAD SHAPES

Detailed data on commercial-sector load shapes were required for this DSM assessment but were unavailable. Based on the commercial sector's estimated annual energy consumption by end-use, the average consumption for each equipment type, and the usage patterns of these end-uses, the load shapes for the principal commercial end-uses in Guatemala were modeled using the DSM Impact Model. This simulation was no different in approach than the load curve modeling exercise discussed in the previous chapter on the industrial sector.

The simulated load shape for the commercial sector as a whole reveals that the peak period is at mid-day with a late afternoon spike. Exhibit 5-3 shows the load curve for the Guatemalan commercial sector in terms of hourly diversified demand by end-use.

Exhibit 5-3
Guatemala Commercial Sector
Hourly End-Use Profile



The load shape simulation also shows the end uses with the most important contribution to the system peak. "Other" end uses refers to technologies such as motors, ventilation equipment, and water heating equipment, which in the aggregate play a significant role in the commercial sector. (A breakdown of these end uses was not available at the time this report was prepared.) The "other" end uses contribute 31 percent to the commercial sector peak, and exterior lighting makes a 30 percent contribution to the peak. Interior lighting, the principal end use in the commercial sector, contributes 15 percent to the commercial peak. These relative effects are shown in Exhibit 5-4, which is based on results from the DSM Impact Model.

5.2 DSM MEASURES FOR THE COMMERCIAL SECTOR

Energy-efficient technologies and measures targeting the four major commercial end-uses -- interior and exterior lighting, refrigeration and "other" --were analyzed to determine those DSM measures most appropriate for Guatemala. These four end-uses stand out because they are responsible for 70 percent of all electricity consumption in the commercial sector.

As with industrial DSM measures, we grouped commercial DSM measures into programs aimed at achieving significant savings across major end-uses. These programs focussed on the following end uses:

1. Lighting (interior and exterior)
2. Refrigeration
3. Air conditioning
4. End uses amenable to low-cost, no-cost and other measures.

5.2.1 Energy-Efficient Lighting Program

Because lighting is the single most important end use in the commercial sector, we designed an energy-efficient interior and exterior lighting program for Guatemala. In total, lighting applications represented 40 percent of all commercial consumption or about 201 GWh in Guatemala's commercial sector during 1990.

Both interior and exterior lighting make significant contributions to the country's system peak. We determined that the implementation of an energy-efficient lighting program (including compact fluorescent lighting) could provide significant benefits in reducing both energy and demand at the time of system peak.

Exhibit 5-4
Commercial End-Use Contribution at Time of System Peak

End-Uses	Contribution to Commercial Peak (%)	Contribution to System Peak (MW)
Interior Lighting	15%	14.25 MW
Exterior Lighting	30%	28.5 MW
Refrigeration	24%	22.8 MW
Other End-Uses	31%	29.45 MW

In the analysis, we made several assumptions concerning the breakdown of commercial lighting consumption. Of interior lighting applications, it was estimated that about 86 percent of electricity consumption is for fluorescent lighting and 14 percent for incandescent lighting.[2] We also assumed that about 80 percent of exterior lighting is for high-intensity discharge (HID) lighting and 20 percent for incandescent lighting.

Energy-Efficient Lighting Technologies

Many of the energy-efficient lighting technologies appropriate for the commercial sector are identical to those proposed for the industrial sector in the previous chapter. Nevertheless, assumptions regarding average usage differ between the two sectors and have a direct bearing on the results. Finally, four efficient lighting technologies that are not necessarily as appropriate for the industrial sector are introduced here for the first time: efficient magnetic ballasts, compact fluorescent lamps, timers, and occupancy sensors.

Energy-Efficient Fluorescent Lamps. These lamps are the same as those described in the previous chapter. We made the following assumptions regarding their commercial use:

- Lighting energy savings are based on the replacement of a 40 watt fluorescent lamp with a 34 watt energy-efficient fluorescent lamp. The lamps are assumed to operate an average of 3,744 hours per year. The annual energy savings per lamp are 22 kWh with a demand reduction of 6 W, or an energy and demand reduction of 15 percent.

2 Source: Information provided by INDE and EEGSA.

High-Pressure Sodium Lamps. These are also defined in the previous chapter. The assumptions governing commercial use were that:

- Lighting energy savings are based on the replacement of a 250 watt mercury vapor fixture with a 150 watt high-pressure sodium fixture. The lamps are assumed to operate an average of 4,380 hours per year. The annual energy savings are 438 kWh and a demand reduction of 100 W, or an energy and demand reduction of 40 percent.

Metal-Halide Lamps. These are as defined in the previous chapter. The assumptions were:

- Lighting energy savings are based on the replacement of a 250 watt mercury vapor fixture with a 175 watt metal halide fixture. The lamps are assumed to operate an average of 4,380 hours per year. The annual energy savings are 329 kWh and a demand reduction of 75 W, or an energy and demand reduction of 30 percent.

T-8 Lamps with Electronic Ballasts. These are as described in the previous chapter. We assumed that:

- Lighting energy savings are based on the replacement of a standard 4-40 watt fluorescent lamp and two standard magnetic ballasts fixtures with a 4 T-8, 32 watt fluorescent lamp with one electronic ballast. The lamps are assumed to operate an average of 3,744 hours per year. The annual energy savings per fixture are 228 kWh and a demand reduction of 61 W, or an energy and demand reduction of 34.9 percent.

Fluorescent Mirrored Reflectors. The assumptions for the commercial sector differ slightly from the industrial sector:

- Lighting energy savings are based on the reduction of a standard 4-40 watt fluorescent lamp and two standard magnetic ballasts fixtures to a 2-40 watt fluorescent lamp with one standard magnetic ballast and a mirrored reflector. The lamps are assumed to operate an average of 3,744 hours per year. The annual energy savings per fixture are 326 kWh and a demand reduction of 87 W, or an energy and demand reduction of 49.7 percent.

Electronic Ballasts. These are the same as in the industrial sector, except that:

- Lighting energy savings are based on the replacement of a standard 4-40 watt fluorescent lamp and two standard magnetic ballasts fixtures with a 4-40 watt fluorescent lamp and two electronic ballasts. The lamps are assumed to operate an average of 3,744 hours per year. The annual energy savings per fixture are 154 kWh and a demand reduction of 41 W, or an energy and demand reduction of 23.4 percent.

In addition to the lighting technologies presented in the previous chapter, four additional technologies could have a significant effect on demand:

Energy-Efficient Magnetic Ballasts. Magnetic ballasts use copper wire and improved core materials to achieve greater savings as compared to standard magnetic ballasts. We made the following assumptions:

- Lighting energy savings are based on the replacement of a standard 4-40 watt fluorescent lamp with two standard magnetic ballasts with a 4-40 watt fluorescent lamp and two energy-efficient magnetic ballasts. The lamps are assumed to operate an average of 3,744 hours per year. The annual energy savings per fixture are 52 kWh and a demand reduction of 14 W, or an energy and demand reduction of 8 percent.

Compact Fluorescent Lamps. Compact fluorescents are low-wattage, self-ballasted fluorescent lamps that can attach to incandescent lamp sockets on a one-to-one replacement basis. On the average, compact fluorescents draw 25 percent of the electricity of an incandescent for the same lumen output. Incandescent lamps rated at 25 to 100 watts can be retrofit with fluorescent lamps consuming 5 to 28 watts that provide equivalent lighting. For example, an 18-watt compact fluorescent produces the equivalent light of a 75-watt incandescent. New introductions to the market may allow direct replacement of 150 and 200 watt bulbs. Configurations of compact fluorescents include two and four parallel tubes ranging from 4 to 8 inches in length, depending on the lamp wattage.

Prices of compact fluorescent lamps in the U.S. vary depending on the manufacturer and wattage, but generally run between $13 and $25 each. The simple payback period for the installation of compact fluorescents ranges from 1.0 to 2.1 years. Average usage above 4 hours per day also accelerates the payback considerably.

For the Guatemalan commercial sector, we assumed that:

- Lighting energy savings are based on the replacement of a 75 watt incandescent lamp with an 18 watt self-ballasted compact fluorescent. The lamps are assumed to operate an average of 3,744 hours per year. The annual energy savings are 198 kWh and a demand reduction of 53 W, or an energy and demand reduction of 70.7 percent.

Timers. Timers are simple electronic clocks that switch lights on and off at pre-determined intervals. Automatic time control can reduce the number of hours that lights are left on and can save approximately 10 percent of the total lighting consumption for the corresponding circuit. Timers are very often used for outdoor night lighting control. For the commercial sector in Guatemala, we assumed that:

- Lighting energy savings are based on the control of a 200 W lighting circuit with an automatic timer to turn lamps on and off on a preset schedule. The circuit is assumed to operate an average of 3,744 hours per year. The annual energy savings are 75 kWh and a demand reduction of 20 W, or a 10 percent energy and demand reduction.

Occupancy Sensors. Occupancy sensors can detect human presence and can switch lights on or off depending on when individuals enter (or leave) a controlled space. When individuals enter, the lights are switched on; after they leave, lights are switched off automatically. The most common type of occupancy sensors are ultrasonic and infrared. Estimated energy savings are about 30 percent, although greater savings can be achieved in specific locations (such as conference rooms and individual offices). For Guatemala, we assumed that:

- Lighting energy savings are based on the control of a 200 W lighting circuit with an occupancy sensor to turn lamps on and off whenever a room is unoccupied. The circuit is assumed to operate an average of 3,744 hours per year. The annual energy savings are 225 kWh and a demand reduction of 20 W, or a 10 percent demand and 30 percent energy reduction.

Designing Energy-Efficient Lighting Programs

Various commercial lighting technologies can be offered in "programs" for commercial customers. We designed two lighting programs to distinguish between interior and exterior applications (see Appendix D). The technologies we chose are based on a variety of considerations including the suggestions of Guatemalan utility officials and consultants, and the estimated payback for each measure.

We estimated that energy-efficient fluorescent lamps would attract the greatest participation in the interior lighting program (Exhibit 5-5) based in part on the rapid payback and convenience of purchasing and using these technologies. For exterior lighting (Exhibit 5-6), where color rendition is not as important, we estimated that high-pressure sodium lamps would prove to be the most attractive measures, particularly since they are more often appropriate for exterior applications than compact fluorescents. Metal halide fixtures did not turn out to be cost-effective for the replacement of mercury vapor lamps in indoor installations; this technology was thus not included in the program. The technologies offered are those shown below, along with the "likely measure participation percent" (the number of participants projected to participate in a specific measure divided by the total participants projected for that program) for each measure:

Exhibit 5-5
Likely Participation Percentage for Interior Lighting Measures

DSM Measure	Likely Measure Participation Percent
High-Efficiency Fluorescent Lamps	32.9%
T-8 Lamps with Electronic Ballasts	13.2%
Fluorescent Mirrored Reflectors	19.7%
Efficient Magnetic Ballasts	2.2%
Electronic Ballasts	5.1%
Compact Fluorescent Lamps	11.9%
Timers	10.5%
Occupancy Sensors	4.5%

Exhibit 5-6
Likely Participation Percentage for Exterior Lighting Measures

DSM Measure	Likely Measure Participation Percent
High-Pressure Sodium Lamps	80%
Compact Fluorescent Lamps	20%

Energy-efficient and compact fluorescent lamps appear to have the fastest payback of any of the interior or exterior lighting measures. The lighting energy savings and paybacks for each of the measures in the two programs are listed in Exhibit 5-7:

Exhibit 5-7
Energy Savings and Paybacks for Lighting Measures

DSM Measure	Measure Energy Savings	Measure Payback (yrs)
High-Efficiency Fluorescent Lamps	15.0%	0.6
T-8 Lamps with Electronic Ballasts	34.9%	4.6
Fluorescent Mirrored Reflectors	49.7%	2.1
Efficient Magnetic Ballasts	8.0%	2.8
Electronic Ballasts	23.4%	2.5
Timers	50.0%	6.2
Occupancy Sensors	30.0%	3.5
Compact Fluorescent Lamps	70.7%	1.0
High-Pressure Sodium Lamps	40.0%	2.0

Estimated Program Savings

The savings estimated to result from the Guatemalan commercial sector interior lighting program is 31.5 percent of the interior lighting energy consumption per participant. The exterior lighting program will save 42.1 percent of the exterior lighting energy consumption per participant. Energy savings are 477 kWh/year and 213 kWh/year per participant for the interior lighting and exterior lighting programs, respectively. The estimated cost of conserved energy for the interior programs is between 0.6 and 5.7 cents/kWh. For the exterior programs, it is between 2.1 and 8.9 cents/kWh. The simple payback of these measures is between 0.6 years and 6.2 years.

In the year 2010, the estimated maximum technical potential for interior lighting is 113 GWh with a peak demand reduction of 7 MW; for the exterior lighting program, the figures are 56.1 GWh and 21.4 MW peak demand reduction. The achievable market potential in the year 2010 for the interior program is estimated to be 36.76 GWh and 2.26 MW in peak demand reduction; for the exterior lighting program, the figures are 18.17 GWh and 6.91 MW, respectively. In both cases, we assumed a 50 percent market penetration for these lighting programs in 2010.

5.2.2 Energy-Efficient Refrigeration

Refrigeration is the second-most important single end use application in the commercial sector. Refrigeration applications consumed about 10 percent of total commercial sector consumption (100 GWh) in Guatemala during 1990. Because specific information regarding the type of refrigeration equipment installed is not currently available, we assumed that most commercial enterprises in the country have component refrigeration equipment -- a self-contained refrigeration box with a separate compressor. Due to refrigeration's high load factor, we predicted that considerable energy and demand reduction would be available for this commercial end-use.

Energy-Efficient Refrigeration Measures

We chose two measures that appear to be appropriate for increasing commercial refrigeration efficiency in Guatemala: 1) adjustment and maintenance measures, and 2) high-efficiency technology.

Refrigeration Unit Adjustment and Maintenance. Refrigeration energy savings are based on the adjustment and maintenance of the refrigeration equipment components. We made the following assumptions:

- The refrigeration equipment operates 7,008 hours per year. The annual energy savings are 2,453 kWh and a demand reduction of 350 W, or an energy and demand reduction of 10.0 percent.

High-Efficiency Refrigerators. Refrigeration energy savings are based on the replacement of a 5 hp refrigeration system with a higher-efficiency compressor, improved insulation, and better seals. (Note that the average size of high-efficiency refrigerators proposed here is smaller than the units proposed for the industrial sector.) We assumed that:

- The refrigeration equipment operates 7,008 hours per year. The annual energy savings are 2,453 kWh and a demand reduction of 350 W, or an energy and demand reduction of 10.0 percent.

Designing an Energy-Efficient Refrigeration Program

As with commercial lighting technologies, measures aimed at increasing refrigeration end-use efficiency were grouped into a program. We estimated that refrigeration adjustment and maintenance, a low-cost measure, would attract the greatest participation because of the measure's low cost and availability in Guatemala. The applicable DSM measures for refrigeration are listed in Exhibit 5-8 with the corresponding "likely measure participation percentage":

Exhibit 5-8
Likely Percentage Participation for Refrigeration Measures

DSM Measure	Likely Measure Participation Percent
Refrigeration Unit Adjustment and Maintenance	70%
High-Efficiency Refrigerator	30%

Adjustment and maintenance is clearly the measure with the fastest payback. The refrigeration energy savings and paybacks for each of the measures in the program are shown in Exhibit 5-9.

Exhibit 5-9
Energy Savings and Paybacks for Refrigeration Measures

DSM Measure	Measure Energy Savings	Measure Payback (yrs)
Refrigeration Unit Adjustment and Maintenance	10%	Immediate
High-Efficiency Refrigerator	10%	3.2

Estimated Program Savings

The savings estimated to result from the Guatemalan commercial sector refrigeration program is 10.0 percent of the refrigeration energy consumption per participant. Energy savings are 2,453 kWh/year per participant. The estimated cost of conserved energy for these programs is between 0 and 5.8 cents/kWh. The simple payback for these measures is between 0 years and 3.2 years.

In the year 2010, the estimated maximum technical potential for the refrigeration program is 21.3 GWh with a peak demand reduction of 3.2 MW. The achievable market potential in the year 2010 for the refrigeration program is estimated to be 7.95 GWh or 1.21 MW in peak demand reductions. These results assume a market penetration for this program of 50 percent in 2010.

5.2.3 Energy-Efficient Air Conditioning

After lighting and refrigeration, air conditioning is the single most important end-use in Guatemala's commercial sector. In 1990, air conditioning accounted for 10 percent of commercial end-use or about 50 GWh. Data on the exact percentage of commercial accounts with installed air conditioning equipment, however, were not available. We estimated that approximately 20 percent of new commercial construction has air conditioning equipment. We also assumed that approximately half the energy used for air conditioning is used in window units and half in direct-expansion (DX) units.[3]

We estimated that energy reductions would be available for this end-use, but because of the low average air conditioning load at the time of peak, we estimated that coincident demand reductions would be limited.

Energy-Efficient Air Conditioning Technologies

The proposed technologies do not differ greatly from those discussed in the previous chapter on industrial-sector efficiency. High-efficiency window units are commonly available and have a higher energy efficiency rating (EER) than less-efficient models. DX units are defined in the previous chapter.

High-Efficiency Window Units. Air conditioning energy savings are based on the replacement of an 18,000 Btu/h window unit with an estimated efficiency of 5.0 EER with an 18,000 Btu/h window unit with an average efficiency of 9.0 EER. We assumed that:

- The air conditioning equipment operates 1,247 hours per year. The annual energy savings are 1,596 kWh and a demand reduction of 1.3 kW, or an energy and demand reduction of 44.4 percent.

[3] Source: Information provided by INDE and EEGSA.

High-Efficiency Direct Expansion (DX) Units. Air conditioning energy savings are based on the replacement of a 60,000 Btu/h DX unit with an estimated efficiency of 5.0 EER with a 60,000 Btu/h DX unit with an average efficiency of 10.0 EER. We assumed that:

- The air conditioning equipment is assumed to operate 1,247 hours per year. The annual energy savings are 5,986 kWh and a demand reduction of 4.8 kW, or an energy and demand reduction of 50.0 percent.

Designing an Efficient Air Conditioning Program

The program proposed here includes two measures: the installation of high-efficiency window units and of high-efficiency DX units. We predicted that participation would be greater for the window units, largely because they have a lower initial cost than DX units. The applicable DSM measures with the corresponding "likely measure participation percent" are shown in Exhibit 5-10.

Exhibit 5-10
Likely Participation Percentage for Air Conditioning Measures

DSM Measure	Likely Measure Participation Percent
High-Efficiency Window Units	65%
High-Efficiency DX Units	35%

The air conditioning energy savings and paybacks for each of the measures in the program are shown in Exhibit 5-11.

As in the industrial sector, the extended paybacks are due to the limited average yearly use of air conditioning in Guatemala. This results in limited kWh potential savings; however, these measures may be more applicable to certain commercial business segments (e.g., hotels).

Exhibit 5-11
Energy Savings and Paybacks for Air Conditioning Measures

DSM Measure	Measure Energy Savings	Measure Payback (yrs)
High-Efficiency Window Units	44.4%	4.4
High-Efficiency DX Units	50.0%	6.1

Estimated Savings

The savings estimated to result from the commercial air conditioning program for Guatemala is 46.1 percent of the air conditioning energy consumption per participant. Energy savings are 233 kWh/year per participant. The estimated cost of conserved energy for these programs is between 7.8 and 10.6 cents/kWh. The simple payback of these measures is between 4.4 years and 6.1 years.

In the year 2010, the estimated maximum technical potential for the air conditioning program is 61.4 GWh with no peak demand reductions. The achievable market potential in the year 2010 for the air conditioning program is estimated to be 1.63 GWh, again with no peak demand reductions. These results assume a 15 percent market penetration rate for the program in 2010.

5.2.4 Low/No-Cost and Other Conservation Measures Program

End uses other than lighting and cooling consumed about 30 percent of commercial electricity in Guatemala (134 GWh) during 1990. These "other" end uses included such things as motors, fans, office equipment, and water heaters. However, we do not know which of these are more important because a breakdown of these end-uses was not available at the time this report was prepared.

As in the industrial sector, numerous opportunities exist in the commercial sector for achieving significant energy savings at little or no cost. In addition, we identified several technologies that could favorably affect consumption in Guatemala at a competitive cost. Commercial low/no-cost measures include maintenance and operating strategies for existing equipment; other measures include high-efficiency motors (like those discussed in the chapter on industrial motors but smaller in size), and energy management systems, a technology introduced in this chapter.

Low/No-Cost and Other Conservation Technologies/Measures

The technologies and measures designed to capture savings from "other" end uses are quite similar overall to those proposed for the industrial sector

Low-Cost/No-Cost Measures. These measures are based on an energy audit and the implementation of maintenance and operating strategies for existing equipment. We assumed that 15 percent of the electricity used for "other" commercial end-uses could be saved through this approach based on U.S. industry estimates. We made the following assumptions:

- The installed load is 20 kW with a base energy consumption of 13,108 kWh. The annual energy savings are 1,966 kWh and a demand reduction of 3 kW, or a 15.0 percent energy and demand reduction.

High-Efficiency Motors. Commercial end-use energy savings are based on the replacement of a 3 horsepower standard efficiency motor (Eff=80 percent) with a 3 horsepower high-efficiency motor (Eff=87 percent). We made the following operational assumptions:

- The motor operates 3,744 hours per year. The annual energy savings are 418 kWh and a demand reduction of 169 W, or an 8.1 percent energy and demand reduction for motors per participant. We assumed that 30 percent of commercial customers who participated in the program would install high-efficiency motors.

Energy Management Systems (EMS). These are computerized control systems that can limit total building demand by controlling specified loads based on a pre-programmed strategy or schedule. These systems can also turn equipment on and off based on a pre-scheduled program. Energy savings for "other" end uses are based on the installation of 20-point relays available to control loads. We made the following assumptions:

- The controlled load would be 10 kW with a base energy consumption of 6,554 kWh. The annual energy savings are 13,140 kWh and a demand reduction of 1.5 kW, or a 23 percent energy reduction and 15 percent demand reduction for each participant implementing EMS.

Designing a Low-Cost/No-Cost and Other Measures Program

The combined energy consumption of "other" end uses in the Guatemalan commercial sector allows for considerable energy and demand reductions. The applicable DSM measures for these end uses were combined into a program.

We estimated that the low/no-cost measures would attract the greatest participation because of their immediate payback. Energy management systems, however, are relatively expensive and technology-driven, making them less likely to attract high rates of participation in Guatemala, in our estimation. The "likely measure participation percentage" for each program component is shown in Exhibit 5-12.

Exhibit 5-12
Likely Participation Percentage for Other Conservation Measures

DSM Measure	Likely Measure Participation Percent
Low Cost/No Cost Measures	68%
High-Efficiency Motors	30%
Energy Management System	2%

The payback for the program components are shown in Exhibit 5-13.

Exhibit 5-13
Energy Savings and Paybacks for Other Conservation Measures

DSM Measure	Measure Energy Savings	Measure Payback (yrs)
Low Cost/No Cost Measures	15.0%	Immediate
High-Efficiency Motors	8.1%	2.8
Energy Management System	23.0%	5.1

Estimated Program Savings

The savings estimated to result from the low/no-cost and other conservation measures program is 13.1 percent of the "other" end-use energy consumption per participant. This percentage figure represents the weighted average of the measure savings based on the likely participation percentage.

Energy savings are 198 kWh/year per participant. The estimated cost of conserved energy for these programs is between 0 and 6.8 cents/kWh. The simple payback for these measures is between 0 and 5.1 years.

In the year 2010, the estimated maximum technical potential for the program is 33.5 GWh and a 4.3 MW peak demand reduction. The achievable market potential in the year 2010 for the program is estimated to be 17.64 GWh and a peak demand reduction of 2.28 MW. These results assume a 50 percent market penetration rate for the program in 2010.

5.3 SUMMARY OF COMMERCIAL SECTOR DSM IMPACTS

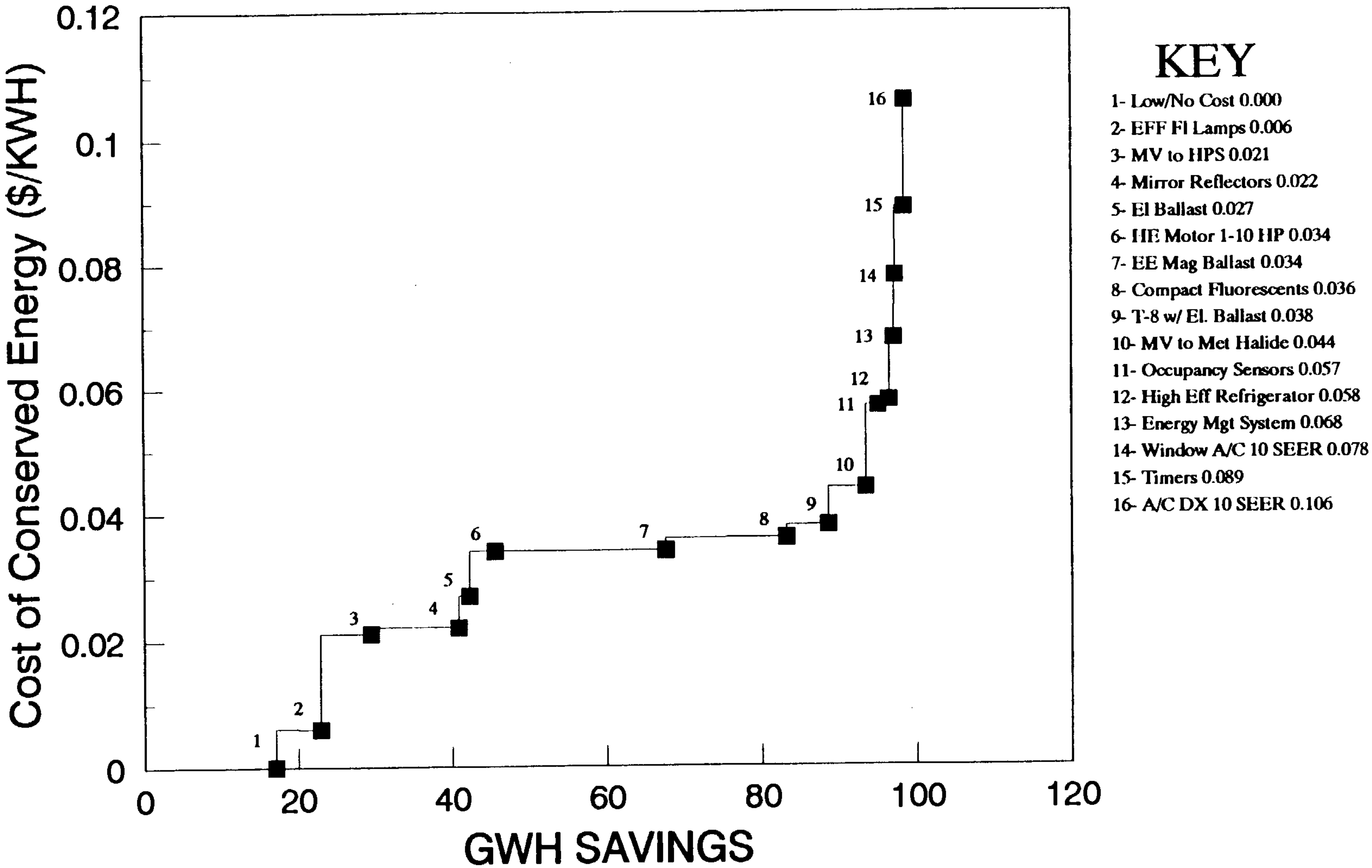
The analysis of demand-side management measures that could be implemented in the commercial sector in Guatemala revealed that the greatest potential impact could be achieved from the interior and exterior lighting program. About 67 percent of energy savings across the commercial sector in 2010 could come from lighting alone (55 GWh) with about 72 percent of demand savings (9.2 MW in 2010). Lighting's share is large because it is the principal commercial end-use and exhibits a high coincident peak demand.

Low/no-cost and other measures are also important. We estimated that these could achieve nearly 22 percent of commercial-sector energy savings (nearly 18 GWh) and nearly 18 percent of coincident peak-demand savings (2.3 MW) in the year 2010.

As in the previous chapter, we developed a conservation supply curve to rank the various DSM measures across all DSM programs in the commercial sector in Guatemala. This curve appears in Exhibit 5-14. The exhibit shows the following results:

- lighting measures yield the greatest energy savings
- low/no-cost measures are significant
- some lighting measures (timers and occupancy sensors) are not very competitive.

Exhibit 5-14
Guatemala Commercial Sector
Cost of Conserved Energy vs. GWh Savings



Note that an additional margin must be allowed for the administrative costs of implementing these programs. These costs will vary depending on the program and will be examined in greater detail in the next phase of this assessment.

A summary of the estimated commercial DSM program impacts is found in Exhibit 5-15. These results show the impact in 2010 of programs begun in 1994, but these results are not cumulative. They show that the market penetration of the various energy-saving technologies and measures proposed for the commercial sector will achieve 82.16 GWh in energy savings and 12.67 MW of demand savings in the year 2010 *if the programs are launched in 1994.* If they are not initiated at that time, the savings we projected for 2010 would be achieved in later years.

Exhibit 5-15
Guatemala -- Total DSM Energy and Demand Savings in the Commercial Sector - 2010

	Guat. Mkt. Pen.	MWh Usage	% Savings /Inst.	Overall GWh Saved	Overall % Savings	Maximum MW	Peak Coinc. Factor	Peak Coinc. MW	% Savings /Inst.	Peak MW Saved	Peak % Savings
Commercial Sector		1,315,000				367	0.67	246			
Lighting		526,000									
Interior Lighting DSM Program	50.0%	394,500	31.5%	36.76	2.80%			27.5	30.6%	2.26	0.90%
Exterior Lighting DSM Program	50.0%	131,500	42.1%	18.17	1.38%			54.9	42.1%	6.91	2.80%
Other		394,500									
Air Conditioning DSM Program	15.0%	131,500	46.1%	1.63	0.12%			0.0	46.1%	0.00	0.00%
Refrigeration DSM Program	50.0%	263,000	10.0%	7.95	0.60%			43.9	10.0%	1.21	0.50
Low Cost/No Cost Measures	50.0%		13.1%	17.64	1.34%				12.9%	2.28	0.90%
Total				82.16	62.0%					12.67	5.20%

CHAPTER 6: THE RESIDENTIAL SECTOR

Residential loads accounted for 30.2 percent of Guatemala's electricity use in 1990 (600 GWh out of a total of 1,989 GWh). This sector consisted of 527,393 residential accounts as of the end of 1990. Lighting, cooking, and refrigeration consumed about 63.8 percent of the residential sector's total consumption in that year.

INDE and EEGSA serve two different types of residential customers. INDE serves approximately 254,677 rural customers who consumed an average of 55 kWh per month during 1990. EEGSA, by contrast, serves the more populated urban areas, providing service to approximately 280,668 residential customers who averaged 145 kWh per month of electricity consumption in 1990.

In 1986, the Ministerio de Energía y Minas performed a survey of 2,500 residential customers across the entire country.[1] The purpose of this study was to determine the types of end-uses and types of energy sources used in Guatemala, and it provides a glimpse of residential end-use consumption patterns in the country.

The study showed that refrigeration is responsible for the single greatest energy usage in Guatemalan homes (nearly 29 percent), followed by lighting (about 20 percent), electric cooking (about 15 percent) and water heating (about 14 percent). A number of other miscellaneous end uses together accounted for a significant share as well (about 22 percent). These end uses are portrayed in Exhibit 6-1.

These results differ considerably from residential usage patterns in some other Latin American countries such as Costa Rica and Brazil. These differences are shown in Exhibit 6-2.

Additional information was available on rural household energy consumption, which differs from urban patterns of consumption. Perhaps the greatest difference is that few rural homes in Guatemala have refrigeration.

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[1] *El Uso de Energia en el Sector Residencial de Guatemala,* Ministerio de Energia y Minas, Secretaria General de Planificacion Economica, September 18, 1986.

Exhibit 6-1
Residential End-Use Breakdown
1990 Energy Usage (MWh)

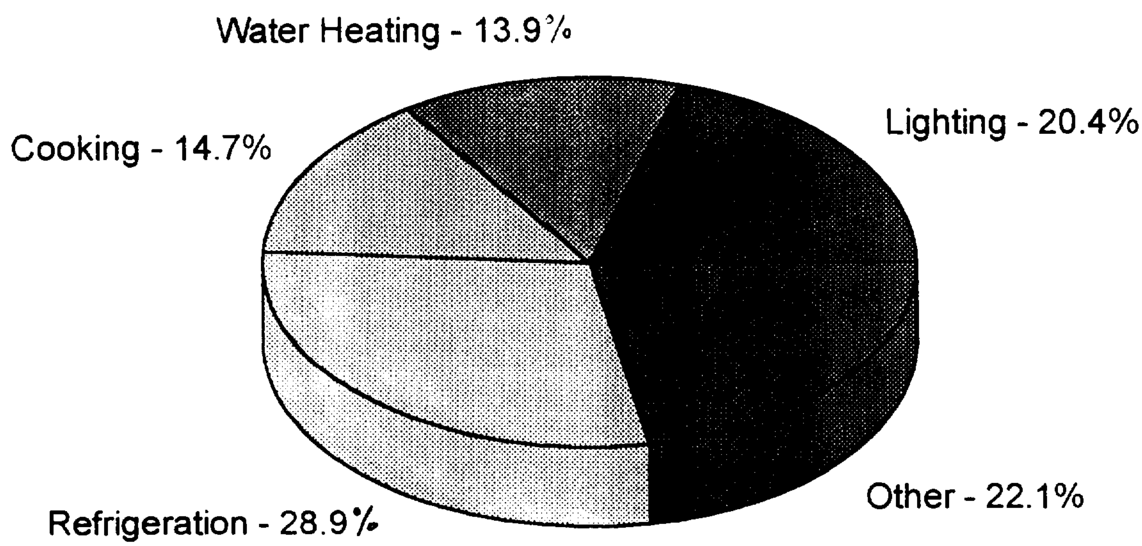

Exhibit 6-2
Residential End-Use in Guatemala, Costa Rica, and Brazil

End-Uses	Guatemala	Costa Rica[1]	Brazil[2]
Electric Cooking	14.7%	40%	--
Water Heating	13.9%	10%	26%
Lighting	20.4%	20%	23%
Refrigeration	28.7%[3]	20%	32%
Other End-Uses	22.2%	10%	10%
Television	---	---	8%

[1] *Costa Rica Power Sector Efficiency Assessment,* RCG/Hagler, Bailly, Inc., June 1991.
[2] *Efficient Electricity Use, A Development Strategy for Brazil,* Howard S. Geller, 1991.
[3] Estimated refrigeration usage based on a comparison with Costa Rica's end-use consumption, after adjustment for differences in end-use saturations.

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From the same 1986 government study, we obtained information on the types of appliances used in rural areas. The breakdown of end uses in Guatemala's rural areas is as follows:

- 40.2 percent of the homes have 1 or 2 light bulbs
- 42.7 percent of the homes have 3 or 4 light bulbs
- 16.9 percent of the homes have electric irons
- 15.4 percent have radios
- 12.7 percent have televisions
- 21.0 percent of the homes in rural areas use hot water, of which 62.4 percent use wood and 33.3 percent use *termo duchas*. (*Termo duchas* are point-of-use showerheads that incorporate a heating elements that is integral to the showerhead. They are used in Guatemala in approximately 4 percent of rural and 37 percent of urban households.)

Further details are revealed in an earlier, 1984 study performed by the University of San Carlos in Guatemala.[2] This study investigated the electrical consumption and demand patterns of rural customers. The study suggests that, despite the low per-household electricity consumption in rural areas, rural households can have a significant impact on the system peak. Guatemalan utility officials suggest that today's pattern of rural residential end-use consumption differs little from that of 1984.

Some of the principal conclusions of the study were:

- electrical consumption in rural homes is very low, with a maximum demand per user of between 0.14 and 0.30 kW

- the connected load per user is between 100 and 500 watts

- the typical load factor per customer is in the range of 0.10 to 0.15

- the load curves shown in the study indicate that consumption in the rural areas is not continuous. Instead, electricity is used primarily during peak hours.

6.1 RESIDENTIAL SECTOR LOAD SHAPES

As in the analysis of industrial and commercial end-uses, we modeled the sectoral and end-use load shapes for the residential sector. We did so based on residential customers'

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[2] *Investigacion del Consumo de Energia Electrica por Usuarios Residenciales Rurales*, Universidad de San Carlos de Guatemala, Facultad de Ingenieria, Escuela de Ingenieria Mecanica Electrica, Julio 1984.

estimated annual energy consumption by end-use, average consumption for each type of appliance, and usage patterns of these end-uses. Subsequently, we used the DSM Impact Spreadsheet to estimate the energy and demand reductions for the various DSM measures to be implemented.

The residential load curves provided by EEGSA and INDE show that the residential peak is in the early evening at about 6:00-7:00 p.m. This coincides with the system peak. An early morning spike is also evident. Exhibit 6-3 shows the estimated load pattern for the residential sector in Guatemala.

Although refrigeration and "other" end uses account for the greatest shares of electricity consumption, they are not the principal contributors to the residential peak. Instead, lighting makes by far the most important contribution to the peak. This is not surprising because refrigeration typically operates as a continuous load; lights, on the other hand, are typically switched on simultaneously as dusk approaches, creating a surge in demand.

The DSM Impact Spreadsheet reveals the following pattern of contributions by end-use to Guatemala's residential system peak (for the interconnected system):

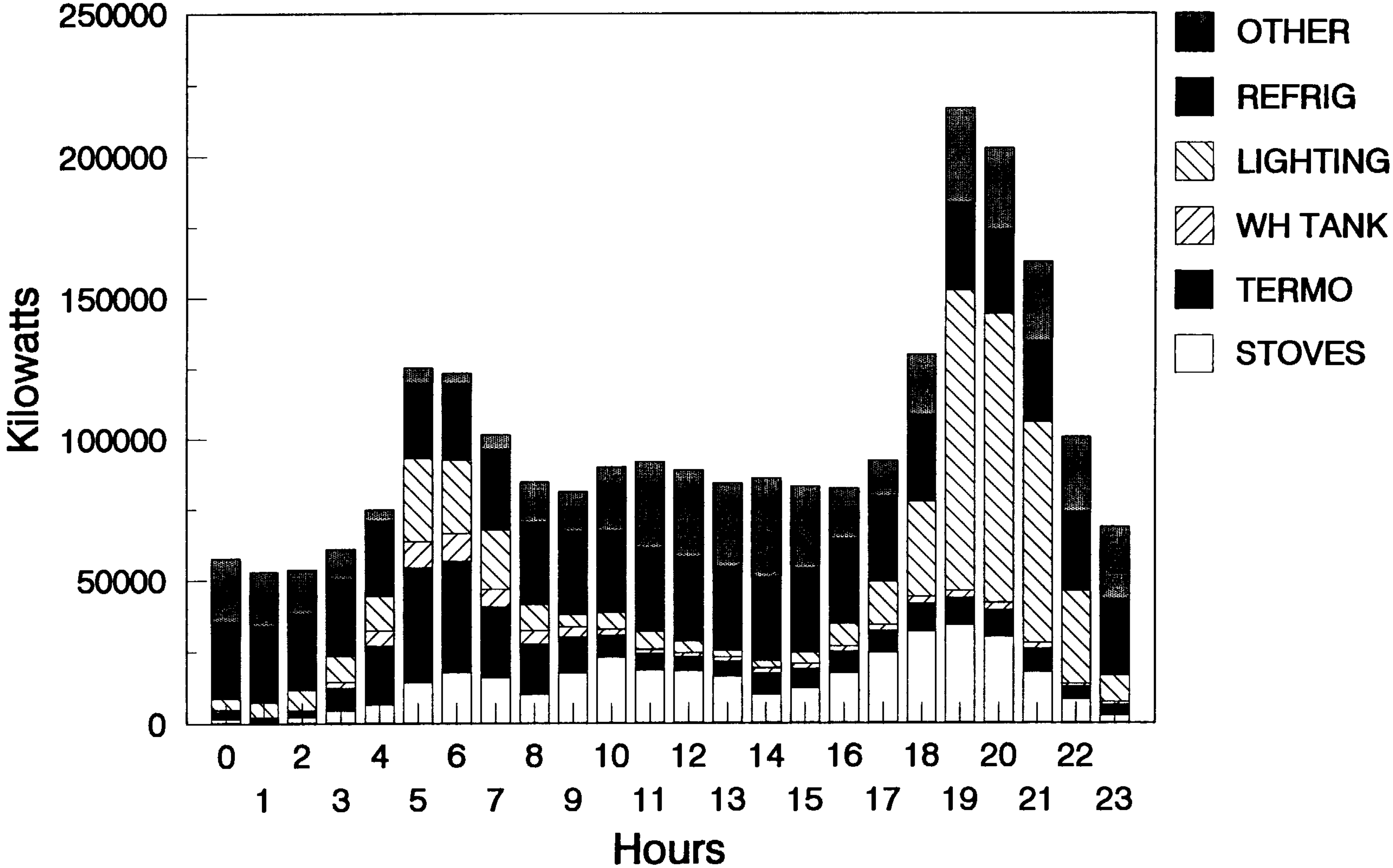
Exhibit 6-4
Residential End-Use Contribution at Time of System Peak

End-Uses	End-Use Contribution to Residential Peak (%)	End-Use Contribution to System Peak (MW)
Electric Cooking	15.8%	34.3 MW
Water Heating	5.5%	11.9 MW
Lighting	49.1%	106.5 MW
Refrigeration	14.3%	31.0 MW
Other End-Uses	15.3%	33.2 MW
Total for all end-uses:		216.9 MW

6.2 DSM MEASURES FOR THE RESIDENTIAL SECTOR

We analyzed energy-efficient technologies for the four major end-uses in the residential sector in Guatemala: lighting, refrigeration, cooking and water heating. These major end-

Exhibit 6-3
Residential Sector
End-Use Contribution to Peak



uses represent 77.7 percent of the residential sector's total energy consumption. We identified those measures most appropriate for implementation and evaluated these measures to determine their potential to reduce energy and demand. The measures were organized into four programs targeting the four principal residential end uses.

The energy and demand reductions achievable with the implementation of DSM measures are based on our estimates of the average hourly diversified demand for the various end-uses. Note that further research is required to validate these estimates. The reductions are also based on program penetration rates, which assume the implementation of standards or of incentives for some measures based on the U.S. experience.

6.2.1 Energy-Efficient Lighting Program

Lighting consumed about 122 GWh in Guatemala's residential sector in 1990, about 20 percent of all residential electricity use. Incandescent lighting accounts for approximately 91 percent of the electricity used for residential-sector lighting; fluorescent lighting accounts for the remainder (9 percent).[3] Because of the large contribution of residential incandescent lighting to the system peak, the importance of lighting as a residential end-use is disproportionately large. The implementation of an energy-efficient lighting program, however, can make a significant contribution to reducing energy and demand at the time of system peak.

Energy-Efficient Lighting Technologies

We identified four efficient-lighting technologies that could have a favorable impact on residential electricity consumption. These were compact fluorescent lamps, energy-efficient fluorescent lamps, high-efficiency incandescent lamps, and electronic ballasts. All these technologies, except for the last one, were defined in the previous chapters on proposed industrial and commercial lighting programs.

Compact Fluorescent Lamps. Lighting energy savings are based on the replacement of one 50-watt and one 75-watt incandescent lamp with 15 watt self-ballasted compact fluorescents. We assumed that:

- Compact fluorescents will operate 3 hours or more each day in each household. The savings are 102 kWh per household per year or 49.5 percent of the total incandescent energy use per household. A penetration rate of 50 percent is assumed by the year 2010 based on an aggressive utility promotion program.

[3] Information provided by INDE and EEGSA.

Energy-Efficient Fluorescent Lamps. Customers participating in this measure would replace all of their 40-watt fluorescent lamps with the Energy Saver 34-watt lamps. We assumed that:

- Energy-efficient fluorescents operate 3 hours or more each day in each household. The energy savings per household would be 19.7 kWh per year per participant. As with compact fluorescents, a 50 percent penetration rate was assumed by the year 2010.

High-Efficiency Incandescent Lamps. These lamps, such as tungsten halogen bulbs, provide increased efficiency in comparison to standard incandescent bulbs, providing the equivalent lumens with less energy consumption. In the analysis performed, customers participating in this measure would replace 75 percent of their standard incandescent bulbs with high-efficiency models. We assumed that:

- High-efficiency incandescents operate 3 hours each day per household. The energy savings per household would be 15.75 kWh per year per participant. A 50 percent penetration rate was assumed by the year 2010.

In evaluating the installation of high-efficiency incandescents as a possible residential lighting measure, our calculations show that the cost of conserved energy (CCE) would be 7.87 cents/kWh. However, the additional cost of the bulb is greater than the total savings. (Note: because these high-efficiency bulbs are imported, the 40 percent import duties placed on them increase their price considerably). As a result, this measure was not included in the residential DSM lighting programs for the residential sector.

Electronic Ballasts. Lighting energy savings assume that customers would replace their standard ballast with an electronic ballast. We assumed that:

- Fluorescent lighting operates 3 hours per day in each household. The energy savings would be 35 kWh per year per participant.

While we evaluated the installation of electronic ballasts as a lighting measure, our calculations show the cost of conserved energy would be 10.9 cents/kWh with a simple payback of 13.6 years. Therefore, this measures was not included in further evaluations.

Designing an Energy-Efficient Lighting Program

The model used to estimate the energy savings impact due to the DSM measures assumes that various lighting technologies can be offered as a "program" to the residential customer. We proposed two measures -- compact and energy-efficient fluorescent lamps -- on the basis of cost and availability. Using these same criteria, we predicted that 80 percent of program participants will likely adopt compact fluorescents and 20 percent will likely adopt energy-efficient lamps. The technologies offered would be those shown in Exhibit 6-5, along with their "likely measure participation percent":

Exhibit 6-5
Likely Participation Percentage for Lighting Measures

DSM Measure	Likely Measure Participation Percent
Compact Fluorescent Lamps	80%
Energy-Efficient Fluorescent Lamps	20%

The lighting energy savings and payback for each of the measures in the program are shown in Exhibit 6-6.

Exhibit 6-6
Energy Savings and Paybacks for Lighting Measures

DSM Measure	Measure Energy Savings	Measure Payback
Compact Fluorescent Lamps	76%	3.8 years
Energy-Efficient Fluorescent Lamps	15%	5.3 years

Estimated Program Savings

For Guatemala, the savings estimated to result from a residential lighting program are 42.6 percent of the total lighting energy consumption per participant. This is based on the weighted average savings obtained if 80 percent of the program participants install compact fluorescents to replace incandescents and if 20 percent install energy-efficient fluorescents to replace standard fluorescent lamps.

For compact fluorescents, the annual energy savings are 51 kWh/year per lamp, with an estimated cost of conserved energy for this measure of 4.3 cents/kWh. The simple payback for this measure is 3.8 years. For energy-efficient fluorescent lamps, the annual energy savings are 7 kWh/year per lamp, with an estimated cost of conserved energy for this measure of 6 cents/kWh. The simple payback for the measure is 5.3 years.

In the year 2010, the maximum technical potential for energy-efficient lighting was estimated to be 151.2 GWh/yr and a peak demand reduction of 82 MW. The achievable market potential in the year 2010 is estimated to be 45.56 GWh/yr and 24.82 MW in peak-demand reduction. These results are based on a projected market penetration rate for this program of 50 percent by 2010.

6.2.2 Energy-Efficient Refrigerators

Considerable energy reduction potential is available in residential refrigeration since this is the end-use with the highest energy consumption in the residential sector (29 percent). Based on the aggregate end-use consumption for refrigeration and the average consumption per unit, we estimated that about 39 percent of Guatemalan homes have refrigerators.[4] Energy reductions of approximately 43 percent could be achieved per refrigerator when comparing standard with efficient models available in Guatemala today.

Energy-Efficient Refrigeration Technologies/Measures

Energy-efficient and standard refrigerators in Guatemala differ considerably in performance, size and availability. The typical refrigerator is manufactured locally or in Mexico or El Salvador, and is a 12 cubic foot one-door model with an internal manual defrost freezer. Energy-efficient refrigerators are available in Guatemala but usually only in stores that cater to the middle and upper classes. These units are typically 14 cubic feet or larger and are manufactured in the U.S., Mexico or Brazil.

We identified three measures that could achieve significant savings in the residential sector. The first is the replacement of standard refrigerators with energy-efficient models, the second is the promotion of energy conservation practices (such as learning not to leave the door open for extended periods of time, setting the thermostat below the maximum level, and/or allowing hot foods to cool before storing in the refrigerator), and the third is the replacement of old seals with new ones to minimize leakage around the door.

Exhibit 6-7, which sets out the assumptions we used in calculating the potential savings for this measure in Guatemala, compares the typical refrigerator in Guatemala to the most efficient, slightly larger model available in the country.

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[4] For more detail on how this figure was derived, refer to Appendix E.

Exhibit 6-7
Comparison of Typical Refrigerator to Most Efficient Model

	Guatemala Refrigerator	Efficient[1] Refrigerator
Single-Door Manual Defrost	12 cu ft	14 cu ft
Annual kWh Consumption	840 kWh	478 kWh
Efficiency Improvement	---	43%
Annual Energy Savings	---	362 kWh

[1] *The Most Energy Efficient Appliances 1991-92,* American Council for an Energy Efficient Economy, 1991.

Designing an Energy-Efficient Refrigeration Program

We designed a program that integrates new technology with low/no-cost measures. Unlike our earlier estimates of likely measure participation rates for technology-driven versus low-cost measures (which generally favored the latter on the basis of cost), we believe that energy-efficient refrigerators could attract greater participation than the low/no-cost measures in this program. This is, in part, attributable to the greater challenge in promoting energy-efficiency practices in the residential, as opposed to the industrial or commercial, sectors. We also assume that standards or incentives are provided to accelerate the penetration rate of this measure by 2010.

Our estimates for the likely measure participation percentages for the residential refrigeration program are shown in the Exhibit 6-8.

Exhibit 6-8
Likely Participation Percentage for Refrigeration Measures

DSM Measure	Likely Measure Participation Percent
Energy-Efficient Refrigerators	60%
Energy-Efficient Practices	25%
Replacement of Seals	15%

The simple payback for these measures is shown in Exhibit 6-9.

Exhibit 6-9
Energy Savings and Paybacks for Refrigeration Measures

DSM Measure	Measure Energy Savings	Measure Payback
Energy-Efficient Refrigerators	43.0%	4.6 years
Energy-Efficient Practices	10.0%	immediate
Replacement of Seals	5.0%	4.0 years

Estimated Program Savings

For Guatemala, the average savings estimated to result from a residential refrigerator program is 29.1 percent of refrigerator energy consumption per participant. This is the weighted average of savings for each of the three measures. With an energy savings of 361 kWh/year per participant, the estimated cost of conserved energy for efficient refrigerators is 3.7 cents/kWh, which suggests that this program should be competitive with new generation.

In the year 2010, we estimated that the maximum technical potential for energy-efficient refrigerators could be 145.3 GWh/yr with 17.9 MW in peak-demand reductions. The achievable market potential in the year 2010 for energy-efficient refrigerators is estimated to be 29.05 GWh/yr with 3.60 MW of peak-demand savings. These energy and demand savings are based on a projected program penetration rate of 55 percent in 2010.

6.2.3 Energy-Efficient Cooking

Stoves are the third-highest electricity consuming end-use in the residential sector (15 percent of all residential consumption). It is estimated that only 8 percent of Guatemala's residential electricity customers have electric stoves and this percentage is declining. The sale of electric stoves decreased 40 percent between 1990 and 1991, as a result of increases in residential electricity rates, which has proved to be an important disincentive to purchasing electric stoves. As a result of this trend, which we expect to continue, we anticipate that the saturation of electric stoves will decline from about 8 percent in 1990 to approximately 5 percent in 2010.

Energy-Efficient Cooking Technologies

Typical electric stoves, whether locally manufactured or imported from within the region, are not as efficient as they could be, but standards currently are not in place to ensure that stoves in Guatemala conform to higher efficiency ratings. U.S.-manufactured units, which are subject to U.S. standards, are typically 15 percent more efficient but are more expensive.

Typical appliance stores in Guatemala sell about three times more locally manufactured stoves than imported stoves, chiefly because the former are less expensive. The middle-income stores sell about 40 percent local and 60 percent imported stoves. In upper middle class stores, the majority of the stoves sold are imported from the U.S.

The principal differences between the stoves manufactured in Guatemala and imported stoves are:

- The appearance of the appliance, such as the interior and exterior finish, differs.
- Local stoves do not seal as well as the U.S.-manufactured stoves and their insulation is not as good. Also, the U.S-manufactured stoves have double-pane glass to reduce heat loss from the oven.
- The sockets for the spiral burners in locally made stoves tend to become loose over time, resulting in poor electrical contact and ensuing electrical losses. This problem is not so prevalent with the imported models.

In the DSM Impact Spreadsheet, we assumed that:

- typical stoves use 180 kWh per stove on average per month
- improved stoves use 153 kWh per stove on average per month (i.e., are 15 percent more efficient).

Designing a Program

The measure included in the analysis to determine the DSM impact of more efficient stoves in Guatemala is the installation of energy-efficient stoves (including upgrading conventional models with added insulation, better sealing of oven doors, and upgrading the cooktop). In the model, these upgrades are all considered as a single measure equivalent to the purchase of an energy-efficient unit.

The implementation of energy-efficiency standards in Guatemala can increase the efficiency of locally manufactured stoves. The local utilities can also provide monetary incentives to their customers for the purchase of energy-efficient equipment to help reduce demand during the evening peak. Another alternative would be to provide assistance or funding to local manufacturers to help in the design or manufacture of energy-efficient stoves to be sold in the country. (It is not uncommon in the U.S. for utilities to collaborate with manufacturers to accelerate the market penetration of energy-efficient appliances.) We assumed that the penetration rate of efficient stoves would increase on the basis of some incentives or standards.

The likely measure participation percentage for this program is 100 (Exhibit 6-10) because only one measure is proposed:

Exhibit 6-10
Likely Participation Percentage for Cooking Measure

DSM Measure	Likely Measure Participation Percent
Energy-Efficient Stoves	100%

The savings estimated to result from a residential electric-cooking program in Guatemala is 15 percent of electric cooking energy consumption per participant. With an energy savings of 324 kWh/year per participant, the estimated cost of conserved energy for this technology is 6.2 cents/kWh. The simple payback for this measure is estimated at 7.7 years (Exhibit 6-11):

Exhibit 6-11
Energy Savings and Paybacks for Air Conditioning Measures

DSM Measure	Measure Energy Savings	Measure Payback
Energy-Efficient Stoves	15.0%	7.7 years

Estimated Program Savings

In the year 2010, we estimated that the maximum technical potential for energy-efficient cooking could be 22.8 GWh/yr and 6.1 MW in peak-demand reduction. The achievable market potential in the year 2010 for energy-efficient cooking is estimated to be 7.90 GWh/yr and 2.10 MW in peak-demand savings. These savings are based on a projected penetration rate for this program of 40 percent in 2010.

6.2.4 Energy-Efficient Water Heating

Water heating is an important electricity end-use in Guatemala. It accounts for about 14 percent of residential electricity use in the country.

Efficient Water-Heating Technologies

Water is heated with electricity in Guatemala using two entirely different technologies. Approximately 21 percent of the residential electric customers in Guatemala use *termo duchas* (point-of-use electric resistance shower head). About 2.6 percent have electric water-heater tanks. The remaining households (76 percent) do not use electricity for hot-water heating.

The majority of *termo duchas* are locally manufactured and the balance are imported from within Central America or from Brazil. By contrast, water heater tanks are mostly locally manufactured. The average monthly energy consumption of *termo duchas* is approximately 50 kWh and that of electric water heaters is 100 kWh.

These two technologies serve quite distinct market segments with middle-class families typically using *termo duchas*, while some upper class families prefer to install water heaters, a much more expensive option, which provides hot water throughout the home. Both technologies differ considerably on technical grounds alone. For these reasons, we developed two different programs to achieve savings in what is otherwise a single end-use (water heating).

Smaller Element Termo Duchas. The larger *termo ducha* market could offer savings with the widespread use of smaller-element, more efficient *termo duchas*. These units can offer comparable water heating capability with less electricity consumption per shower. (This is the only measure evaluated for achieving energy savings with *termo duchas*.) In the DSM Impact Spreadsheet, we assumed that:

- Energy and demand savings are 33.3 percent, or 200 kWh/year per household.

Water-Heater Tank Measures. Unlike the *termo duchas*, the smaller water-heater market could be favorably affected by the implementation of a number of measures. For example, energy-efficient water heaters could be installed. For this measure, we assumed that:

- Energy and demand savings are 20.0 percent, or 240 kWh/year per participant.

Low-flow shower heads are another option. They deliver a comparable shower at a fraction of the volume of hot water ordinarily used. We assumed that, for this measure:

- Energy and demand savings are 20.0 percent, or 240 kWh/year per participant.

Water heater blankets can be very cost-effective as a means of better insulating the water tank, thereby reducing energy requirements. (In the U.S., water-heater tank insulation can save 500 kWh per year.[5]) For this measure, we assumed that:

- Energy and demand savings are 12.0 percent, or 144 kWh/year per participant.

Water-heater timers can turn off the system when it is not needed. For this measure, we assumed that:

- Energy savings are 10 percent and demand savings are 50 percent (since the greatest advantage of timers is to turn off hot-water heaters during the time of peak demand), for an average savings of 120 kWh/year per participant.

Heat pumps for water heaters use simple refrigeration technology to remove heat from the air and use it to heat water in the tank. We assumed that:

- Energy and demand savings are 72.3 percent, or 868 kWh/year per participant.

Solar water heaters are another option. These units are installed on the rooftop and positioned to capture maximum exposure to the sun. They can serve as preheaters, delivering warm water to the heating tank inside the household where the temperature can be raised and maintained at the desired level. We assumed that:

- Energy and demand savings were 92.0 percent, or 1,104 kWh/year per installation.

Although solar water heating typically has a long payback and a high initial investment requirement, some customers install this measure, especially if incentives are offered. Also,

[5] Usibelli, A. "Monitored Energy Use of Residential Water Heaters." *Proceedings of the ACEEE 1984 Summer Study on Energy Efficiency in Buildings*, p. E-266.

large families, which use a lot of hot water, can obtain a quicker payback for this measure. For these reasons, this measure was included in the program.

Designing a Program

In designing a program for energy-efficient residential water heating, we separated direct-electric water heating (*termo duchas*) from indirect technologies (conventional water heaters). We also factored in the payback of each measure and assumed that incentives or standards would be implemented to accelerate their market penetration by 2010.

Guatemalan utility personnel and local consultants project that *termo duchas* would gain wider acceptance in the future while water heater tanks would decline in importance. INDE and EEGSA predict that the market saturation of *termo duchas* in Guatemala will reach 40 percent by the year 2010. Electric water heaters, by contrast, are projected to decline to a 1.5 percent market share by the year 2010, according to the Guatemalan utilities, because of the disincentive that rising electricity costs -- combined with the technology's higher electricity consumption -- will provide.

In the *termo ducha* market, we sought to achieve savings by promoting modifications in the technology itself. We analyzed the single-measure program promoting the use of smaller heating elements in *termo duchas*. This could be achieved through mandated efficiency standards. The likely measure participation rate is 100 percent (Exhibit 6-12):

Exhibit 6-12
Likely Participation Percentage for Water Heating Measures

DSM Measure	Likely Measure Participation Percent
Smaller-Element *Termo Duchas*	100%

The savings estimated to result from a residential program for *termo duchas* is 33 percent of *termo ducha* electric energy consumption per participant. The simple payback for this measure is rapid, as shown in Exhibit 6-13:

Exhibit 6-13
Energy Savings and Paybacks for Water Heating Measure

DSM Measure	Measure Energy Savings	Measure Payback
Smaller-Element *Termo Duchas*	33.3%	0.8 years

We also examined a number of options to increase efficiency in hot-water tanks, whose paybacks ranged widely from 0.8 to 11.3 years. The two measures with the fastest payback, low-flow showerheads and water-heater blankets, would likely attract substantial participation, in our judgment (50 and 20 percent, respectively). Energy-efficient water heaters would also attract a high likely participation in the program.

The likely measure participation percentages in the hot-water tank program are shown in Exhibit 6-14.

Exhibit 6-14
Likely Participation Percentage for Hot Water Tank Measures

DSM Measure	Likely Measure Participation Percent
Energy-Efficient Water Heaters	50%
Heat Pump Water Heaters	5%
Solar Water Heaters	2%
Water Heater Blankets	20%
Water Heater Timers	10%
Low-Flow Showerheads	50%

It is assumed that utility incentives or standards would be provided to encourage participation in both energy-efficient water heaters and heat pump water heaters. (Note: incentives were not included in the economic analysis, but were included in estimating the participation rates.)

The participation rate is much higher (50 percent) for energy-efficient water heaters because the passage of efficiency standards would have an impact on this measure's adoption. In contrast, heat pump water heaters would not be included as a measure if efficiency standards are passed and it is a much more expensive measure in terms of initial cost.

Note that a number of these measures could be implemented simultaneously, such as low-flow showerheads and water heater blankets. That is why the likely measure participation rates add to more than 100 percent.

The estimated savings per measure and simple payback are shown in Exhibit 6-15.

Exhibit 6-15
Energy Savings and Paybacks for Water Tank Measures

DSM Measure	Measure Energy Savings	Measure Payback
Energy-Efficient Water Heaters	20.0%	7.0
Heat Pump Water Heaters	72.3%	6.6
Solar Water Heaters	92.0%	11.3
Water Heater Blankets	12.0%	1.2
Water Heater Timers	10.0%	4.9
Low-Flow Showerheads	20.0%	0.8

Estimated Savings

The savings estimated to result from a residential *termo ducha* program is 33.3 percent of electric water-heating energy consumption per participant. The corresponding figure for the hot water tank program is 20.8 percent. This is the weighted average of all the measures given the different participation rates. The cost of conserved energy for all of these measures ranges from 0 to 9.0 cents/kWh, with paybacks between 0.8 and 11.3 years.

For the year 2010, we estimate the maximum technical potential for energy-efficient *termo duchas* to be 67.2 GWh/yr with 6.5 MW in peak-demand reduction. The achievable market potential for this technology in that year is estimated to be 30.18 GWh/yr with a 2.93 MW peak-demand reduction. The projected penetration rate for this program is 50 percent in 2010.

For the year 2010, we estimated the maximum technical potential for energy-efficient water heating to be 5.4 GWh/yr with 0.6 MW in peak demand reductions. The achievable market potential in the year 2010 for energy-efficient hot water tanks is estimated to be 1.16 GWh/yr with a 0.13 MW peak demand reduction. The projected penetration rate for this program is 50 percent.

6.3 SUMMARY OF RESIDENTIAL SECTOR DSM IMPACTS

The analysis of potential demand-side management measures that can be implemented in Guatemala revealed the potential savings for several measures in the residential sector. These measures target lighting, refrigeration, water heating, and cooking energy end-uses. The greatest impact can be achieved from lighting and refrigeration, primarily because these are the largest end-uses and provide the largest contributions to the system peak.

We developed a conservation supply curve to rank the various DSM measures across all DSM programs in the residential sector in Guatemala (Exhibit 6-16). This curve shows the magnitude of GWh savings and the levelized cost per kWh for each measure proposed here. The exhibit illustrates the following preliminary results:

- The single largest reduction in coincident peak demand arises from the lighting program, which contributes 24.8 MW (74 percent) of the total potential reduction of 33.6 MW.

- Lower-element *termo duchas* emerge as one of the most economical and significant energy savers in the residential sector despite the fact that water heating is not among the top three end-uses in terms of residential electricity consumption.

- High-efficiency refrigeration appears to be an important and competitive measure.

- Compact fluorescents also achieve significant savings at an economical cost.

As in previous chapters, an additional margin must be allowed for the administrative costs of running these programs. These costs will vary depending on the program and will be examined in the next phase of this assessment.

A summary of the estimated residential DSM program impacts is found in Exhibit 6-17. These results show the impact in 2010 of programs begun in 1994, but these results are not cumulative. They show that the market penetration of the various energy-saving technologies and measures proposed for the residential sector will achieve 114 GWh in energy savings and 33.6 MW of demand savings by the year 2010 *if the programs are launched in 1994*. This represents a savings of 6.5 percent of the residential sector's total energy consumption by the

Exhibit 6-16
Guatemala Residential Sector
Cost of Conserved Energy vs. GWh Savings

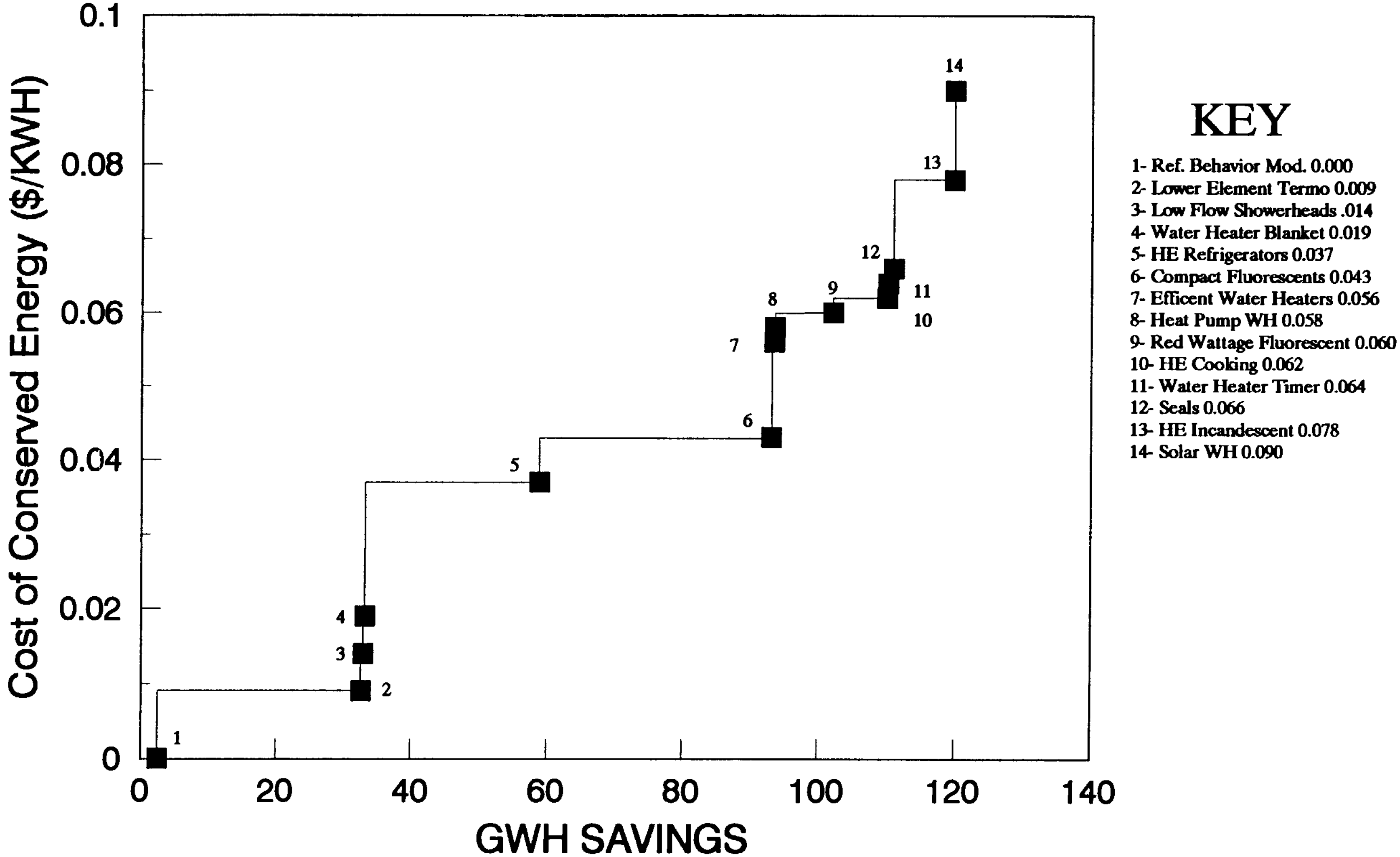


Exhibit 6-17
Summary of Energy and Demand Savings by the Year 2010

	Guat. Mkt. Pen.	MWh Usage	% Savings /Inst.	Overall GWh Saved	Overall % Savings	Maximum MW	Peak Coinc. Factor	Peak Coinc. MW	% Savings /Inst.	Peak MW Saved	Peak % Savings
Residential Sector		1,765,000				562	1.00	562			
Refrigeration	55.0%	510,085	29.1%	29.05	1.65	80.4	1.00	80.4	4.5%	3.60	0.64
Lighting	50.0%	360,060	42.6%	45.56	2.58	275.9	1.00	275.9	9.0%	24.82	4.42%
Termoduchas	50.0%	197,327	33.3%	30.18	1.71%	105.0	0.24	24.7	11.8%	2.93	0.52%
Water Heating - WH Tanks	50.0%	48,185	28.9%	1.20	0.07%	25.8	0.24	6.2	2.1%	0.13	0.02%
Cooking	40.0%	259,455	15.0%	7.90	0.45%	88.8	1.00	88.8	2.4%	2.10	0.37%
Total				113.85	6.50%					33.6	6.0%

CHAPTER 7: APPLICATION OF LOAD MANAGEMENT IN GUATEMALA

Load management refers to measures that can reduce or shift the demand for electricity during days when demand reaches high peaks. In the U.S., load management measures are applied with success to selected groups of industrial, commercial and residential customers. These measures tend to be highly cost-effective because they generally (though not always) rely on inducing changes in patterns of consumption rather than the installation of energy-efficient technologies. The principal costs lie in administering the program and in "lost" utility revenues.

Guatemala has a pronounced system peak, which has required an investment in additional capacity just to meet brief, high levels of demand that occur regularly every day. Guatemala's system peak is in the evening between the hours of 6:00 p.m. and 9:00 p.m. Lighting is the primary contributor to Guatemala's peak, especially residential lighting. Public lighting and commercial and industrial exterior lighting also contribute to the peak.

7.1 LOAD MANAGEMENT MEASURES AND SAVINGS

The primary DSM objectives of load management programs are "peak clipping" (reduction) and "load shifting" (displacing the peak). These DSM measures are usually implemented using direct load-control methods (such as radio-controlled on/off switches) and load management rates (such as interruptible rates and time-of-use rates).

The proposed peak-reduction programs evaluated for Guatemala were:

- interruptible rates for industrial customers
- time-of-use rate for industrial customers
- time-of-use rate for commercial customers
- a residential load-control program for customers with electric water-heater tanks
- a residential time-of-use rate for customers with monthly consumption over 500 kWh.

7.2 POTENTIAL DEMAND REDUCTION FROM LOAD MANAGEMENT PROGRAMS

This section analyzes each of the proposed peak-reduction programs to determine their potential demand reduction from 1994 to 2010. The target markets for the programs and the expected penetration rates of each are also identified.

Opportunities for peak-demand reductions are available in the industrial, commercial, and residential sectors. The extent to which the various programs can achieve reductions depends on a variety of factors. Some key factors are commitment from the utility's upper management to implement load management programs, adequate resources for effective implementation, cost control of program expenditures, selectivity in choosing markets with the greatest potential for reduction, and effectively communicating program benefits to potential participants. The last factor can mean the difference between the success and failure of a program.

7.2.1 Industrial Interruptible Rates

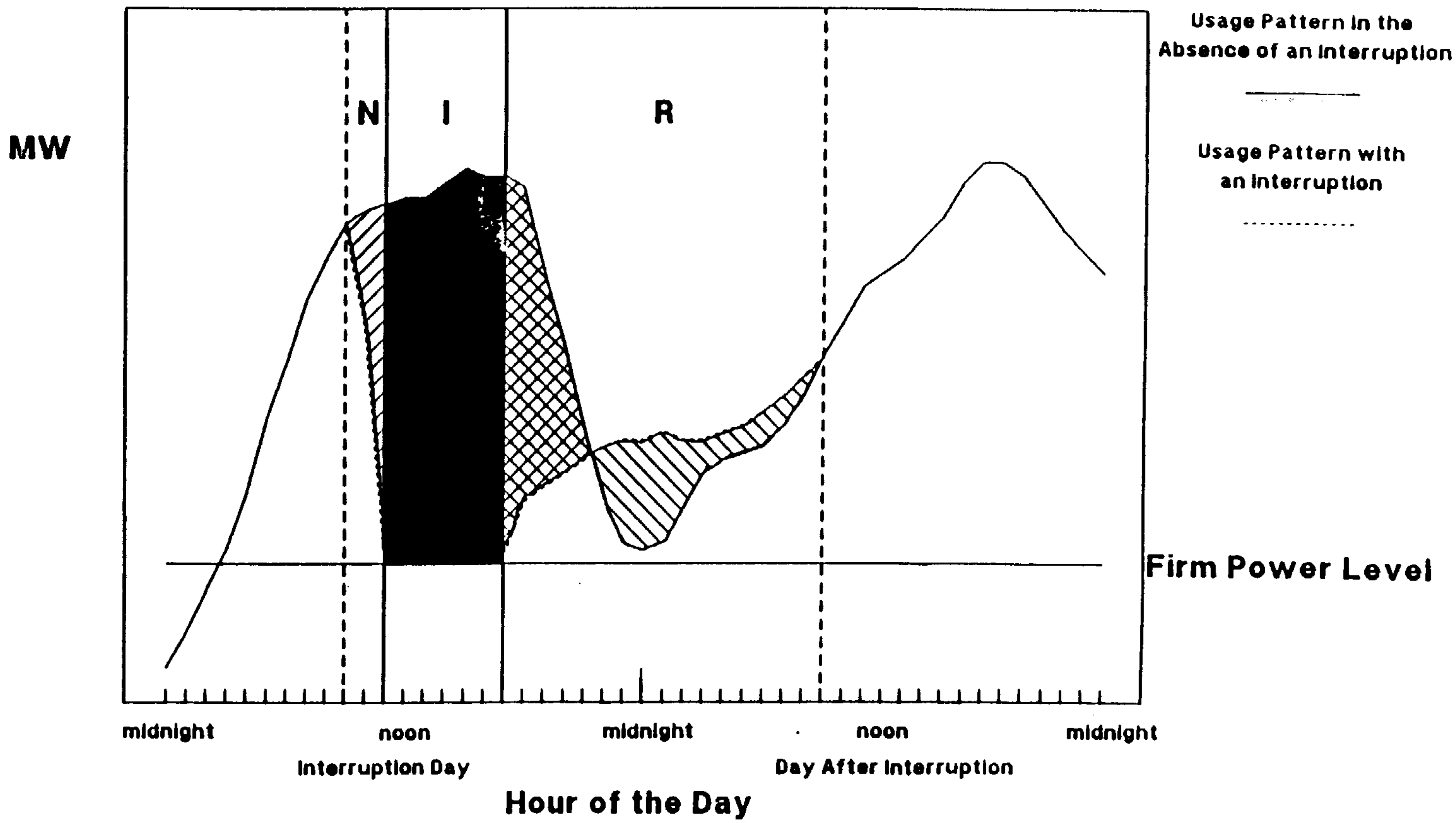
Under interruptible tariffs, the utility provides customers an incentive (usually in the form of reduced demand charges) for allowing the utility to interrupt all or part of their load during "critical days" for the utility. Critical days are defined as those days during which the utility's generation is not sufficient to meet its expected loads. U.S. utilities have found that, with the implementation of an interruptible tariffs program, commercial and industrial (C/I) customers can provide significant demand reductions during peak days.

U.S. utilities have also found that the industrial sector has the potential to provide large reductions from very few customers in a very short period of time. Several studies on interruptible rates have been performed in the United States. A sample profile for an interruptible customer may be similar to the graph shown in Exhibit 7-1. Currently in Guatemala, neither of the two utilities offers interruptible tariffs.

There are numerous industrial segments that offer opportunities for savings with interruptible rates. A sample of some of the largest customers served by EEGSA, broken down by industrial activity, is shown in Exhibit 7-2. Some of the customer classifications that are good candidates for interruptible rates include:

- steel
- plastics
- cement, sand and gravel
- food processing (especially meat processing).

Exhibit 7-1
The Response to an Interruption



N = Notification Period
I = Interruption Period
R = Recovery Period

Source: *Customer Response to Interruptible and Curtailable Rates,* EPRI, March 1988.

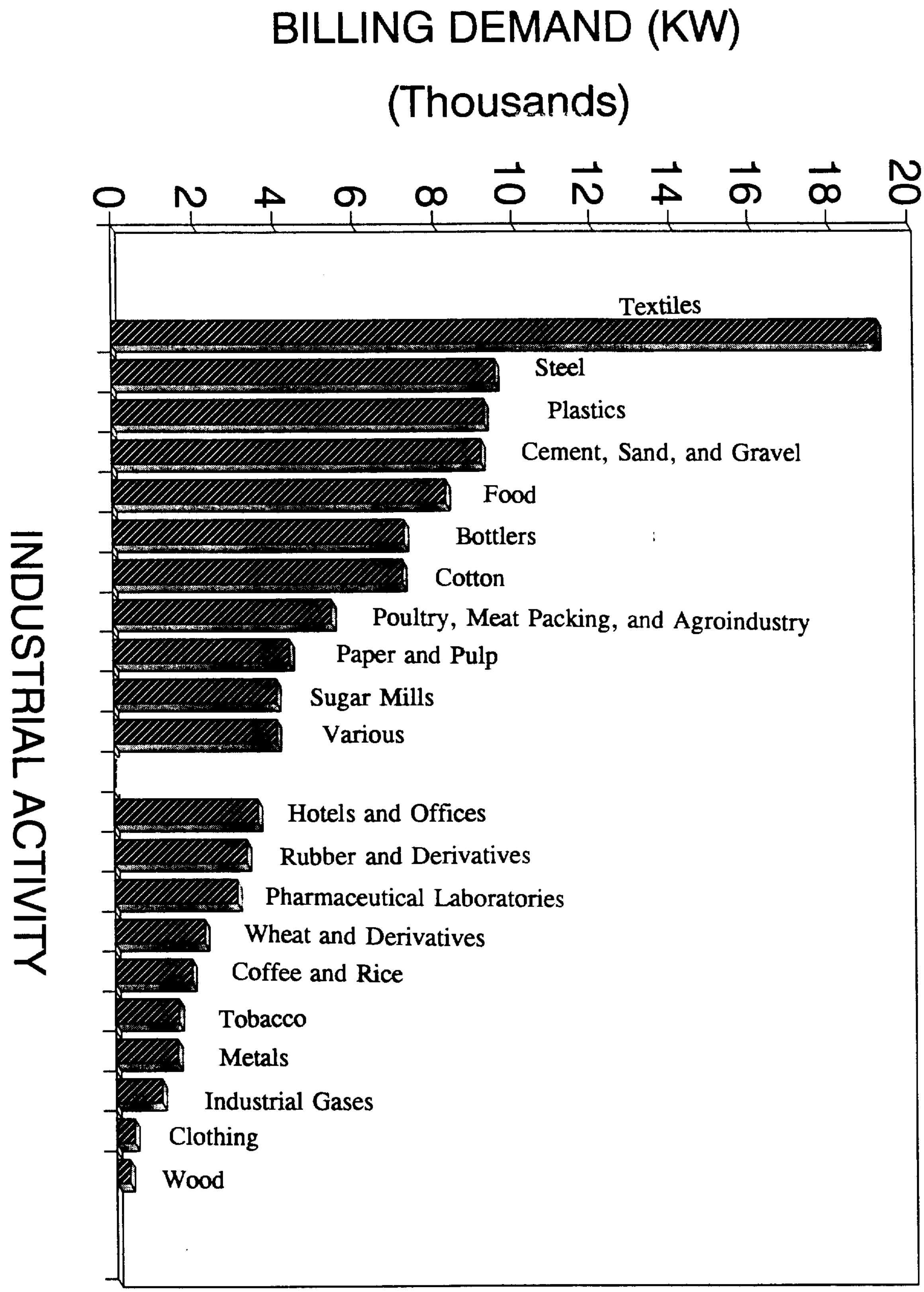


Exhibit 7-2
Billing Demand by Industrial Activity
EEGSA (Tarifa I-31)

- agro-industry (wheat and byproducts)
- industrial gases
- wood products
- glass manufacturing
- hotels and offices.*

* Primarily those with back-up generators.

There are many factors which influence a customer's likelihood to participate in an interruptible rates program. These factors include the availability of back-up generation, discretionary loads, type of process (which will determine how much advance time is required), capacity factor for the plant, and ability to shift fabrication to utility off-peak times. That is why information is required regarding specific customer facilities and operations. Surveying customers is one of the most efficient ways to obtain the necessary data in order to identify the amount of load reduction possible from a specific customer. The survey process is also an opportunity to explain the potential benefits of interruptible rates to customers.

Beginning in 1989, Florida Power & Light Company (FPL) in the U.S. performed a commercial/industrial load control pilot project to test the potential reductions that interruptible rates could make available and to explore the receptivity of major commercial and industrial customers to this type of DSM program. The project was a success: 82 MW of demand reduction was achieved during the pilot project from a group of only 14 customers.

FPL is continuing to offer a load-control tariff to its largest commercial and industrial (C/I) customers. Currently, approximately 200 of FPL's largest customers are able to provide about 275 MW of peak reduction during control periods. FPL plans to continue the program to achieve a peak-demand reduction of 335 MW (approximately 19 percent of the coincident demand for large C/I customers with demands greater than 500 kW) by 1994.

This type of program should work in Central America as well. A load control demonstration project performed in Costa Rica, for example, estimated that the maximum potential reduction from an interruptible rates program would be on the order of 53 MW, or approximately 40 percent of coincident peak demand for the target population. The 53 MW reduction represents an estimated 8 percent of Costa Rica's 1989 system peak load.[1]

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[1] *Costa Rica Power Sector Efficiency Assessment*, Technical Volume, USAID, June 1991.

These past experiences, combined with the substantial amounts of back-up generation available in Guatemala, suggest that cost-effective savings with interruptible tariffs could be achieved in Guatemala as well. The country has about 40.6 MW of emergency generators installed in the commercial and industrial sectors. This is expected to increase to 55.2 MW by 1993 (see Exhibit 7-3) and to 105 MW by the year 2010.

Estimated Potential Savings

Assuming the participation of all customers with back-up generators, the maximum technical potential demand reduction from an interruptible rates program by the year 2010 could be 105 MW. The achievable market potential of an interruptible rates program, assuming a 20 percent market penetration of the measure by the year 2010, is projected to be 21 MW. The estimated cost of conserved demand for an interruptible tariff is $7.09/kW/year, which is below the utilities' estimated avoided capacity costs.

Exhibit 7-3
Plantas de Emergencia Instaladas

Empresa	Capacidad Instalada kW	Capacidad Futura kW (1993)	Combust.
Cavisa	2,500	2,500	diesel
Listex I	1,200	1,200	diesel
Listex II	1,200	1,200	diesel
Aurotex	1,200	1,200	diesel
C. Progreso	15,000	29,000	Bunker
Ginsa	300	930	diesel
Cerveceria	4,200	4,200	diesel
Plantas Peq.	15,000	15,000	diesel
Total	**40,600**	**55,230**	

7.2.2 Time-of-Use Rates for Industrial Customers

Time-of-use (TOU) rates are designed such that demand and/or energy charges are priced differently for specified peak (higher) and off-peak (lower) periods. One of the rationales for TOU rates is to better reflect the variation of real energy and demand costs, which vary by time of day, day of the week, and season of the year. In other words, these rates provide more accurate electricity pricing signals in the market.

TOU rates provide customers with incentives to reduce electricity consumption during the peak in order to avoid higher energy charges and/or peak-demand charges. Changed patterns of consumption away from the peak result in a more efficient use of the utility's generation, transmission and distribution facilities. In a recent EPRI survey, 55 percent of large investor-owned utilities and 15 percent of publicly-owned utilities in the U.S. offered voluntary TOU rates to their customers. Exhibit 7-4 provides a sample of the load profile for some U.S. customers with TOU rates.

The projected energy and demand reductions from TOU rates for the industrial sector in the United States are shown in Exhibit 7-5.[2]

Exhibit 7-5
Energy and Demand Reductions from TOU Rates

Year	Annual Energy Reduction (%)	Summer On-Peak Demand Reduction
1990	0.13%	1.37%
2000	0.34%	3.5%
2010	0.35%	3.7%

There is evidence that TOU tariffs should work in Guatemala as well. In recent years, one of the local utilities in Guatemala has negotiated a special TOU-type agreement with one of the large industrial customers in its service territory. The agreement limits the customer's demand during peak periods in exchange for a lower rate.

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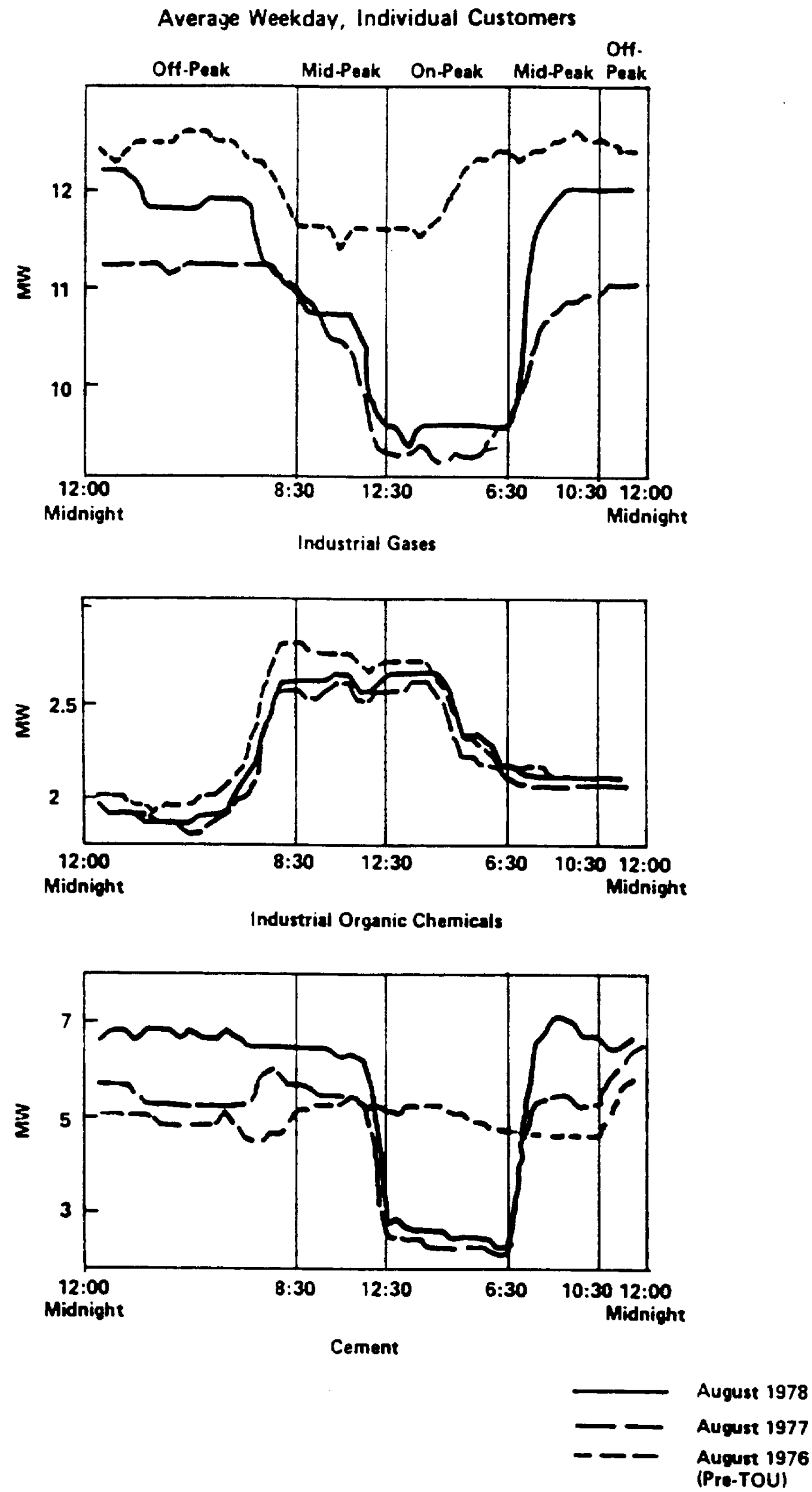
[2] *Impact of Demand-Side Management on Future Customer Electricity Demand: An Update*, Electric Power Research Institute, September 1990.

Exhibit 7-4
Load Curves, Pacific Gas and Electric Company



Source: *Time-of-Use Rates for Very Large Customers: Second Annual Report.* Pacific Gas and Electric Company, March 31, 1979.

Estimated Potential Savings

The achievable market potential demand and energy reductions from TOU rates for Guatemala could be:

1,887 GWh x 0.35% = 6.6 GWh

The potential demand savings at the time of system peak could be:

288 MW [3] x 3.7% = 10.6 MW

The estimated cost of conserved demand for an industrial time-of-use tariff is approximately $12.71/kW/year, which is below the utilities' estimated avoided capacity costs.

7.2.3 Time-of-Use Rates for Commercial Customers

Because of the wide variation of equipment in the commercial sector, even within one customer class, the implementation of load control programs is more difficult. In Guatemala, the low energy consumption for commercial customers presents an added hurdle since the average coincident diversified demand for these customers is estimated to be only 0.96 kW. As a result, time-of-use rates -- as opposed to interruptible rates -- are the more attractive load management measure for this sector.

Estimated Potential Savings

The achievable market potential energy reduction for this sector is estimated at 4.6 GWh by the year 2010. Assuming a 15 percent penetration of the potential target market, this would result in a 5.5 MW peak reduction by the year 2010. The estimated cost of conserved demand for a commercial time-of-use tariff is about $109.45/kW/year, which is above the cost-of-conserved-demand level recommended for implementation. Therefore, this program is not recommended for implementation.

The equivalent capacity cost of this generation is $17 per kW per month. This is the value that could be used for evaluating the feasibility of programs to be implemented; however, only programs whose cost of conserved demand is less than 50 percent of this value are recommended for implementation. This is because, as discussed in Chapter 3 on

[3] Assumes an 85 percent coincident peak load factor for industrial customers.

methodology, it would be prudent to use conservative estimates of potential savings with innovative rates such as this one, which have not been fully tested in Guatemala.

7.2.4 Load Control Programs for the Residential Sector

The programs analyzed for Guatemala's residential sector were load control for electric water heating and a residential time-of-use tariff.

Residential Load Control of Electric Water Heater Tanks

The residential loads most often controlled by utilities in the United States are electric water heaters and air conditioners. The most viable residential load that can be controlled in Guatemala is the water heater tank, which is found in 2.7 percent of the country's homes. Thus, an estimated 14,300 water heater tanks are available to be controlled in 1992 and 21,480 in 2010 in a residential load control program.

Based on the appliance consumption data provided by INDE and EEGSA, it is estimated that the average diversified demand of a water heater is approximately 0.12 kW at the time of system peak. This would provide a potential controllable load of 1.7 MW in 1992 and 2.6 MW in the year 2010 at the time of system peak.

However, because the water heater demand is so low at the time of system peak, a load control program would not be cost-effective to implement in Guatemala. The estimated cost of conserved demand for a load control program for water heater tanks is around $116.51/kW/year, which is above the cost-of-conserved-demand level recommended for implementation.

Residential Time-of-Use Rates

Since most of the residential sector's electricity consumption in Guatemala is used for cooking, refrigeration and lighting, there are few loads available for control under a load control program. Instead, a potential strategy to reduce residential demand at the time of system peak could be to offer a residential time-of-use rate.

The target market for this program consists of the 2.2 percent of residential customers whose consumption is over 500 kWh per month. These customers consume 20.8 percent of the energy in this sector. The estimated contribution of this customer class to the coincident peak of the residential sector is 17 MW, which represents 10 percent of the total contribution to the residential peak.

A properly designed residential time-of-use rate in the form of a mandatory tariff for customers with average consumption over 500 kWh per month could provide savings of approximately 3 MW. This customer class consists of approximately 12,800 customers as of 1992, which should rise to 30,800 by the year 2010.

Due to the high cost of time-of-use meters, the implementation of a TOU tariff would not be cost-effective in Guatemala. The estimated cost of conserved demand for a residential time-of-use tariff is around $134.38/kW/year, which is above the cost-of conserved-demand level recommended for implementation.

7.3 SUMMARY OF LOAD MANAGEMENT DSM IMPACTS

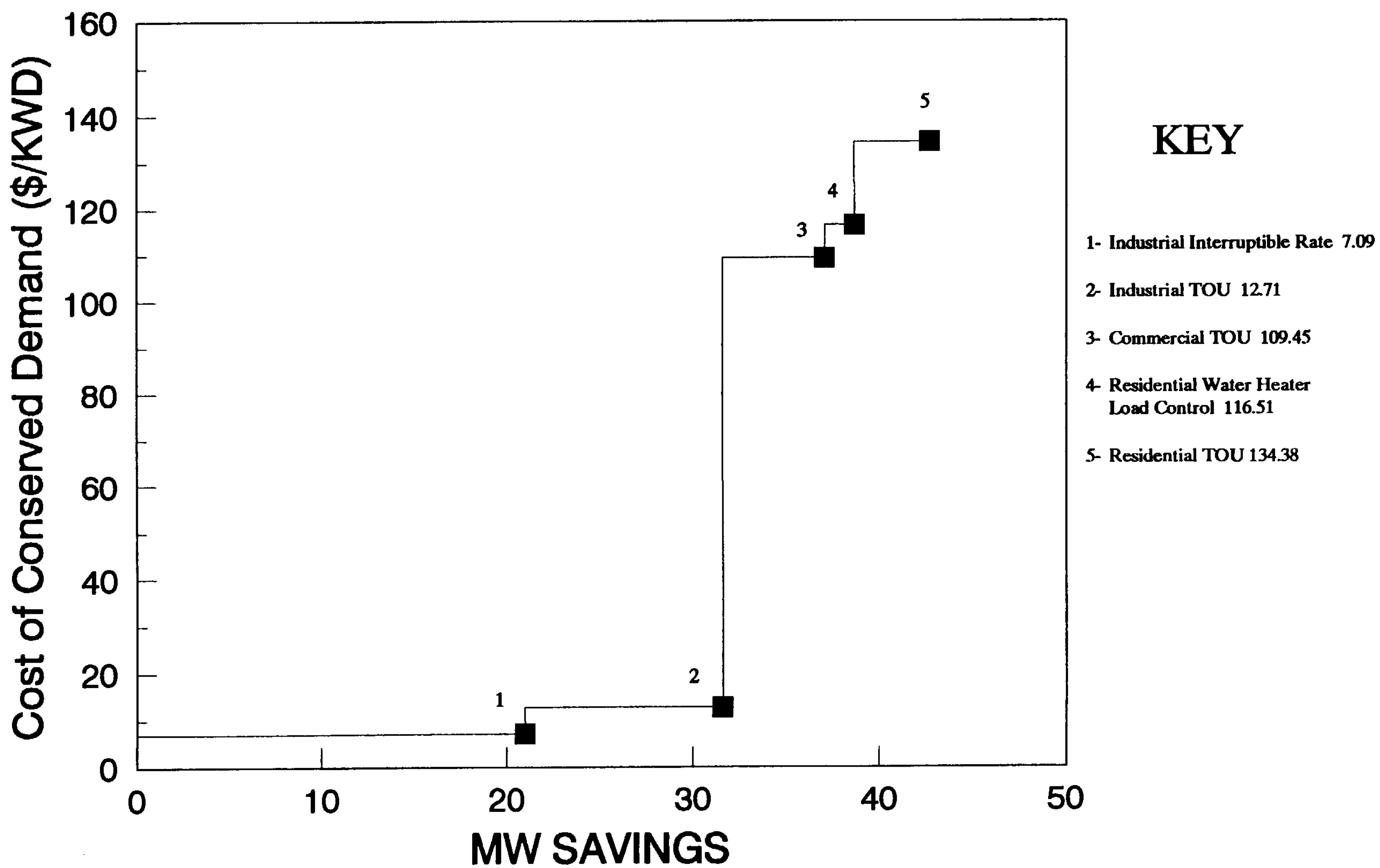
The programs analyzed in this chapter could provide energy savings at a cost of conserved demand of between $7.09 and $134.38 per kilowatt of demand per year. Two of the programs compare favorably with the recommended level of program implementation of $102/kW/year, which is half of the estimated avoided capacity cost in Guatemala of $204/kW/year. Exhibit 7-6 shows the conservation supply curve for the load management measures for the year 2010.

The two most cost-effective programs are the implementation of interruptible rates and TOU rates for the industrial sector. These programs can provide an estimated coincident demand savings of 31.6 MW by the year 2010. The costs of conserved demand for these programs are $7.09 and $12.71/kW, respectively. The comparable costs for the remaining programs are higher than the recommended level for program implementation. The demand reductions that can be achieved by cost-effective load management programs are shown in Exhibit 7-7.

Exhibit 7-7
Achievable Market Potential
Demand Reductions Through 2010

Industrial Interruptible Rates Program	21.0 MW
Industrial Time-of-Use Rates	10.6 MW
Total reduction from all programs	31.6 MW

Exhibit 7-6
2010 Cost of Conserved Demand: Load Management Measure



Note that the projected savings for these programs are based on estimates of the sectoral contribution to the coincident peak. Additional research is needed to verify the actual demand contribution of these sectors and subsectors. Projected savings for these programs could be verified with pilot projects.

CHAPTER 8: PUBLIC LIGHTING EFFICIENCY IMPROVEMENTS

Opportunities exist in Guatemala for energy savings in public lighting, and utilities in the country are gradually replacing their stock of outdoor public lighting with more efficient technologies.

EEGSA, not INDE, provides power for most of the public lighting fixtures in Guatemala (over 60 percent). The current stock of outdoor public lighting for EEGSA includes incandescents (18 percent), *luz mixta*[1] (1 percent), mercury vapor fixtures (42 percent), and sodium vapor fixtures (38 percent). A much greater percentage of public lights in INDE's domain are mercury vapor (80 percent), in addition to some sodium vapor (15 percent) and incandescents (5 percent). The stock of public lighting in Guatemala is shown in Exhibit 8-1.

Estimated Potential Savings

In order to reduce public lighting energy consumption, all non-sodium fixtures could be replaced with more efficient sodium vapor lamps. The estimated maximum technical potential from the replacement of the remaining stock of inefficient public lighting is 13 GWh with a peak demand reduction of 2.5 MW upon the completion of the replacement program. The maximum achievable potential is the same as the technical potential in this case because we assume that the Government mandates efficiency changes for public lighting, thereby achieving the full technical potential. The results can be seen in Exhibit 8-2.

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[1] *Luz mixta* refers to a hybrid incandescent/gas lamp used in Guatemala.

Exhibit 8-1
Distribution of Lamps by System Type

Type	Lumens	Quantity	%
EEGSA			
Incandescent	1,000	2,000	6
Incandescent	2,500	3,498	11
Incandescent	4,000	436	1
Total Incandescent		**5,934**	**18**
Fluorescent	6,000	216	1
Mixed Lighting	2,900	280	1
Mixed Lighting	5,000	48	0
Total Mixed Lighting		**328**	**1**
Mercury Vapor	3,200	3,189	10
Mercury Vapor	7,000	7,014	22
Mercury Vapor	11,000	2,115	7
Mercury Vapor	18,000	1,245	4
Mercury Vapor	32,000	34	0
Total Mercury Vapor		**13,597**	**42**
Sodium Vapor	5,200	7,941	25
Sodium Vapor	8,500	702	2
Sodium Vapor	14,400	91	0
Sodium Vapor	23,000	1,361	4
Sodium Vapor	36,000	621	2
Sodium Vapor	42,000	1,396	4
Sodium Vapor	105,000	60	0
Total Sodium Vapor		**12,172**	**38**
Total All Lamps		**32,247**	**100**
INDE			
Incandescent	100 watts	1,100	5
Mercury Vapor	175 watts	16,660	80
Sodium Vapor	150 watts	3,120	15
Total All Lamps		**20,880**	**100**

Exhibit 8-2
Potential Energy Savings from an Efficient Public Lighting Replacement Program

TYPE OF LIGHTING	LUMENS	# OF UNITS	EXISTING FIXTURE WATTS	REPLA-MENT FIXTURE WATTS	WATT SAVINGS PER FIXTURE	TOTAL ENERGY SAVINGS (MWh)	COINCIDENT DEMAND REDUCTION (MW)
Incandescent	1,000	2,000	75	35	40	350.4	0.026
Incandescent*	1,750	1,100	100	50	50	240.9	0.024
Incandescent	2,500	3,498	150	50	100	1,532.1	0.230
Incandescent	4,000	436	200	70	130	248.3	0.050
Tota Incandescent		7,034					
Fluorescent	6,000	216	75	--			
Luz Mixta	2,900	280	150	50	100	122.6	0.018
Luz Mixta	5,000	48	250	70	180	37.8	0.009
Total Luz Mixta		328					
Mercury Vapor	3,200	3,189	100	50	50	698.4	0.070
Mercury Vapor*	7,000	23,674	175	100	75	7,776.9	1.361
Mercury Vapor	11,000	2,115	250	150	100	926.4	0.232
Mercury Vapor	18,000	1,245	400	200	200	1,090.6	0.436
Mercury Vapor	32,000	34	700	250	450	67.0	0.047
Total Mercury Vapor		30,257					
Sodium Vapor	5,200	7,941	70	N/A	70	–	–
Sodium Vapor	8,500	702	100	N/A	100	–	–
Sodium Vapor*	14,400	3,302	150	N/A	150	–	–
Sodium Vapor	23,000	1,361	250	N/A	250	–	–
Sodium Vapor	36,000	621	375	N/A	375	–	–
Sodium Vapor	42,000	1,396	400	N/A	400	–	–
Sodium Vapor	105,000	60	1,000	N/A	1,000	–	–
Total Sodium Vapor		15,383					
Total Lamps		53,218					
		Maximum Technical Potential Energy Savings (MWh) =				13,091	
		Maximum Technical Potential Demand Reduction (MW) =					2.5
1) Operating hours per fixture/day =			12		C:\GUA\PUB-LITE		21-Sep-92
* INDE Public Lighting included in this total.					Source: EEGSA and INDE.		

CHAPTER 9: INSTITUTIONAL ISSUES IN DSM/IRP

Demand-side management has become a major player in U.S. electricity markets and is attracting substantial interest in the developing world. This may be in part due to the successful approach U.S. electric utilities have taken, drawing on DSM resources at a faster rate than any other energy resource. In 1991 alone, some 200 electric utilities in the U.S. will invest $2 billion in 1,300 conservation programs. Through the year 2000, these programs will satisfy a demand of 24,000 MW, according to the Edison Electric Institute. For example, Pacific Gas and Electric, a major California utility, is planning to procure 2,500 MW of DSM power in the 1990s through a $2 billion program targeting all major end-use sectors in its service territory. The Electric Power Research Institute (EPRI) predicts that DSM will cut the U.S. national summer peak by 6.7 percent -- or 45,000 MW -- by the year 2000.

The successful implementation of demand-side management and integrated resource planning requires an appropriate institutional configuration that can address some of the many issues that arise in implementing this relatively new approach to power planning and resource acquisition. In the U.S., where the successful implementation of DSM has benefited from over a decade of rapid evolution, many of these institutional issues have now been identified and some solutions tested.

To understand why the U.S. is so successfully and aggressively procuring conservation and load management resources requires a better understanding of the historical/institutional development of energy planning in the U.S. This additional background can highlight some of the advantages -- and limitations -- of transferring the U.S. DSM/IRP experience to Guatemala.

9.1 EVOLUTION OF DSM IN THE U.S.

Utility efforts to influence customer demand in the U.S. date back to the first generating station, Thomas Edison's Pearl Street facility in New York City. In the 1890s, when nighttime lighting was the only load, Edison hired people to promote electric motors and other daytime uses of electricity.[1] By encouraging round-the-clock electricity consumption, Edison was able to increase the utilization of generation capacity and reduce unit production costs.

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1 "Shaping DSM as a Resource", *EPRI Journal*, October/November 1991.

DSM has since re-emerged as an important tool for utility planning and operation, although the emphasis today is on conservation and load management. The U.S. experience may have some unique features, but many useful lessons have been learned.

Public utility commissions (PUCs) in each of the 50 United States closely regulate the country's many private utilities, which provide the bulk of electric power in the country. These commissions must approve utility expansion plans and rates charged to customers. In the past, the PUCs relied heavily on utility analyses of cost-effective supply-side options for expansion, including private utility forecasts of demand growth.

In the 1980s, it became very clear in some states that utility estimates of load growth were highly inaccurate (exaggerated) and that resource choices (such as nuclear) were neither cost-effective nor publicly acceptable. These two factors demonstrated that in some states, effective (least-cost) power planning had broken down, and in at least one region (the Pacific Northwest), a special energy planning body had to be established to put the process back on track. At the federal level, the rules of the game changed dramatically when independent power producers were guaranteed access to the grid, requiring that regulatory commissions open to bidding the acquisition of new power plants.

In light of these developments, regulators in some key states began to change their approach to utility planning. Much greater attention was paid to both the methodologies behind utility forecasting and the selection of supply resources. The DSM option began to be explored as a means of better managing growth by deploying conservation in increments as needed, enhancing the predictability of load growth, achieving environmentally acceptable resource acquisition, and of prime importance, achieving the least-cost delivery of energy services to the end-user.

Regulators began to modify the types of costs and benefits included in their cost/benefit analyses of energy resources. Instead of simply weighing avoided capital and operating costs against DSM program administration, incentive costs and lost revenues, *customer bill savings, costs and benefits* were factored into the equation. On the benefits side, customer bill savings represent the savings over the useful lifetime of the DSM measure. Customer costs refer to the portion of the total installed cost of the DSM measure that is not paid for by the utility through incentive fees. These new cost/benefit equations often -- but not always -- yielded energy conservation as a least-cost option.

9.2 IMPLEMENTATION ISSUES IN DSM

With the new methodologies in place, state regulators and utilities in the U.S. began to confront a series of implementation issues. The first was how to design effective utility-sponsored DSM programs. The second was how to effectively bring private contractors into the bidding process for DSM resources. The third was how to engage the utilities, who stood to lose substantial revenues through conservation, in the successful and aggressive implementation of DSM. And the fourth was how to measure the success of DSM.

9.2.1 Utility-Managed DSM Programs

Many utilities in the U.S. have themselves undertaken to achieve the demand savings required in their expansion plans by promoting energy audits, rebate programs for energy efficiency appliances and motors, and incentives for new construction where energy efficiency can be "built in" at a fraction of the cost of later retrofits.

Audits and customer rebates on energy-efficient technologies are classic approaches to utility implementation of DSM programs. Rebates, although sometimes referred to as "subsidies," are actually payments by the utility to procure DSM resources. With rebates, the utility buys down the incremental cost of energy-efficient supplies and equipment as an inducement to customers to participate in the DSM program. Audit and rebate programs for energy-efficient appliances and lighting are now commonplace in the U.S.

Much of the challenge in acquiring DSM resources through audits and rebates is to gain broad customer participation. In the U.S., utilities have learned that programs with high participation rates feature simple application procedures, attractive marketing materials, the active involvement of equipment dealers and other trade allies, free energy audits to help customers identify conservation measures, and extensive personal marketing with an emphasis on developing a personal relationship with customers, especially large ones.[2] Some programs have failed to achieve a significant impact by having ignored some or all of these ingredients for success.

Industrial Motor Programs. One of the most important end-use applications in the industrial sector is electric motors. In New York State, for example, motors are estimated to account for 78 percent of industrial sector electricity use.[3] Motor energy use offers potential savings of between 28 and 60 percent, and the installation of high-efficiency motors and adjustable-

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[2] *Lessons Learned: A Review of Utility Experience with Conservation and Load Management Programs for Commercial and Industrial Customers*, New York State Energy Research and Development Authority (NYSERDA), April 1990, pp. S-6 to S-8.

[3] *The Potential for Electricity Conservation in New York State*, Miller et al., American Council for an Energy Efficient Economy, 1989, p. 29.

speed drives for applications where the avoided energy cost is less than 5¢ per kWh can reduce industrial sector electricity use by 13 percent.[4]

A number of utility programs have offered rebates for energy-efficient motors, concentrating on the upgrade of replacement motors after the old model has exhausted its useful life. These rebates are designed to absorb some of the incremental cost of an efficient motor compared to a standard model, with some utilities providing rebates on a per horsepower basis while others list specific rebate levels for each standard horsepower rating. All programs also specify minimum qualifying efficiencies for each standard horsepower rating. Most of these programs are promoted through direct mail brochures and personal contacts with trade allies and eligible customers, particularly large industrial customers. Other utilities offer added incentives for reducing motor system size, while others offer rebates for adjustable speed drives.[5] Exhibit 9-1 displays a number of motor programs assessed by the New York State Energy Research and Development Authority (NYSERDA). As the table shows, of this sample of utility motor programs, utility costs on a per kWh basis tended to be far below avoided costs.

In the NYSERDA study, participation levels were found to be disappointingly low, although a few large customers representing a significant percentage of energy consumption responded very favorably in some programs. The Niagara Mohawk (NiMo) program stands out with way above-average participation (33 percent). This program carefully targeted customers (large customers with long operating hours) using personal approaches to all of them and providing free computer assessment of costs and savings coupled with high rebate levels (25 percent per horsepower, enough to pay for over half the cost of the motor in many cases). Those who did not participate were generally concerned about disruptions to production caused by downtime.

Low participation rates are attributed to a number of factors. These include unfavorable early experiences with high-efficiency motors on the part of the customer due to improper sizing and installation. The unfamiliarity of customers and dealers with the substantial operating cost savings that efficient motors can provide has also been a factor. Diffuse decision-making on motor purchases and the difficulty in identifying the key decision-maker have complicated matters. Some customers have been hesitant to shut down production lines to replace motors, and when they do, many tend to speed the process by replacing burned-out motors with an identical model, or try to cut costs by rewinding the old motor. Low

4 Ibid., pp. S-6 and 29.

5 NYSERDA, op. cit., p. 79.

Table 9–1
Summary of Motor Program Results

Utility	State	Program	Time Period Start	Time Period End	Pilot or Full Scale	Number Eligible	Number of Participants Custm.	Number of Participants Proj.	Cum. Partici-pation Rate	Custo-mers or Projects?	Estimated Savings Coin. MW	Estimated Savings Absol. MW	Estimated Savings GWh	1987 Peak Demand	Savings as % of Pk	Coin-ciden or Absolute	Expenses (1000s of $) Direct	Expenses (1000s of $) Total	Util. Costs $/kW	Direct or Total	Util. Costs $/kWh
BC Hydro	BC	High–Effic. Motor Rebate	7/88	6/89	Full	142,779	95	126	0.1%	C	0.57		3.75	6,830	0.01%	C	$210	$320	$566	T	$0.008
Jersey Cen.	NJ	Motor Rebate	6/87	12/88	Full	28,000								3,766			$43				
NEES	MA/RI	Lg. C&I Custom	1/88	6/89	Full	1,890	23		1.2%	C	0.28			3,798	0.01%	C	$112		$401	D	
NEES	MA/RI	Energy Initiative	6/89	8/89	Full	~6,000	10	12	0.2%	C	0.09			3,798	0.00%	C	$74		$822	D	
NSP	MN	C&I Motor Efficiency	1/87	12/87	Full	111,751	54		0.0%	C	0.14	0.21	0.86	5,543	0.00%	C	$25	$103	$744	T	$0.012
Palo Alto	CA	Partners Elec. Incentive	1985	7/89	Full	2,409		10	0.4%	P		0.16	0.77	182	0.09%	A	$29		$185	D	$0.005
PG&E	CA	Energy–Efficient Motor	1983	1983	Full	~25,000		431	1.7%	P				14,142			$1,273				
So. Cal Ed.	CA	A Rewarding Connection	11/86	9/87	Full	70,000	177		0.3%	C		0.52	5.20	14,775	0.00%	A	$41		$79	D	$0.001
So. Cal Ed.	CA	Hardware Rebate	1/82	12/84	Full	393,754						6.62	49.99	14,775	0.04%	A	$1,011		$153	D	$0.003
Wisc. Elec.	WI	Smart Money	6/87	3/89	Full	81,750	64	128	0.1%	C		0.27	1.66	3,810	0.01%	A	$81		$307	D	$0.006
Bangr Hydro	ME	C/I Motor Efficiency	4/86	12/88	Pilot	~1,750	24	97	1.4%	C		0.08	0.34	262	0.03%	A	$20	$23	$305	T	$0.007
CMP	ME	Motor Rebate	1986	12/88	Pilot	43,686	232	320	0.5%	C			1.69	1,455							
Met–Ed/GPU	PA	High Efficiency Motor	1/87	12/87	Pilot	43,959						0.22	0.77	1,673	0.01%	A		$27	$122	T	$0.003
Nevada Pwr	NV	En. Eff. Elec. Motor Reb.	4/89	6/89	Pilot	32,927	5		0.0%	C				1,740							
NiMo	NY	Motor Rebate Pilot	5/86	12/86	Pilot	24	8		33.3%	C				5,403			$117	$144			

Note: $/kWh assumes a 15 year average motor life and a 6% real discount rate. For an explanation of these assumptions, see Chapter 1.

Source: Lessons Learned: A Review of Utility Experience with Conservation and Load Management Programs for Commercial and Industrial Customers, New York State Energy Research and Development Authority (NYSERDA), April 1990, pp. S–6 to S–8.

rebate levels have also been a key factor: participation rates respond greatly to changes in the rebate levels based on the small NYSERDA sample.

9.2.2 Contracting Out DSM Services

Many utilities have preferred not to implement conservation programs themselves and have instead turned to specialized "energy service companies" (ESCOs) to provide energy savings services. Regulators have required that these services be procured competitively. The competition of private power developers for supply-side resources provided an obvious and tested model for the competitive acquisition of DSM resources. States began to experiment with direct competition between ESCOs and supply-side developers for the provision of hundreds of megawatts of new (or avoided) capacity. States would award contracts to the company offering the least-cost option (with some provision for experience, approach, financing capability and reliability issues). Other states chose not to have ESCOs compete directly with supply-side developers, holding separate "demand-side bidding" and "supply-side bidding" procedures.

There are many ways in which an ESCO can be contracted to deliver "negawatts" (avoided megawatts). ESCOs can develop projects on a performance contracting or "shared savings" basis wherein the ESCO finances the installation of energy conservation measures and is paid a percentage of the energy savings based on a baseline audit or model of existing energy consumption in specific residential, commercial or industrial unit, and on an agreed price per unit of energy saved. This is the price that the ESCO has bid and it cannot exceed the utility's avoided cost rate or baseload "ceiling" rate. Bids can be structured as the price to supply a block of kW demand reductions, kWh energy savings, or both.[6] Payments to ESCOs can be made once or over time in installments. The utility can invite the ESCOs to target specific end-use sectors or to promote an all-inclusive program.

DSM bidding has had numerous advantages for utilities and regulators. ESCOs can provide "turn-key" energy conservation services for utilities not interested in implementing energy conservation measures themselves. Often, utilities lack the engineering and management capabilities that ESCOs can provide in helping customers assess and implement an optimal set of energy efficiency improvements. ESCOs also assume the technical, financial and operational risks of DSM implementation: if no energy savings are achieved, the ESCO does not get paid -- most contracts call for some guaranteed level of savings.[7]

6 "Energy Performance Contracting and Demand-Side Management," David Wolcott, *Performance Contracting for Energy and Environmental Systems*, Shirley Hansen, ed., October 1992 (forthcoming).

7 Ibid.

ESCOs also add value by monitoring retrofit performance. Since the ESCO provides the financing and is paid based on the amount of energy saved, these firms have a strong incentive to operate and maintain the equipment at a high level of efficiency in order to maximize the return on capital investment. This suggests that the delivery and duration of energy conservation services by ESCOs, as opposed to customers left to their own devices, will be highly reliable, an important utility and regulatory consideration.[8] Because ESCOs aggressively pursue savings and have a financial stake in doing so, DSM bidding has also served as a mechanism for overcoming the lack of utility enthusiasm for implementing energy conservation measures -- all of which traditionally have diminished utility revenues.

From the ESCO's perspective, DSM bidding affords the opportunity to earn attractive rates of return on investment, leverage utility payments contracts into additional financing for those investments, and take advantage of utility incentive rebate programs to also invest in measures that would otherwise be uneconomic. Participation in a bidding program also affords the benefit of reduced marketing costs if the utility is willing to support the ESCO in marketing the DSM program. For example, using billing data, utilities can easily identify for the ESCO the largest energy consumers, the subsectors that consume the most energy, load data, and contact names and phone numbers. DSM bidding has also opened up markets for ESCOs that did not previously exist.

The U.S. experience with ESCOs has not, however, been trouble-free. Because ESCOs seek to maximize profits, they search for short payback measures with investments that are easy to monitor. These investments may compete with the utility's own DSM programs or result in the implementation of measures that preclude maximum economic savings. This "cream skimming" is characterized by, for example, a predominance of efficient lighting retrofits and the lack of attention to implementing a comprehensive package of efficiency options in the customer's long-term interest. ESCOs also seek to minimize their transaction costs by focusing on the largest commercial and industrial customers, leaving the smaller ones unserved.

Some utilities have criticized DSM bidding as too complex and burdensome. Lengthy and complicated performance contracts with utility customers must be developed and many of these customers have no experience entering into these types of agreements. This complexity slows the pace of project implementation -- a problem for the ESCO which is often required to deliver energy services within a specified time-frame. Utilities have also been concerned that ESCOs may damage the relationship between utilities and their customers in the event they do not perform effectively.

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[8] "The Pros and Cons of Demand-Side Bidding," David R. Wolcott, testimony before the *Conservation Report Proceedings*, California Energy Commission, Sacramento, California, 1990.

ESCOs themselves have been displeased with the design of specific DSM bidding programs, including what has sometimes been perceived as onerous performance-guarantee requirements. ESCOs are also averse to intrusive impact-evaluation requirements, particularly if they must bear the cost of these data acquisition measures. ESCOs have had some unsatisfactory experiences attempting to deliver energy conservation services in areas where the local utility was uncooperative. In deciding to participate in a demand-side bid, ESCOs will look for the level of commitment of the utility to DSM in its expansion plans, the time the utility is willing to invest in the program, the administrative requirements (such as submetering and other evaluation mechanisms), and avoided cost ("ceiling") prices that bound the range of cost-effective measures which would interest an ESCO.

One of the most difficult problems, from the ESCO's point of view, is the level of risk the company must undertake. ESCOs are often asked to guarantee a minimum level of savings that must be included in the performance contract. The difficulty is that the ESCO often does not have the benefit of auditing end-use facilities with which to develop estimates of projected savings. Moreover, guarantees are provided for an entire utility service territory, not merely for specific customers. This greatly complicates the ability to develop projections of demand savings with great confidence. This problem becomes more onerous in cases where an ESCO bids for a DSM project only to find that the utility rejected the proposal because it was priced higher than the utility's own rebate program -- although the utility was free of the performance, O&M, and evaluation costs and risks which the ESCO must incur over the 10- to 15-year life of the project.

This last difficulty highlights another key problem the U.S. has had in effectively integrating ESCOs into the bidding process: marketing risks. It is not unusual for an ESCO to spend between $50,000 and $100,000 on a bid proposal, yet these proposals are sometimes rejected if they compete with the utility's own programs, or if they do not conform to unpublished, qualitative criteria, or if the utility later decides, after soliciting bids, that it no longer needs the DSM "capacity."

9.2.3 Utility Incentives

A third major DSM implementation issue has surrounded the conflict between the interest of regulators in promoting energy conservation on the one hand, and the interest of utilities in maximizing revenues on the other. Clearly, in the past, most DSM measures -- with the exception of some peak load-shifting programs -- have reduced utility profits. Not surprisingly, private utilities have viewed DSM as a threat to their financial viability. At the least, utilities are concerned with recovering through customer rates the costs of DSM program administration, incentives and lost revenues.

"Regulatory incentive" mechanisms include a variety of formulas that regulators are using to either leave utilities indifferent to DSM or go further and give them extra rewards for energy conservation. Some minimal measures simply allow the utility to pass the costs of economic DSM programs, including lost revenues, on to its customers. Others "decouple" utility revenues from sales volume, recoupling revenues to customer growth. Other approaches reward utilities above and beyond opportunity and program costs. The most popular of these approaches is to provide utilities with a percentage of the shared savings -- the difference between the life-cycle cost of the DSM program and the avoided cost of the power that is conserved. Other approaches have provided utilities with a cost-effective performance incentive in which a utility's earnings depend on its performance relative to a pre-determined target for the cost-effectiveness of the measures and programs employed. Utilities can also be paid a pre-specified amount per unit of energy saved.

The importance of gaining active utility interest in promoting DSM is a major lesson learned in the U.S. Without some mechanism with which to reward the utility for energy efficiency, the probability of achieving optimal exploitation of all the available DSM resource potential is slim.

9.2.4 Measuring DSM Achievements

One of the challenges of acquiring DSM resources is measuring the impact of various DSM programs. Utilities usually must choose an approach to estimating the difference between energy consumption under a business-as-usual scenario and energy consumption under a DSM regime.[9] Several techniques can be used for measurement, including engineering simulations, estimates of the amount of savings from each measure (multiplied by the expected penetration rate), detailed submetering of specific applications in commercial and industrial processes, and sampling of customer bills before and after the installation of measures. Any of these approaches tends to require substantial amounts of data on end-use consumption, current stock of equipment, customer decision-making, and likelihood of energy efficiency technology adoption in the absence of added market push and promotional activities (the free-rider problem).

Engineering studies and savings calculations based on each measure and its expected contribution and penetration are the two most commonly used techniques in the U.S. to estimate savings. Engineering estimates have sometimes been overly optimistic in areas where wood or other secondary heat sources are extensively used, because electricity represents a much smaller share of energy consumption in these households than the engineering model would suggest. In rebate programs, it is necessary to ensure that

[9] Meade and Roseman, op cit.

measures are actually implemented and the expected penetration rates achieved by requiring that customers present an invoice for the services performed and accept a one-time inspection by the utility. Unlike utility programs aimed directly at the customer, ESCOs must satisfy their contract requirements that energy savings at a certain level continue to be realized at the customer site over a ten- to fifteen-year period. These savings must be carefully documented, and some utilities require that ESCOs install monitoring equipment to measure energy consumption for specific applications.

Measuring the gains in new construction built with added energy efficiency above and beyond required standards (paid for or subsidized by the utility) is less difficult to measure and predict. An energy-efficient home or commercial building built by a trade ally to utility energy efficiency specifications will provide some "guaranteed savings" over the lifetime of the unit. These "lost or one-time opportunity resources" (opportunities for a one-time installation of efficiency measures during construction) have been one of the most effective market segments for minimizing the impact on load growth of residential and commercial sector growth in some states in the U.S. (California).

9.2.5 Establishing Energy Efficiency Standards

Energy efficiency standards are one mechanism by which to lock in energy savings in what would otherwise be "lost opportunities." Although utilities in the U.S. do not themselves establish and enforce energy efficiency standards for household appliances, buildings, and industrial motors, these standards play an important complementary role to utility DSM programs. In some states, utilities have even advocated and helped to achieve higher energy efficiency standards for certain end-uses than would otherwise have been the case.

These standards would appear to have been a success. In the U.S., refrigerators sold in 1987 used 42 percent less energy than those in 1972; air conditioner efficiency increased 25 to 35 percent on average over the same period; and buildings built in 1980-83 used 18 percent less energy per square foot than those built in the 1974-79 period. But it is important to note that there is disagreement regarding to what degree these efficiency improvements should be attributed to the development and enforcement of standards versus market forces. Also, industrial sector energy efficiency improvements lag way behind the residential and commercial sectors: less than 5 percent of the industrial motors in use in 1985 were of the energy-efficient variety, and the adoption of electronic adjustable-speed drives for industrial motors is proceeding slowly in the U.S. and is far from achieving its cost-effective potential.[10]

In the U.S., the three major players in the establishment and enforcement of efficiency standards are the federal government, state (and sometimes local) governments, and industry associations. Despite some important legislation in 1975, the federal government has not played an aggressive role in promoting and enforcing appliance and buildings efficiency standards, with the exception of government-funded houses and buildings. This includes the Department of Housing and Urban Development's (HUD) low-income housing construction. Nevertheless, a 1984 Department of Energy (DOE) study estimated that standards could reduce residential energy demand alone by 6.4 percent by the year 2005, saving consumers $10 to $16 billion (net present value over a 20-year period).

Federal legislation that touches the private sector has been largely limited to the development and implementation of energy performance labels for appliances and heating, ventilating and air conditioning (HVAC) equipment. These labels provide the estimated energy cost for a particular model, and indicate the highest and lowest energy costs across similar models. Room air conditioner labels include the efficiency rating and estimated annual operating cost. These labels have been criticized for lack of accuracy and complexity, and their effectiveness has not been well documented.[11] And although a number of financial incentive and grant programs exist, none are targeted toward the industrial sector.

Unlike the federal government, many states have adopted thermal efficiency standards for new building construction based on those developed by the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), an industry association. Since the average efficiency of new homes in most states significantly exceeds these standards, it is questionable whether these standards have had much if any impact.[12]

The implementation of state (and local) building codes differs greatly from state to state. Sometimes residential construction is covered, while other times commercial and government-owned buildings are targeted. Enforcement mechanisms vary greatly from guidelines to voluntary to mandatory standards.

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10 "Implementing Electricity Conservation Programs: Progress Toward Least-Cost Energy Services Among U.S. Utilities," Howard S. Geller, *Electricity: Efficient End-Use and New Generation Technologies and Their Planning Implications*, Thomas B. Johansson et al., eds., 1988, p. 742.

11 *Energy Efficiency in Buildings: Progress & Promise*, F.M. O'Hara, ed., American Council for an Energy Efficient Economy, 1986, p. 148.

12 Ibid., p. 167.

A major issue has surrounded performance-based versus prescriptive standards. Performance standards give designers, builders and retrofitters maximum flexibility in achieving efficiency goals, but are more difficult to enforce than standards that prescribe certain levels of thermal integrity in different building components.[13] Some states, such as Florida and South Dakota, have even combined the two.

The effectiveness of performance standards depends upon a number of critical factors. These include the training and education of builders and local code officials; the way in which these officials enforce the code (on-site inspections versus review of design plans); and the length of time the code has been in effect, its complexity and the frequency with which it is modified.

Numerous states have enacted minimum efficiency standards for appliances sold within the state. California has been a market leader, adopting minimum-efficiency standards for refrigerators, freezers, and air conditioners in 1976 and for water heaters, furnaces, heat pumps and other gas-fired products in 1983. All of these standards have subsequently been revised upwards several times. The State of California estimated that appliance standards alone would cut peak power demand by 1,750 MW between 1983 and 1987, saving the state more than $600 million in avoided energy costs. Besides California, nearly all states in the U.S. have adopted building codes that include equipment efficiency requirements.

9.3 DSM FOR GUATEMALA

Guatemala may have an even more acute need for DSM than industrialized countries, because the country faces rapid demand growth and a limited ability to finance additional capacity. Power loans for developing countries generally account for about 25 percent of total public sector external debt obligations in developing countries; this figure is as high as 40 percent in some cases.[14] A rapid increase in energy demand in many developing countries, due to factors such as increasing economic activity, rapid population growth, and subsidized power tariffs, has imposed growing capital requirements to finance utility capacity expansion. The growing gap between debt burden and revenues has resulted in a financial crisis for many developing country utilities. This crisis has obliged many governments and utilities to seek alternatives to the strategy of ever-increasing capacity and subsidized pricing. DSM can assist utilities in Guatemala and other developing countries in avoiding or delaying costly capacity additions by slowing demand growth.

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13 Ibid., p. 168.

14 Schramm, G., "Electric Power in Developing Countries: Status, Problems, Prospects", *Annual Review of Energy*, vol. 15, 1990.

9.3.1 Institutional Requirements and Incentives

Guatemala has yet to initiate DSM programs, although a number of other developing countries are now beginning to actively explore the option.[15] To do so requires the development of new capabilities as well as the regulatory provision of incentives to the utility, consumers, and trade allies[16] to promote and participate in DSM programs. Assuming DSM is indeed part of a least-cost plan, the purpose of incentives is to make this least-cost plan the most profitable plan for all parties. Because DSM programs must mobilize all three of these groups to succeed, crafting a package of incentives that motivates all parties can be a complex task. It is also one that must be completed prior to embarking on DSM program design and implementation.

General

In many countries, the first step towards the use of DSM will be a presidential or ministerial decree, or a public law, which directs the utility to introduce IRP and DSM, and sets the foundation for building and appliance standards. The IRP requirement is important because it places supply-side and demand-side resources on an equal footing in terms of utility planning.

These first steps, to be effective, must be comprehensive. To promote the appropriate use of DSM, the law or decree would also have to specify changes in the utility's accounting, performance, and project evaluation procedures. These additions would stipulate the use of IRP, would make DSM attractive to the utility from an accounting and incentive standpoint, and would empower the utility to conduct direct installation programs, offer the necessary incentives to consumers and trade allies, or contract with energy service companies to deliver a specified amount of energy or capacity savings. Specific building codes or appliance standards may also be outlined, which may be enforced by other agencies.

Assuming that DSM programs are economically justified and that a country therefore wants to encourage the introduction of DSM programs, financial incentives to the utility are particularly important, especially since the consumer and trade ally incentives (such as rebates or innovative tariffs) are generally offered through the utility.

Utility incentives must encourage utilities to transform from commodity producers into service providers. Until recently, tariffs were the primary power sector policy issue, as they

[15] Such as Costa Rica, Colombia, Brazil, Mexico, Jamaica, Thailand, Indonesia, India, and others.

[16] DSM programs are sometimes more effective if they are delivered through intermediaries who in turn sell goods and services to consumers, rather than delivered directly by the utility to consumers. *Trade allies* are enterprises such as builders or equipment distributors who can help to implement DSM programs through their normal business activities. Utilities typically offer incentives to trade allies to sell higher-efficiency equipment or construct energy-saving buildings.

often were formulated to balance the economic efficiency of long-run marginal cost (LRMC) pricing with the government's broader socio-economic and political considerations. Utilities were, in effect, regulated on a cost of service basis, and utility success was measured by power sales. Revenue collection, usually a direct function of sales, was thought to be the only incentive utilities needed for operation. Utilities had to maximize their sales to maximize their revenues (although in cases in which certain tariff classes are subsidized, the utility has an incentive to limit sales). Existing regulatory arrangements in these countries seldom recognize that saving energy and reducing demand can be economically less costly than generating electricity and adding capacity. Consequently, incentives are seldom provided for utilities to introduce DSM programs that aim to *reduce* sales. Regulation must therefore provide incentives for utilities to implement DSM if the economic benefits of DSM are to be captured.

However, to provide incentives for the implementation of least-cost plans that consider both demand- and supply-side options, the criteria for utility success must change. Utility profits (or other measures of success) must be de-coupled from power sales. Consumers and trade allies must be encouraged to participate in the transition to new end-use technologies and consumption behavior. Such a transition naturally entails risk for all parties. Changes in utility, consumer, and trade ally incentives are not simply money "give-aways," but are critical to help each group overcome its risk aversion, and to give each group a stake in adopting the least-cost plan.

In Guatemala, non-tariff financial incentives are needed in addition to an IRP requirement to stimulate DSM implementation. Financial incentives for DSM should provide the utility with:

- full recovery of all costs associated with DSM programs, including interest and adjustments for under-recovered fixed costs resulting from:
    - program participation and/or costs exceeding budgeted amounts
    - lack of carrying charges on deferred expenditures
    - lack of authorized return on amortized program expenditures
- bonuses in addition to cost recovery to offset risks and encourage performance.

Cost recovery mechanisms can include:

- ratebasing DSM costs as they are incurred
- balancing account recovery, i.e., decoupling revenues from electricity sales by allowing the utility to collect sufficient revenues regardless of costs or sales

- directly offsetting revenues lost through DSM implementation, either on a program-specific or comprehensive basis.

Bonuses can be included through several means including:

- providing ratebased DSM costs with a bonus rate of return for the purposes of tariff calculations

- allowing a utility markup on DSM expenditures

- granting unit savings bonuses, i.e., per kW or kWh saved (the "bounty system" approach)

- providing the utility with a percentage share of the total savings, i.e., avoided costs less program costs (the "shared net resource savings" or simply "shared savings" approach).

Of course, these utility incentives also should be reflected among the performance incentives for utility staff.

The capabilities to administer and deliver DSM programs must also be developed, and responsibilities for program implementation allocated. While the utility is ultimately responsible for the design of an optimal program delivery strategy, and always retains substantial administrative control of DSM activities, the delivery of utility-designed programs may be delegated to private contractors. Alternatively, private energy service companies (ESCOs) can contract with the utility, or bid competitively, to provide energy savings from opportunities they have identified independently of the utility.

The selection of an appropriate approach will depend in part on the match between capabilities that already exist within the utility and the private sector, and the types of measures and delivery mechanisms to be used. For instance, the direct installation of high-efficiency lighting could allow for either the use of contractors or utility staff, while rebate programs could be handled by the utility alone. New construction efficiency programs, on the other hand, could be handled by trade allies with incentives provided by the utility. In any case, it is likely that utility personnel will require hands-on familiarization with DSM program design, implementation, and evaluation through workshops, training courses, and interaction with personnel from utilities that have already introduced DSM. An overview of delivery mechanisms is given in the box on the next page.

Delivery Mechanisms for DSM Programs

Delivery mechanisms for DSM programs range from a centralized approach in which the utility is responsible for the identification of opportunities and installation of measures on the consumer's side of the meter, to a decentralized approach in which the utility only provides incentives for consumers, who are then responsible for identifying DSM opportunities and deciding whether or how they wish to take advantage of those incentives.

Direct installation is the most centralized approach. In its simplest form, it entails utility staff visiting consumers and physically installing equipment that will modify consumer load shapes. Alternatively, a utility may hire a contractor to carry out this work.

Closer to the middle of the spectrum are delivery mechanisms that rely on third parties to identify DSM opportunities. **Energy service companies** may contract with utilities in much the same way as an independent power producer, but will instead be expected to provide a certain level of reduction in peak demand and total annual energy consumption. ESCO staff are responsible for identifying the DSM opportunities and gaining the cooperation of the consumer. **Trade allies** are typically equipment vendors or builders who come in contact with DSM opportunities in the course of their primary business. For example, utilities might pay air conditioning retailers for each high-efficiency unit they sell, or might encourage property developers to adopt efficient designs that may be more expensive on a capital cost basis.

Finally, utilities may offer **direct incentives to consumers**. **Tariff options**, such as time-of-use rates or interruptible and curtailable rates are the most direct incentives. **Rebates** can also be used to motivate consumers to purchase more efficient end-use equipment which the consumer might not have otherwise purchased because of its higher capital cost. Alternatively, a utility can offer **loans** to consumers to purchase more efficient equipment, or **lease** such equipment to them at attractive rates. Utilities can also offer consumers **shared savings programs** in which the utility would make payments to consumers commensurate with the benefits that accrue to the utility as a result of changes in consumer consumption patterns. Finally, utilities can provide **information only programs** in which the utility simply describes how the consumer can modify his or her consumption and the benefits that will accrue to the consumer under existing tariffs with these modifications.

These financial incentives for consumers may be packaged with personal marketing contact and/or technical assistance from either the utility or a contractor to help the consumer take advantage of particular DSM opportunities. Similarly, delivery may be administered, and consumer actions verified, by either the utility itself or a contractor acting on its behalf.

9.3.2 Key DSM Objectives

As described in Exhibit 9-2, there are six principal ways in which DSM programs can influence consumer demand. Some of these entail a reduction in peak demand or total consumption, while others increase demand or consumption. The desired effects depend on the utility in question; clearly, not all of these objectives (such as load building) are relevant to Guatemala. The primary objective in any case is to manipulate the timing or level of customer demand so as to achieve the financial, economic, and environmental benefits of the least-cost plan. In cases of underutilized capacity, such as in Edison's first utility, valley filling would be desirable. On the other hand, in countries with rapidly growing demand, peak clipping or strategic conservation may be used to help defer costly new capacity additions, improve customer service, reduce environmental impacts, and maximize national economic benefits.

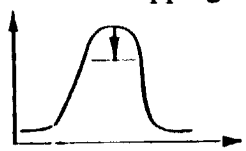
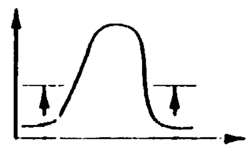
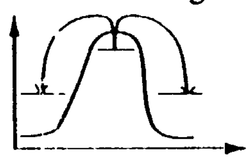
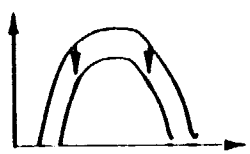
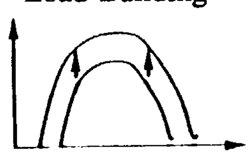
9.3.3 Framework for DSM Program Design and Implementation

Since Guatemala does not yet have experience with DSM implementation, it is not obvious whether to proceed first with IRP or DSM: IRP would identify cost-effective DSM resources, but requires information such as estimated costs, benefits, and market penetration for the DSM options under consideration. This type of information is typically only available through actual DSM experience.

In the near term, the results of modeling efforts can highlight attractive candidates for pilot DSM programs. The results of these programs can be used to establish an experience base in Guatemala. In the longer term, IRP can then optimize the selection and mix of DSM programs and supply-side options when knowledge of actual program performance is available. DSM and IRP should proceed in parallel, the results of one feeding into the other. For example, once there are some successful DSM programs, resistance to IRP may diminish as demand-side resources are shown to be real. Conversely, IRP can create a policy and regulatory framework that legitimizes DSM.

DSM program design and implementation follow several steps, which are described below. These steps are typically conducted iteratively, e.g., the results of the pilot program may suggest changes to the program design, and the results of the program evaluation may guide the formulation of objectives for subsequent DSM programs. These activities presuppose that an institutional environment conducive to DSM implementation has already been established.

Exhibit 9-2. The Effects of DSM on Load Shape

Effect on Load Shape	Description	Means of Implementation
Peak Clipping 	**Peak clipping** refers to the reduction of utility loads during peak demand periods. This can defer the need for additional generation capacity. The net effect is a reduction in both peak demand and total energy consumption.	Direct utility control of consumer appliances or end-use equipment. Time of use rates may also accomplish peak clipping.
Valley Filling 	**Valley filling** entails building off-peak loads. This may be particularly desirable when the long-run incremental cost is less than the average price of electricity. This is often the case when there is underutilized capacity that can operate on low cost fuels. The net effect is an increase in total energy consumption, but no increase in peak demand.	Creation of new off-peak electric loads that previously operated on non-electric fuels, such as overnight charging of electric cars and thermal energy storage.
Load Shifting 	**Load shifting** involves shifting load from on-peak to off-peak periods. The net effect is a decrease in peak demand, but no change in total energy consumption.	Time-of-use rates and/or the use of storage devices that shift the timing of conventional electric appliance operation.
Conservation 	**Strategic conservation** refers to reduction in end-use consumption. There are net reductions in both peak demand (depending on coincidence factor) and total energy consumption.	End-use efficiency.
Load Building 	**Strategic load growth** consists of an increase in overall sales. The net effect is an increase in both peak demand and total energy consumption.	Increased energy intensity and/or the addition of new customers.
Flexible Load Shape 	**Flexible load shape** refers to variations in reliability or quality of service. Instead of influencing load shape on permanent basis, the utility has the option to interrupt loads when necessary. There may be a net reduction in peak demand and little if any change in total energy consumption.	Interruptible and curtailable rates.

1. **Select appropriate DSM objectives.** Based on utility requirements, load shape objectives (as described in the preceding section) should be established for the utility as a whole as well as for each target customer class or market segment. These objectives will guide program design and facilitate evaluation. Specific objectives should be derived from broader objectives regarding, on the primary level, financial performance of the utility, and on a secondary level, specific operational needs of the utility, such as increased system utilization, capacity deferment, or reduced dependency on critical fuels.

2. **Acquire data and identify market segments.** DSM aims to modify consumer behavior. DSM programs must therefore focus on the technologies used by consumers, and must stimulate consumers to act. For instance, even if there were considerable scope for efficiency improvements in residential air conditioners, a sufficient number of residential consumers must use this technology before it is worthwhile to target it. If a sufficient number of consumers in fact use the technology, then a DSM program targeting that technology can only be effective if it takes into account consumer considerations regarding technology selection, as well as the actual patterns of use.

   DSM program design and marketing must clearly identify the target population and take into account the values, actions, consumption patterns and perceptions of that population. The required data can be acquired through a combination of customer surveys and focus groups, billing data analysis, and load research. In addition, this data can be used to establish a baseline against which net program impacts can be estimated.

3. **Design program.** Based on load shape objectives and the characteristics of each target market segment, various DSM measures can be put forward and evaluated with respect to their technical and economic potential. Technical potential refers to the impact of the measure if it were adopted wherever technically feasible. Economic potential refers to the impact of the measure if it were adopted wherever economically justified -- including costs and benefits to the consumer.

   Measures with promising technical and economic potential can be packaged with delivery strategies and utility and participant incentives to constitute program concepts. The market potential of a program concept can then be assessed. Market potential is generally less than economic potential because of logistical considerations associated with program delivery. Delivery strategies and institutional arrangements are frequently selected to maximize market potential. Pilot programs and administration, tracking, and evaluation plans are then developed for promising program concepts. Other screens of cost-effectiveness may be applied at this time to ensure that adequate incentives for participation exist. This phase should incorporate the following considerations:

- **Explicit recognition of uncertainty.** DSM in Guatemala, as in other developing countries, is relatively new. Consequently, there is a great deal of technical, economic, and market uncertainty related to the impact of particular DSM programs. These sources of uncertainty are discussed in the box on the following page. Program design should recognize uncertainty explicitly, and should include measures, such as pilot programs, to reduce the resulting risk and increase the likelihood of program success.

- **Attention to the institutional environment.** DSM program planning and implementation require the involvement and commitment of a broad range of groups, including regulatory bodies, utilities, trade allies, and consumers. Each of these groups must have the capabilities and incentives to implement their portion of a given DSM program if it is to be successful. With respect to incentives, regulatory bodies must ensure that the least-cost plan should be the most profitable plan from the standpoint of each party. The savings generated by program implementation must be distributed in some way among all groups to ensure their participation and support.

4. **Conduct pilot programs.** If the technical and economic potential and market penetration of DSM measures were known with certainty, there would be no risk associated with DSM program implementation. Utilities would be informed on program impacts and could compare the value of these impacts to the cost of the program, prior to implementation, to determine its cost-effectiveness. However, as pointed out in the box on the next page, these parameters are quite uncertain.

   Risk reduction strategies aim to decrease the variance of the prior probability distributions of technical, economic, and market parameters. Risk may be reduced by acquiring further information about key parameters, which may decrease the uncertainty associated with these parameters. Pilot programs are effective in gaining further information when needed; in effect, they serve as additional market research. Pilot programs do not remove all uncertainty, but decision analysis techniques can identify the most sensitive parameters and suggest the maximum amount one should be willing to pay to gain even imperfect information. These "value of information" assessments are an important part of pilot program design.

   Pilot programs include not only the implementation of a program on a limited basis, but also the means of monitoring and evaluating performance of the pilot program. Pilot programs typically involve additional load research, customer surveys, and billing data analysis to facilitate evaluation and yield the additional information originally sought.

Types of Uncertainty in DSM Program Design

There are four sources of uncertainty in DSM program design, each of which ultimately reduces the accuracy of program impacts estimates. Inaccurate estimates can lead to the allocation of resources or to the design of programs that ultimately prove to be ineffective. Risk reduction strategies can be used to mitigate the potential impacts of this uncertainty in program design.

Technical uncertainty arises due to many contributing factors, predominant among which is the lack of detailed, accurate information on the targeted applications and the variability of operational factors that characterize those applications. For example, suppose we were to attempt to estimate the technical potential of an industrial motive power optimization program that consisted of motor replacements, installation of variable-speed drives, power factor correction, line-balancing, use of synthetic lubricants, and improved maintenance of conveyors, fans and other driven equipment. Ideally, to accurately estimate savings potential, we would like to know the age and size distributions of the existing inventory of motors, their nominal efficiencies, and their duty cycles (in terms of hours of operation, fixed versus variable speed/torque operation, part-load performance, etc.). We might also want to know something about current maintenance practices and the ability to affect savings by modifying driven equipment (e.g., trimming pump impellers). All of these variables represent a distribution of values, and in selecting point estimates to reflect "average" or "typical" values to perform our savings analysis, we may or may not choose values that closely approximate their true means, let alone capture their variability.

Economic uncertainty results from the variability or lack of understanding regarding factors that determine the financial attractiveness of participation in DSM programs. For example, discount rates may vary widely among market segments, so that measures that appear attractive to some consumers do not appear worthwhile to others.

Market uncertainty results from the range of potential consumer responses to DSM programs. Knowing the technical impact of a DSM measure among all consumers for whom it would be economically attractive to participate is insufficient to accurately estimate program impacts. For instance, it may take time for consumers to find out about or understand DSM programs. Or, only limited resources may be available for program delivery, so that not all consumers who wish to participate can. Such factors can slow the market penetration or consumer acceptance of DSM programs.

Uncertainty regarding the persistence of measures may be thought of as the temporal dimension of uncertainty. The adoption of a measure does not ensure its consistent use. There is no assurance that a consumer will not revert to prior consumption patterns when a program expires or a piece of high efficiency equipment is replaced.

Because each of these factors influences savings potential with different degrees of importance, the value of having more detailed or accurate information on each can be correspondingly higher or lower. Decision analysis techniques allow one to assess the value of additional information; pilot programs provide the opportunity to collect it.

Pilot programs also provide an important demonstration function. Successful pilots can convince utilities, regulatory bodies, and consumers alike of the effectiveness and value of DSM programs under consideration.

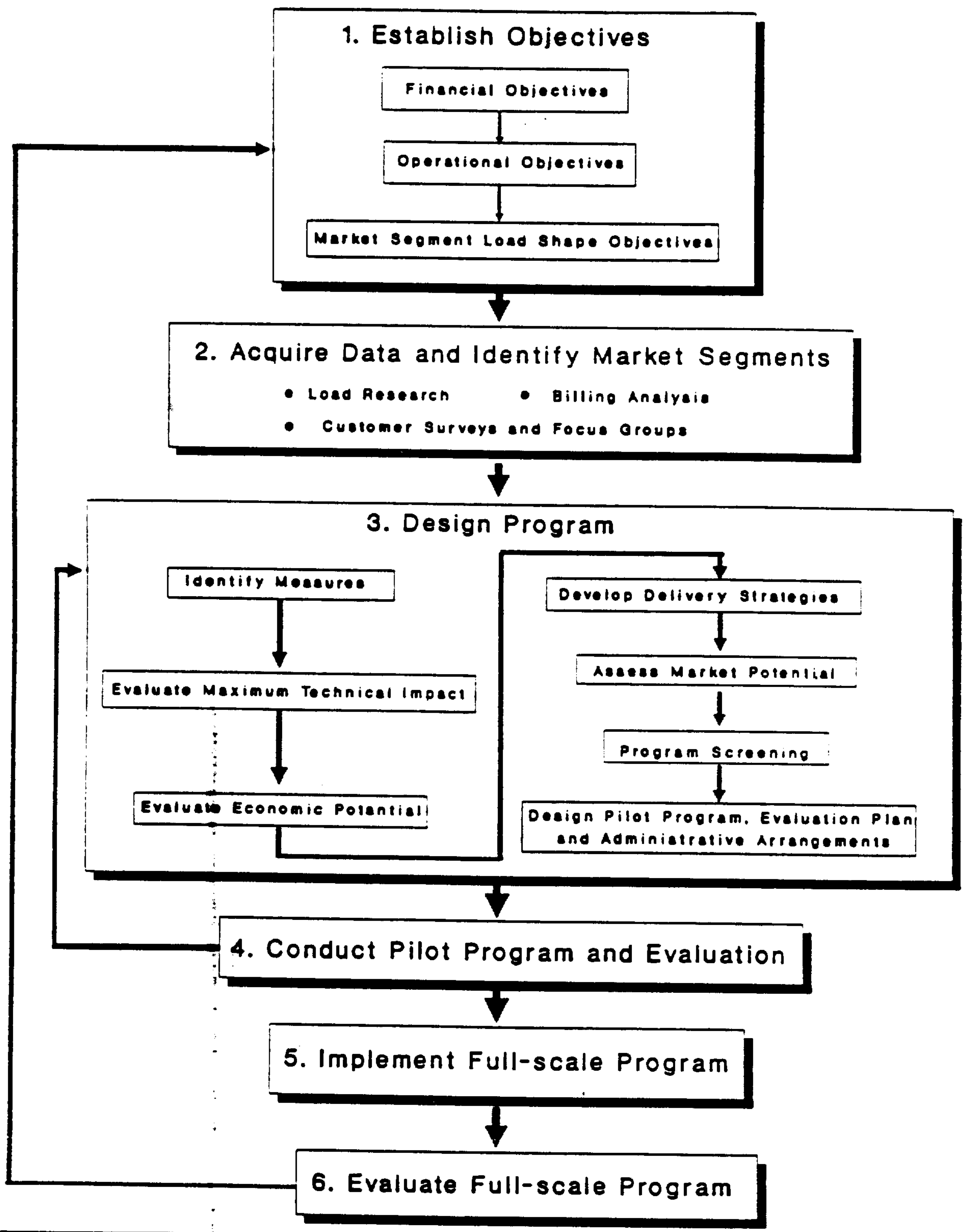
5. **Implement full scale programs.** Based on the evaluation of pilot programs, it is possible to re-design the program to make it more cost-effective. As with pilot programs, full-scale programs include marketing, monitoring and administration along with the actual delivery of various DSM measures. Programs can be implemented by utilities alone, although it is common to have the participation of private sector contractors, ESCOs, or trade allies.

6. **Evaluate programs.** If DSM programs are to be utilized as true utility resources that defer conventional capacity and reduce generation, program impacts must be quantified in terms of energy and demand savings. Evaluation is also critical to establish the exact level of incentives for program implementation or participation. *Impact evaluation* determines the change in energy consumption patterns as a result of the program. *Process evaluation*, on the other hand, examines the way in which programs are marketed and delivered to determine how programs may be improved. *Market evaluation* is sometimes distinguished from process evaluation as a specific assessment of why consumers choose to participate or not in a particular program, leading to a re-estimation of the program market potential and impacts, and program design and marketing techniques.

   Program evaluation also provides an important feedback, or course correction activity. It should include on-going monitoring and program tracking to suggest adjustments to components as well as to verify program impacts.

The interaction of steps is depicted in Exhibit 9-3.

Exhibit 9-3
The Framework for DSM Program Design and Implementation



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CHAPTER 10: DEMAND-SIDE MANAGEMENT ACTION PLAN

This demand-side management action plan stresses the need for both institutional and programmatic changes and initiatives. This action plan is intended to serve as a starting point for the development of a set of concrete and specific technical and institutional recommendations for implementing demand-side management in Guatemala.

10.1 INSTITUTIONAL SECTOR

As discussed in this report, aggressive, comprehensive, and effective DSM programs require specialized skills and with them new institutional configurations which lend themselves to DSM and integrated resource planning. There are several principal recommendations for institutional strengthening in Guatemala for DSM/IRP planning, implementation, and evaluation:

Sector Goal: Effectively implement an integrated resource plan.

Action 1: Strengthen the technical capabilities of INDE, EEGSA and government regulatory agencies in evaluating and implementing demand-side management programs. This will involve the transfer of experience from other countries to Guatemala.

Action 2: INDE and EEGSA should organize a department that is tasked with the responsibility of developing a demand-side management plan. This department will also be responsible for the design, implementation, and evaluation of DSM programs.

Action 3: Involve public and private sector institutions in collaborative committees to discuss and analyze the opportunities and needs in the public and private sectors, and make recommendations for specific actions.

The development and implementation of an integrated resource plan (IRP) for Guatemala will require the cooperation and participation of several key public and private-sector agencies.

The IRP issues that must be addressed include:

- assessment of human resource, training and technical assistance needs at INDE, EEGSA, and other public agencies to implement IRP
- data collection, selection of criteria/methodologies for cost-benefit analyses, identification of targeted measures and sectors; and selection of pilot/demonstration projects
- identification of financing options and incentives for the utilities and their customers, and of external financial assistance
- consensus on the criteria for evaluating the various DSM programs.

10.2 INDUSTRIAL SECTOR

The results of this preliminary study suggest that promoting the implementation of low/no cost efficiency measures and efficient industrial motors and drives should be a top priority because of the savings potential and impact of this sector on the overall system peak. Other recommendations include the development of industrial interruptible rates and time-of-use rates.

10.2.1 Low Cost/No Cost and Other Measures

Low cost/no cost measures in the industrial sector, as in all other sectors, represent important opportunities for savings. As a group, these measures offer greater overall savings than any single measure or program. However, these measures, which can be diffuse, can raise some added implementation and evaluation issues in Guatemala.

Sector Goals:

1. Promote broad-based measures that can be adopted by most industrial customers.
2. Promote specific technologies that do not represent major industrial end uses.

Action 1: Develop utility-sponsored programs to offer energy surveys for industrial facilities. This will identify different practices and measures that are specific to individual customers. Training seminars should be offered periodically to increase facility managers' awareness of energy management techniques.

Action 2: One end-use that may be applicable to the industrial sector is energy-efficient refrigeration systems. These systems include higher efficiency compressors and other components. The utilities should develop brochures and train their energy service representatives to promote regular maintenance of refrigeration systems.

10.2.2 Industrial Motors and Drives Program

The actions below are designed to promote the installation of high-efficiency motors instead of standard efficiency motors, and they will improve the efficiency of belt transmission devices. This program should be introduced in two concurrent phases targeting different motor users.

Sector Goal: Improve motor and drive efficiency.

Action 1: Phase I: Attempt to have customers with burned-out motors begin to replace the old motors instead of rewinding. This can be accomplished through the use of point-of-purchase incentives from the utilities or by government-established efficiency standards. Most of the motors observed in industrial applications were from the United States and had NAEMA efficiency ratings on the nameplate, which will aid in identifying actual efficiencies.

Phase II: Attempt to have industrial customers that use belt drive mechanisms use cogged V-belts for motors smaller than 10 hp and synchronous drives for motors 10 hp and greater. Again, these technologies could be promoted through the use of point-of-purchase incentives.

10.2.3 Industrial Interruptible Rates Program

Industrial interruptible rates programs can be attractive not only because of the potential savings they can offer, but also because they can be less complex to implement than other DSM measures.

Sector Goals:

1. Reduce demand during peak load times.
2. Help to defer the need for new capacity.

Action 1: Conduct a survey of industrial and large commercial customers to determine customer interest in this type of program. If it is determined that the potential market for this program is the one estimated by this study, then a pilot program should be performed to determine how customers respond to this tariff. This would also allow the utilities to test the system and procedures used in controlling these customers.

Action 2: Implement an interruptible rates program to take advantage of customers who have back-up generators or have the ability to reduce their demand upon notification by the utility.

10.2.4 Industrial Time-of Use (TOU) Rates

Like interruptible rates, TOU rates can be straightforward to implement and evaluate. Like interruptible rates, they reduce the peak load. Unlike interruptible rates, they help to boost the average load factor of the system, delivering added value to the utility. Customers who may not be able to take advantage of an interruptible tariff may be able to take advantage of a TOU tariff, because they may be able to schedule their operations to avoid the peak.

Sector Goals:

1. Shift load from peak to off-peak hours.
2. Improve system efficiency and reduce operating costs.

Action 1: Perform a survey of industrial and large commercial customers to determine customer interest in TOU tariffs. The surveys for both TOU and interruptible rates can be performed together.

Action 2: Once the results of the survey are obtained, the utilities can determine whether a voluntary or mandatory TOU program should be implemented.

Action 3: A time-of-use tariff should be implemented for large industrial customers, who tend to be more responsive to TOU rates than smaller industrial customers. The higher the on-peak to off-peak price ratio, the greater the customer response.

10.3 COMMERCIAL SECTOR

The commercial sector in Guatemala appears to present important opportunities for savings in lighting and in a variety of "housekeeping" (no/low cost) measures. End-use applications will need to be carefully monitored in order to evaluate the effectiveness of the DSM programs set out here.

10.3.1 Energy-Efficient Lighting

Sector Goal: Implement incentive programs to encourage the use of efficient lighting technologies for exterior and interior applications.

Action 1: Focus initially on technologies that are available in Guatemala such as compact fluorescents, reduced-wattage fluorescent lamps, and delamping with reflectors.

Action 2: Once the programs are established, expand them to include emerging technologies such as T-8s with electronic ballasts.

10.3.2 Low Cost/No Cost Measures and Other Measures Program

Sector Goal:

1. Promote broad-based measures that can be adopted by most commercial customers.
2. Promote specific technologies that do not represent major commercial end uses.

Action 1: Develop utility-sponsored programs to offer energy audits for commercial facilities. This will identify different practices and measures specific to individual customers. Training seminars should be offered periodically to increase facility managers' awareness of energy management techniques.

Action 2: Promote energy-efficient motors through incentives. Motors should be targeted for replacement at the end of their life instead of rewinding. The program should include education on the benefits to commercial customers associated with higher-efficiency motors.

10.3.3 Commercial End-Use Monitoring

Sector Goal: Improve the knowledge of commercial end-use patterns and behavior.

Action 1: Perform end-use monitoring studies of commercial customers to validate the load shapes projected as part of this study. Of particular interest are the load shapes for commercial interior and exterior lighting, and refrigeration, which are the largest contributors to the system peak. This monitoring will provide a basis for use in verifying the reductions obtained from DSM programs.

10.3.4 New Energy-Efficient Buildings

Sector Goals:

1. Increase electricity efficiency in new commercial and public buildings.
2. Initiate research and demonstration of energy-efficient building techniques and technologies.
3. Build a data base on commercial electricity end-uses.
4. Assess the need to establish minimum building energy standards.

Action 1: Create an ongoing design workshop for commercial building designs that maximize both natural ventilation and daylighting potential. In addition, a design competition should be initiated among the professional and buildings communities to produce energy-efficient designs. Prizes should be awarded to the winners and their designs published.

Action 2: Prepare energy-efficiency information packets for developers.

Action 3: Review the institutional and financial requirements necessary to establish an energy building standard in Guatemala, including a training, technical assistance, and enforcement program. The current U.S. ASHRAE 90.1 standard may serve as a useful model. Determine the appropriateness of establishing an energy code.

Action 4: Create an ongoing design workshop for establishing a set of new commercial and public building design and equipment guidelines for a variety of building categories. The workshop would include training for architects and builders in daylighting techniques, lighting system design, and control strategies.

Action 5: Sponsor a design competition for high energy-efficiency commercial and public buildings.

Action 6: Develop a data base of electrical end-uses in the commercial sector. Conduct some end-use metering projects for several building types to estimate baseline electricity use.

10.4 RESIDENTIAL SECTOR

Several end-uses in the residential sector can provide significant efficiency gains. Lighting, refrigerators, cooking, water heating and *termo duchas* present savings opportunities. A program designed to target each of these end-uses is recommended. As with the commercial program, residential end-use monitoring is suggested as a means of confirming the estimated savings in this report.

10.4.1 Existing Residential Lighting

Sector Goal: Install energy-efficient lamps in homes.

Action 1: Utilities should implement an incentive/rebate program to facilitate the purchase of compact fluorescent and energy-efficient fluorescent lamps, at competitive prices.

Action 2: Develop a brochure that explains the benefits of energy-efficient lighting. The program should be targeted so that compact fluorescents are installed in locations where lights are on three or more hours a day.

Action 3: Conduct an end-use research project to determine the impact on demand and energy as a result of installing energy-efficient lighting in a random sample of homes. This will be very important because this end-use can provide the greatest energy and demand savings in the residential sector.

Notes:

If energy auditors are used to implement this program, the auditors should replace the incandescent with a compact fluorescent. They should then return the incandescent to the utility for disposal to ensure that the incandescent does not return to the utility system.

Also, when customers bring in burned-out compact fluorescents, the utility should sell them a new compact fluorescent at a very reasonable price to encourage the replacement of a compact fluorescent with another compact fluorescent. Similar actions would apply to energy-efficient fluorescent lamps.

If the utility is able to purchase energy-efficient lights directly from the manufacturers and sell them for this program, they could avoid paying import duties. As a result, customers would find the prices they pay in an incentive/rebate program to be much more attractive. In fact, this could make energy-efficient incandescent lighting cost-effective and could be included in the utility rebate program.

10.4.2 Energy-Efficient Refrigerators

Sector Goals:

1. Replace inefficient refrigerators with efficient refrigerators.
2. Provide education, technical assistance, and financial assistance to ensure the efficient use of existing refrigerators.

Various programs can be pursued by the utilities and regulatory agencies to improve the efficiency of refrigerators. These are:

Action 1: Energy-efficient refrigerator rebate program to encourage the purchase of efficient refrigerators.

Action 2: Appliance labeling program to help educate customers on purchasing more efficient refrigerators.

Action 3: Implementation of efficiency standards that require an increase in refrigerator efficiency.

Action 4: Rebate program for the replacement of door seals for refrigerators.

Action 5: Undertake discussions with local manufacturers to determine the resources and logistics required to improve the efficiency of their refrigerators. The result should be a plan for improving the energy efficiency of refrigerators to be sold locally.

10.4.3 Energy-Efficient Cooking

Sector Goals:

1. Replace inefficient stoves with efficient stoves.
2. Provide education, technical assistance, and financial assistance to ensure the efficient use of existing stoves.

The greatest improvement in efficiency for electric cooking can be achieved from the improvement of locally manufactured stoves in Guatemala.

Action 1: Test locally manufactured stoves to determine the difference in efficiency between these stoves and imported stoves.

Action 2: Hold discussions with local manufacturers to determine the resources and logistics required to improve the efficiency of stoves. The result should be a plan for increasing the efficiency of stoves to be sold locally.

Action 3: Implement a rebate program as an incentive for customers to purchase efficient stoves or for the manufacturer to help keep the cost down.

10.4.4 Energy-Efficient Water Heater Tanks

Sector Goals:

1. Replace inefficient water heater tanks with efficient ones.
2. Provide education, technical assistance, and financial assistance to ensure the efficient use of existing water heater tanks.

Although the percent of water heater tanks in Guatemala is low, these units operate on a continuous basis and typically have poor insulation.

Action 1: Implement a water heater rebate program to provide incentives for the installation of water heater blankets, high-efficiency water heaters and heat pumps, low-flow showerheads in homes with water heater tanks, and solar water heaters.

10.4.5 Smaller-Element *Termo Duchas*

Sector Goal: Reduce the energy consumption and demand from *termo duchas*.

Action 1: Implement efficiency standards to limit the size of the elements in *termo duchas*. This can eliminate the purchase of *termo duchas*, which are oversized for their application, and promote their replacement with more efficient models.

Action 2: Investigate the use of a power controller to control the power level to the *termo ducha*. This would provide better control of the power used by the *termo ducha* instead of increasing the water flow to achieve the proper temperature.

Action 3: Provide education, technical assistance, and financial assistance to ensure the efficient use of *termo duchas*.

10.4.6 Residential End-Use Monitoring

Sector Goal: Improve the knowledge of residential end-use patterns and behavior.

Action 1: Perform end-use monitoring studies of residential customers to validate the residential load shapes projected in this study. Of particular interest are the load shapes for residential lighting, refrigeration, and electric cooking, the largest contributors to the residential peak. This monitoring will provide a basis for verifying reductions obtained from DSM programs, but most important, these results can be used by the Utility System Planning Department (Departmento de Planeamiento) in making projections of future load growth and load forecasting.

10.4.7 New Energy-Efficient Buildings

Sector Goal: Develop energy-efficient housing designs, as for the commercial sector.

Action 1: Create an ongoing design workshop for housing designs that maximize both natural ventilation and daylighting potential. In addition, a design competition should be initiated among the professional and buildings communities to produce energy-efficient designs. Prizes should be awarded to the winners and their designs published.

Action 2: Prepare energy-efficiency information packets for developers.

Action 3: Review the institutional and financial requirements necessary to establish an energy building standard in Guatemala, including a training, technical assistance, and enforcement program. The current U.S. ASHRAE 90.1 standard may serve as a useful model. Determine the appropriateness of establishing an energy code.

Action 4: Create an ongoing design workshop for establishing a set of new housing building design and equipment guidelines for a variety of housing types. The workshop would include training for architects and builders in daylighting techniques, lighting system design, and control strategies.

Action 5: Sponsor a design competition for high energy-efficiency houses.

Action 6: Develop a data base of electrical end-uses in the residential sector. Conduct some end-use metering projects for several housing types to estimate baseline electricity use.

10.5 PUBLIC LIGHTING

Public lighting offers modest but easily achievable over-all savings for the Guatemalan economy.

10.5.1 Lighting Efficiency

Sector Goals:

1. Increase the efficiency of the public lighting sector.
2. Reduce demand at the time of system peak.

Action 1: Accelerate the replacement of public lighting fixtures in order to achieve the energy and demand savings (estimated at 13 GWh per year) and coincident peak demand reduction (2.5 MW) for this measure as early as possible.

The Office of Energy and Infrastructure

The Agency for International Development's Office of Energy and Infrastructure plays an increasingly important role in providing innovative approaches to solving the continuing energy crisis in developing countries. Three problems drive the Office's assistance programs: high rates of energy use and economic growth accompanied by a lack of energy, especially power in rural areas; severe financial problems, including a lack of investment capital, especially in the electricity sector; and growing energy-related environmental threats, including global climate change, acid rain and urban pollution.

To address these problems, the Office of Energy and Infrastructure leverages financial resources of multilateral development banks such as The World Bank and the InterAmerican Development Bank, the private sector and bilateral donors to increase energy efficiency and expand energy supplies, enhance the role of private power, and implement novel approaches through research, adaption and innovation. These approaches include improving power sector investment planning ("least-cost " planning) and encouraging the application of cleaner technologies that use both conventional fossil fuels and renewable energy sources. Promotion of greater private sector participation in the power sector and a wide-ranging training program also help to build the institutional infrastructure necessary to sustain cost-effective, reliable and environmentally sound energy systems integral to broad-based economic growth.

Much of the Office's strategic focus has anticipated and supports recently enacted congressional legislation directing the Office and A.I.D. to undertake a "Global Warming Initiative" to mitigate the increasing contribution of key developing countries to greenhouse gas emissions. This strategy includes expanding least-cost planning activities to incorporate additional countries and environmental concerns, increasing support for feasibility studies in renewable and cleaner fossil energy technologies that focus on site-specific commercial applications, launching a multilateral global energy efficiency initiative and improving the training of host country nationals and overseas A.I.D. staff in areas of energy that can help reduce expected global warming and other environmental problems.

The Office also helps developing countries speed their economic development through promoting technology cooperation between U.S. suppliers and developing country companies, institutions and governments. This effort involves Business Opportunity Identification to define and analyze the range of commercially viable trade and investment opportunities, technologies and services that have a positive impact on the environment and are appropriate for developing countries; Venture Promotion to encourage the involvement of the U.S. private sector; Innovative Finance; and Policy Development assistance to developing counties as they pursue policy and regulatory changes to provide market incentives for environmentally beneficial technologies.

To pursue these activities, the Office of Energy and Infrastructure implements the following six projects: (1) Biomass Energy Systems and Technology Project (BEST); (2) The Renewable Energy Applications and Training Project (REAT); (3) The Private Sector Energy Development Project (PSED); (4) The Energy Training Project (ETP); (5) The Energy Technology Innovation Project (ETIP); and (6) The Energy Efficiency Project (EEP).

The Office of Energy and Infrastructure helps set energy policy direction for the Agency, making its projects available to meet generic needs (such as training), and responding to short-term needs of A.I.D.'s field offices in assisted countries.

Further information regarding the Office of Energy and Infrastructure projects and activities is available in our Program Plan, which can be requested by contacting:

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Report of the

Office of Energy and Infrastructure
Bureau for Research and Development
United States Agency for International Development

GUATEMALA: POWER SECTOR EFFICIENCY ASSESSMENT

Demand-Side Management Final Report
Appendices

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Energy Conservation Services Program
DHR-5728-Z-00-7014-00

March 1993

APPENDIX A

GUATEMALA SECTORAL ENERGY BALANCE 1990

GUATEMALA SECTORAL ENERGY BALANCE 1990 (MWh)

	EEGSA	INDE	INDE LARGE CONSUMERS	INDE BLOCK SALES	INDE TOTAL	GRAND TOTAL
Industrial	497,530	11,687	132,667		144,354	641,884
Residential	473,567	126,405			126,405	599,972
Commercial	393,359	51,570	2,673		54,243	447,602
Municipalities	111,392	7,395		95,181	102,576	213,968
Government	32,786	9,922	11,841		21,763	54,549
Public Lighting	2,347	14,749			14,749	17,096
Agriculture			9,742		9,742	9,742
Other		4,555			4,555	4,555
Totals	1,510,981	226,283	156,923	95,181	478,387	1,989,368

IN PERCENT	EEGSA	INDE	INDE LARGE CONSUMERS	INDE BLOCK SALES	INDE TOTAL	GRAND PERC
Industrial	32.9	5.2	84.5	0.0	30.2	32.3
Residential	31.3	55.9	0.0	0.0	26.4	30.2
Commercial	26.0	22.8	1.7	0.0	11.3	22.5
Municipalities	7.4	3.3	0.0	100.0	21.4	10.8
Government	2.2	4.4	7.5	0.0	4.5	2.7
Public Lighting	0.2	6.5	0.0	0.0	3.1	0.9
Agriculture	0.0	0.0	6.2	0.0	2.0	0.5
Other	0.0	2.0	0.0	0.0	1.0	0.2
Totals	100	100	100	100	100	100

APPENDIX B

SELECTED LIST OF DOCUMENTS CONSULTED

LIST OF DOCUMENTS OBTAINED DURING THE NOVEMBER 11 TO 22, 1991 TRIP TO GUATEMALA

"Proyecto de Planificacion Energetica, 2 volumes," UNDP, Secretaria General del Consejo Nacional de Planificacion Economica, Ministerio de Energia y Minas, 2 volumes, (GUA/81/002), February 1987

"Proyecto de Planificacion Energetica, Informe Final," UNDP, Secretaria General del Consejo Nacional de Planificacion Economica, Ministerio de Energia y Minas, (GUA/81/002), February 1987

"El Uso de Energia en el Sector Residencial de Guatemala," (part of Proyecto de Planificacion Energetica), Jose Eddy Torres and Mario Rene Moscoso, September 18, 1986

"Historial de Consumos, Servicios del INDE con Demanda de Potencia," INDE, October 1991

"Listado de Consumidores con Demanda Registrada; Saldos al Mes de Noviembre," EEGSA, November 1991

"Usuarios Residenciales," (4 categories of residential consumers), EEGSA, Novmber 1991

"Distribucion de Lamparas por Tipo, Sistema EEGSA," (including number of lamps per tariff), EEGSA, November 1991

"Tarifa General de Alumbrado Publico," EEGSA, September 1991

"Primer Plan Nacional de Energia," Ministerio de Energia y Minas, 1990

"Resultados Estudio de Mercado Consumidores Industriales 1988," EEGSA, June 1989

"Informe Estadistico 1990," INDE, 1991.

"Informe Estadistico 1989," INDE, 1990.

"Datos del Sistema y Comportamiento de la Demanda," (load curves), EEGSA, 1991

"Proyecto de Control de Consumidores Industriales," EEGSA, 1986

"Encuesta sobre Usos Energeticos en el Sector Industria Manufacturera en la Republica de Guatemala," (part of Proyecto de Planificacion Energetica), Marco Antonio Davila, October 1986

"Sector Electrico de Guatemala," Cora Kamman for the Interamerican Development Bank, April 1991

"Plan Nacional de Electrificacion (Resumen Ejecutivo)," INDE, November 1990

Fax summarizing operating information for Escuintla steam plants, INDE, August 1990

Summary of INDE generating plants, letter from Gerente de Produccion to Ing. Lionel Pineda, October 17, 1991

"Informe Estadistico 1990, Documento de Trabajo (Cifras Preliminares), February 1991

Catalago de Plantas, Plantas Hidroelectricas, INDE

"Pliegos Tarifarios Unificados del Servicio Publico de Electricidad," INDE, July 1991

"Tipificacion de los Consumidores Residenciales," EEGSA, DP-DEP-01-91, July 1991 (actually a description of the EEGSA planning department)

"Investigacion del Consumo de Energia Electrica por Usuarios Residenciales Rurales," Universidad de San Carlos de Guatemala, Facultad de Ingenieria, Escuela de Ingenieria Mecanica Electrica, Julio de 1984.

"Encuesta de Consumo Energetico en el Sector Pequeña Industria y Artesania. Informe Final", Ministerio de Energia y Minas, May 1990.

"Informe Estadistico 1989", Ministerio de Energia y Minas.

APPENDIX C

DEMAND-SIDE MANAGEMENT IMPACT MODEL
Industrial Sector

Guatemala -- Total DSM Energy and Demand Savings in the Industrial Sector - 2010

	Guat. Mkt. Pen.	MWh Usage	% Savings /Inst.	Overall GWh Saved	Overall % Savings	Maximum MW	Peak Coinc. Factor	Peak Coinc. MW	% Savings /Inst.	Peak MW Saved	Peak % Savings
Industrial Sector (1)		2,358,750				436	0.76	332			
Motors & Drives		2,224,301						319			
Motors & DSM Program	49.9%		4.4%	27.81	1.18%				4.5%	3.42	1.0%
Lighting		44,816						6.9			
High-Efficiency Lighting	70.0%		29.5%	5.30	0.22%				29.5%	0.73	0.22%
Other		25,946						0			
High-Efficiency A/C	40.0%		40.0%	4.1	0.18%				40.0%	0.00	0.00%
Low Cost/No Cost	68.0%		13.0%	150.5	6.38%				9.6%	13.20	3.98%
Power Factor Correction				9.96	0.42%					1.75	5.27%
Innovative Rates*											
Time of Use	15.0%			6.60	0.28%					10.60	3.2%
Interruptible	22.0%			6.30	0.27%					21.00	6.3%
Total				210.57	8.9%					50.7	15.3%

(1) Cogeneration from Ingenios is not included in the industrial maximum MW.

* See Chapter 7 for a discussion of load management rates.

1	Reference	I-1	I-2	I-3	I-4	I-5
2	Sector	Industry	Industry	Industry	Industry	Industry
3	Subsector	All	All	All	All	All
4	End Use	Mot. (1-10hp)	Mot. (10-30hp)	Mot. (>30hp)	Mot. (>30hp)	Mot. (1-10hp)
5	Measure	Hi Eff Motors	Hi Eff Motors	Hi Eff Motors	Var. Speed Dr.	Cogged V-belts
6	Application	Replac. Burned	Replac. Burned	Replac. Burned	Fans, pumps, compr.	
7	Base Case	3 HP Motor E=80%	15 HP Motor E=86%	50 HP Motor E=90.4%	50 hp fan	Std motor 3 hp
8	Motor Loading Factor	0.75	0.75	0.75	0.75	0.75
9	Demand (W)	2098	9759	30946	30946	2098
10	Energy (kWH/Yr)	7637	35522	112643	112643	7637
11	Equip. Cost (US$)	350	750	2100	2100	430
12	Labor Cost (US$/h)	2.5	2.5	2.5	2.5	2.5
13	Instal. Time (h)	2	2	2	2	2
14	Total Cost	355	755	2105	2105	435
	Replacement	3 HP Motor E=87%	15 HP Motor E=91%	50 HP Motor E=94.1%	Var. Speed Dr.	Cogged V Belt
15	Demand (W)	1929	9223	29729	27851	2056
16	Energy (kWH/Yr)	7023	33570	108214	84482	7484
17	Equip. Cost (US$)	480	1190	3326	9000	11
18	Labor Cost (US$/h)	2.5	2.5	2.5	2.5	2.5
19	Instal. Time (h)	2	2	2	40	1
20	Total Cost	485	1195	3331	9100	13.5
	Incremental or Full Cost	I	I	I	I	F
21	Operating time (h/y)	3640	3640	3640	3640	3640
	Applicable Tariff					
22	Energy Cost (US$/kWh)	0.067	0.067	0.067	0.067	0.067
23	Demand Cost (US$/kW/y)	3.22	3.22	3.22	3.22	3.22
24	% Savings	8.0%	5.5%	3.9%	10.0%	2.0%
25	Energy Savings (kWh/y)	614	1952	4429	28161	153
26	Demand Savings (W)	169	536	1217	3095	42
27	Total Savings (US$/y)	42	133	302	1903	10
28	Cost of Measure (US$)	130	440	1226	6995	14
29	Simple Payback (y)	3.1	3.3	4.1	3.7	1.3
30	Cost Conserved Energy	$0.031	$0.033	$0.041	$0.036	$0.052
31	Discount Rate	0.12	0.12	0.12	0.12	0.12
32	Capital Recovery Fact.	0.147	0.147	0.147	0.147	0.592
	Life of Equipment (yrs)	15	15	15	15	2

1	Reference	I-6	I-7	I-8	I-9	I-10
2	Sector	Industry	Industry	Industry	Industry	Industry
3	Subsector	All	All	All	All	All
4	End Use	Mot. (10-30hp)	Mot. (>30hp)	Compr. Air	Refrigeration	Refrigeration
5	Measure	Synchr. Belts	Synchr. Belts	Adjustment	Unit maint.	Hi Eff Refr.
6	Application			Optimization	maint./adjust.	
7	Base Case	Std motor 15 hp	Std motor 50 hp	20 hp compr	15 hp system	15 hp system
8	Motor Loading Factor	0.75	0.75	0.65	0.9	0.9
9	Demand (W)	9759	30946	11277	11710	12282
10	Energy (kWH/Yr)	35522	112643	41047	57447	60249
11	Equip. Cost (US$)	961	2753	0	0	800
12	Labor Cost (US$/h)	2.5	2.5	2.5	2.5	2.5
13	Instal. Time (h)	2	2	1	1	4
14	Total Cost	966	2758	2.5	2.5	810
	Replacement	Synchr. Belts	Synchr. Belts	adj., fix leaks	cleaned, adj.	new system
15	Demand (W)	9271	29399	11277	11710	11067
16	Energy (kWH/Yr)	33746	107011	36943	51702	54290
17	Equip. Cost (US$)	325	500	5	5	1200
18	Labor Cost (US$/h)	2.5	2.5	2.5	2.5	2.5
19	Instal. Time (h)	1	1	2	3	4
20	Total Cost	327.5	502.5	10	12.5	1210
	Incremental or Full Cost	F	F	F	F	I
21	Operating time (h/y)	3640	3640	3640	6132	6132
	Applicable Tariff					
22	Energy Cost (US$/kWh)	0.067	0.067	0.067	0.067	0.067
23	Demand Cost (US$/kW/y)	3.22	3.22	3.22	3.22	3.22
24	% Savings	5.0%	5.0%	0.0%	0.0%	9.9%
25	Energy Savings (kWh/y)	1776	5632	4105	5745	5959
26	Demand Savings (W)	488	1547	0	0	1215
27	Total Savings (US$/y)	121	384	276	386	405
28	Cost of Measure (US$)	328	503	10	13	400
29	Simple Payback (y)	2.7	1.3	0.036	0.032	1.0
30	Cost Conserved Energy	$0.077	$0.037	$0.001	$0.002	$0.010
31	Discount Rate	0.12	0.12	0.12	0.12	0.12
32	Capital Recovery Fact.	0.416	0.416	0.592	0.768	0.147
	Life of Equipment (yrs)	3	3	2	2	15

1	Reference	I-11	I-12	I-13	I-14	I-15
2	Sector	Industry	Industry	Industry	Industry	Industry
3	Subsector	All	All	All	All	All
4	End Use	General	Lighting	Lighting	Lighting	Lighting
5	Measure	Energy Audit	Hi eff fl	T-8 System	Mirror Reflect	EE Mag Ballasts
6	Application	Low/No Cost	retrofit	new	mew	retrofit
7	Base Case	200 kW demand	fluor. 40 W	4 x F40	4 x F40	4 x F40
8	Motor Loading Factor					
9	Demand (W)	200000	40	175	175	175
10	Energy (kWH/Yr)	1248000	250	1092	1092	1092
11	Equip. Cost (US$)		1.48	25.92	25.92	25.92
12	Labor Cost (US$/h)	2.5	2.5	2.5	2.5	2.5
13	Instal. Time (h)	2	0.25	0.5	0.5	0.5
14	Total Cost	5	2.105	27.17	27.17	27.17
	Replacement	adj.	Red. Wattage F40	4 x T8 32W	2 x F40	4 x F40
15	Demand (W)	170000	34	114	88	161
16	Energy (kWH/Yr)	1060800	212	711	549	1005
17	Equip. Cost (US$)	0	2.5	52	50	37.92
18	Labor Cost (US$/h)	5	2.5	2.5	2.5	2.5
19	Instal. Time (h)	10	0.25	1	1.5	1
20	Total Cost	50	3.125	54.5	53.75	40.42
	Incremental or Full Cost	F	I	I	F	I
21	Operating time (h/y)	6240	6240	6240	6240	6240
	Applicable Tariff					
22	Energy Cost (US$/kWh)	0.067	0.067	0.067	0.067	0.067
23	Demand Cost (US$/kW/y)	3.22	3.22	3.22	3.22	3.22
24	% Savings	15.0%	15.0%	34.9%	49.7%	8.0%
25	Energy Savings (kWh/y)	187200	37	381	543	87
26	Demand Savings (W)	30000	6	61	87	14
27	Total Savings (US$/y)	12684	3	26	37	6
28	Cost of Measure (US$)	50	1	87	54	17
29	Simple Payback (y)	0.004	0.4	3.4	1.5	2.8
30	Cost Conserved Energy	$0.000	$0.011	$0.031	$0.013	$0.029
31	Discount Rate	0.12	0.12	0.12	0.12	0.12
32	Capital Recovery Fact.	0.818	0.395	0.134	0.134	0.151
	Life of Equipment (yrs)	1	3	20	20	14

1	Reference	I-16	I-16	I-17	I-18	I-19
2	Sector	Industry	Industry	Industry	Industry	Industry
3	Subsector	All	All	All	All	All
4	End Use	Lighting	Lighting	Lighting	Lighting	HVAC
5	Measure	El. Ballasts	MV to HPS	MV to MH	MV to LPS	HE A/C
6	Application	retrofit	retrofit	retrofit	retrofit	new
7	Base Case	4 x F40	250 W MV	250 W MV	250 W MV	7.5 TON 6 SEER
8	Motor Loading Factor					
9	Demand (W)	175	287.5	287.5	287.5	12000
10	Energy (kWH/Yr)	1092	1259	1259	1259	18696
11	Equip. Cost (US$)	25.92	71.05	71.05	71.05	2625
12	Labor Cost (US$/h)	2.5	2.5	2.5	2.5	2.5
13	Instal. Time (h)	0.5	1	1	1	2.5
14	Total Cost	27.17	73.55	73.55	73.55	2631.25
	Replacement	4 x F40	HPS 150W	MH 175W	100 W LPS	7.5 TON 10 SEER
15	Demand (W)	134	150	175	100	7200
16	Energy (kWH/Yr)	836	657	767	438	11218
17	Equip. Cost (US$)	85.92	149.71	175	212.25	5250
18	Labor Cost (US$/h)	2.5	2.5	2.5	2.5	2.5
19	Instal. Time (h)	1	1	1	4	2.5
20	Total Cost	88.42	152.21	177.5	222.25	5256.25
	Incremental or Full Cost	I	I	I	I	I
21	Operating time (h/y)	6240	4380	4380	4380	1558
	Applicable Tariff					
22	Energy Cost (US$/kWh)	0.067	0.067	0.067	0.067	0.067
23	Demand Cost (US$/kW/y)	3.22	3.22	3.22	3.22	3.22
24	% Savings	23.4%	47.8%	39.1%	65.2%	40.0%
25	Energy Savings (kWh/y)	256	602	493	821	7478
26	Demand Savings (W)	41	138	113	188	4800
27	Total Savings (US$/y)	17	41	33	56	518
28	Cost of Measure (US$)	70	101	161	176	2625
29	Simple Payback (y)	4.0	2.5	4.8	3.2	5.1
30	Cost Conserved Energy	$0.037	$0.022	$0.044	$0.029	$0.047
31	Discount Rate	0.12	0.12	0.12	0.12	0.12
32	Capital Recovery Fact.	0.134	0.134	0.134	0.134	0.134
	Life of Equipment (yrs)	20	20	20	20	20

TABLE 1

1990 INDUSTRIAL SECTOR ENERGY CONSUMPTION

	EEGSA	INDE	TOTAL
1)1990 Industrial Sector Energy Use:	608,922 MWH	246,930 MWH	855,852 MWH
2) % of Total:	71.1%	28.9%	

AUGUST 1991
INDUSTRIAL HOURLY LOAD IN KW

TIME OF DAY	EEGSA SYSTEM IND LOAD (kW)	EEGSA IND LOAD AS % OF DAILY USE*	EEGSA IND LOAD (%) OF PEAK	INDE SYSTEM IND LOAD (kW)	INDE IND LOAD AS % OF DAILY USE*	INDE IND LOAD (%) OF PEAK	SNI IND LOAD (kW)	SNI IND LOAD (%) OF PEAK
	(Input)			(Output)	(Input)			
0	49,214	3.0%	68.8%	19,957	3.0%	68.8%	69,172	68.8%
1	47,212	2.8%	66.0%	19,146	2.8%	66.0%	66,358	66.0%
2	48,380	2.9%	67.6%	19,619	2.9%	67.6%	67,999	67.6%
3	47,713	2.9%	66.7%	19,348	2.9%	66.7%	67,061	66.7%
4	48,046	2.9%	67.1%	19,484	2.9%	67.1%	67,530	67.1%
5	47,546	2.9%	66.4%	19,281	2.9%	66.4%	66,827	66.4%
6	54,553	3.3%	76.2%	22,122	3.3%	76.2%	76,675	76.2%
7	67,232	4.0%	93.9%	27,264	4.0%	93.9%	94,495	93.9%
8	80,578	4.8%	112.6%	32,676	4.8%	112.6%	113,254	112.6%
9	87,084	5.2%	121.7%	35,314	5.2%	121.7%	122,399	121.7%
10	85,082	5.1%	118.9%	34,503	5.1%	118.9%	119,585	118.9%
11	88,752	5.3%	124.0%	35,991	5.3%	124.0%	124,743	124.0%
12	86,917	5.2%	121.4%	35,247	5.2%	121.4%	122,164	121.4%
13	84,081	5.0%	117.5%	34,097	5.0%	117.5%	118,178	117.5%
14	88,586	5.3%	123.8%	35,923	5.3%	123.8%	124,509	123.8%
15	93,757	5.6%	131.0%	38,020	5.6%	131.0%	131,778	131.0%
16	83,080	5.0%	116.1%	33,691	5.0%	116.1%	116,771	116.1%
17	82,079	4.9%	114.7%	33,285	4.9%	114.7%	115,364	114.7%
18	77,241	4.6%	107.9%	31,323	4.6%	107.9%	108,564	107.9%
19	70,235	4.2%	98.1%	28,482	4.2%	98.1%	98,716	98.1%
20	71,569	4.3%	100.0%	29,023	4.3%	100.0%	100,592	100.0%
21	64,729	3.9%	90.4%	26,249	3.9%	90.4%	90,978	90.4%
22	59,391	3.6%	83.0%	24,084	3.6%	83.0%	83,475	83.0%
23	55,554	3.3%	77.6%	22,528	3.3%	77.6%	78,082	77.6%
Daily kWh:	1,668,279	100.0%	(Input)>	676,521 676,656	100.0%		2,345,269	

Daily Industrial Energy Consumption for Typical Day in August 1991: .... 2,345 MWH

Daily Industrial Energy Consumption for Typical Day in August 1991, as a % of 1991 Annual kWh. 0.26%

Annual Industrial Energy Consumption for 1990: 855,852 MWH

Annual Industrial Energy Consumption for 1991: (Assumes an annual growth rate of 6% in 1991) 907,203 MWH

(*) = Consumption as % of daily energy consumption.
(**) = INDE consumption was estimated at the same % as EEGSA.

TABLE 2

TYPICAL DAY

1990 INDUSTRIAL SECTOR ENERGY CONSUMPTION

Residential	EEGSA (MWH)	INDE (MWH)	TOTAL (MWH)
Annual Usage	608,922	246,930	855,852 (INPUTS)
Average Weekday Usage	1,933	784	2,717

NOTE: The above variables will change the spreadsheet below.

1990 TYPICAL DAY
INDUSTRIAL HOURLY LOAD IN KW

TIME	EEGSA LOAD (kW)	EEGSA LOAD AS % OF DAILY USE*	INDE LOAD (kW)	INDE LOAD AS % OF DAILY USE*	SNI LOAD (kW)	INDE LOAD AS % OF DAILY USE*	INDE LOAD AS % OF DAILY PEAK
0	60,680	3.1%	24,607	3.1%	85,286	3.1%	55.9%
1	60,765	3.1%	24,641	3.1%	85,406	3.1%	56.0%
2	59,628	3.1%	24,180	3.1%	83,808	3.1%	55.0%
3	59,116	3.1%	23,973	3.1%	83,088	3.1%	54.5%
4	58,263	3.0%	23,627	3.0%	81,890	3.0%	53.7%
5	59,400	3.1%	24,088	3.1%	83,488	3.1%	54.7%
6	68,495	3.5%	27,776	3.5%	96,271	3.5%	63.1%
7	82,421	4.3%	33,423	4.3%	115,844	4.3%	76.0%
8	98,139	5.1%	39,797	5.1%	137,936	5.1%	90.4%
9	98,622	5.1%	39,993	5.1%	138,615	5.1%	90.9%
10	102,459	5.3%	41,549	5.3%	144,009	5.3%	94.4%
11	108,512	5.6%	44,004	5.6%	152,516	5.6%	100.0%
12	92,255	4.8%	37,411	4.8%	129,666	4.8%	85.0%
13	99,985	5.2%	40,546	5.2%	140,531	5.2%	92.1%
14	102,316	5.3%	41,491	5.3%	143,808	5.3%	94.3%
15	102,146	5.3%	41,422	5.3%	143,568	5.3%	94.1%
16	95,011	4.9%	38,529	4.9%	133,540	4.9%	87.6%
17	89,726	4.6%	36,386	4.6%	126,112	4.6%	82.7%
18	77,410	4.0%	31,391	4.0%	108,801	4.0%	71.3%
19	76,736	4.0%	31,119	4.0%	107,856	4.0%	70.7%
20	75,174	3.9%	30,484	3.9%	105,656	3.9%	69.3%
21	70,967	3.7%	28,779	3.7%	99,746	3.7%	65.4%
22	66,817	3.5%	27,096	3.5%	93,913	3.5%	61.6%
23	67,244	3.5%	27,269	3.5%	94,513	3.5%	62.0%
Daily kWh:	1,932,289		783,581		2,715,870		

Daily Industrial Energy Consumption for Typical Day in 1990: .... 2,716 MWH

Daily Industrial Energy Consumption for Typical Day in 1990, as a % of 1990 Annual kWh 0.317%

Annual Industrial Energy Consumption for 1990 .... 855,852 MWH

(*) = Hourly consumption as % of daily energy consumption.

TABLE 3T

SNI INDUSTRIAL SECTOR END-USE MODEL

	(MWH)
Total SNI 1990 Consumption:	855,852 (Input)
Total 1990 SNI Consumption:	855,852 (Calculated)
Total 1990 SNI Consumption as % of SNI:	100.00%
Average Weekday 1990 SNI Consumption:	2,717
Number of SNI Customers in 1990:	5,314 (Input)

CONSUMPTION BY END-USE	(Inputs) % of Total Sector kWh	Annual Usage (MWh)
Motors & Drives Energy Consumption: (SNI)	94.30%	807,068
Lighting Energy Consumption: (SNI)	1.90%	16,261
Air Conditioning Energy Consumption: (SNI)	1.10%	9,414
Process Heating Energy Consumption: (SNI)	0.80%	6,847
Electrolytic Energy Consumption (SNI):	0.40%	3,423
Other End-Use Energy Consumption (SNI)	1.50%	12,838
Total SNI Annual Consumption:		855,852

	MOTORS & DRIVES	LIGHTING	A/C	PROCESS HEAT	ELECTR-OLYTIC	OTHER END-USES	
Annual MWh	807,068	16,261	9,414	6,847	3,423	12,838	
# Cust w/Appl	5,314	5,314	5,314	5,314	5,314	5,314	
# of Days	315	315	315	315	315	315	
Avg kWh/Cust/Day	482.15	9.71	5.62	4.09	2.05	7.67	
Avg kWh/Cust/Yr:	151,876	3,060	1,772	1,288	644	2,416	161,056
Coincident KWD/Cust:	19.066	0.420	0.000	0.000	0.080	0.298	19.863

TABLE 3T

SNI INDUSTRIAL SECTOR – CONTRIBUTION TO HOURLY LOAD BY END-USE

(NOTE: These are the load shape inputs to the MODEL.)

TIME	MOTORS & DRIVES % OF HOUR	LIGHTING % OF HOUR	A/C % OF HOUR	PROCESS HEAT % OF HOUR	ELECTRO-LYTIC % OF HOUR	OTHER END-USES % OF HOUR	SNI LOAD (%)	CALCULATED SNI HOURLY COINCIDENCE FACTOR (% pk)	(INPUTS) ACTUAL SNI LOAD (kW)	ACTUAL SNI HOURLY COINCIDENCE FACTOR (% pk)
0	96.27%	1.83%	0.00%	0.00%	0.40%	1.50%	100%	55.92%	85,286	80.72%
1	96.27%	1.83%	0.00%	0.00%	0.40%	1.50%	100%	56.00%	85,408	80.83%
2	96.18%	1.92%	0.00%	0.00%	0.40%	1.50%	100%	54.95%	83,808	79.32%
3	96.17%	1.93%	0.00%	0.00%	0.40%	1.50%	100%	54.46%	83,086	78.64%
4	96.06%	2.04%	0.00%	0.00%	0.40%	1.50%	100%	53.69%	81,890	77.50%
5	95.06%	1.87%	0.00%	1.17%	0.40%	1.50%	100%	54.74%	83,488	79.02%
6	95.15%	1.62%	0.00%	1.33%	0.40%	1.50%	100%	63.12%	96,271	91.12%
7	95.59%	1.36%	0.00%	1.16%	0.40%	1.50%	100%	75.96%	115,844	109.64%
8	94.17%	1.45%	1.46%	1.02%	0.40%	1.50%	100%	90.44%	137,936	130.55%
9	93.66%	1.57%	1.82%	1.06%	0.40%	1.50%	100%	90.89%	138,615	131.19%
10	93.23%	1.95%	1.66%	1.06%	0.40%	1.50%	100%	94.42%	144,009	136.30%
11	93.25%	1.64%	1.69%	1.12%	0.40%	1.50%	100%	100.00%	152,516	144.35%
12	92.29%	2.17%	2.33%	1.32%	0.40%	1.50%	100%	85.02%	129,666	122.72%
13	92.57%	2.00%	2.33%	1.20%	0.40%	1.50%	100%	92.14%	140,531	133.01%
14	92.76%	1.95%	2.22%	1.15%	0.40%	1.50%	100%	94.29%	143,808	136.11%
15	92.93%	1.96%	2.10%	1.10%	0.40%	1.50%	100%	94.13%	143,568	135.88%
16	92.72%	2.10%	2.14%	1.14%	0.40%	1.50%	100%	87.56%	133,540	126.39%
17	92.51%	2.21%	2.22%	1.16%	0.40%	1.50%	100%	82.69%	126,112	119.36%
18	92.52%	2.24%	2.23%	1.11%	0.40%	1.50%	100%	71.34%	108,801	102.97%
19	94.93%	2.15%	0.00%	1.02%	0.40%	1.50%	100%	70.72%	107,856	102.08%
20	95.99%	2.11%	0.00%	0.00%	0.40%	1.50%	100%	69.28%	105,658	100.00%
21	96.07%	2.03%	0.00%	0.00%	0.40%	1.50%	100%	65.40%	99,746	94.40%
22	96.09%	2.01%	0.00%	0.00%	0.40%	1.50%	100%	61.58%	93,913	88.88%
23	96.35%	1.75%	0.00%	0.00%	0.40%	1.50%	100%	61.97%	94,513	89.45%
	94.53%	1.91%	0.94%	0.71%	0.40%	1.50%	24		2,715,870	

TABLE 3T

SNI COMMERCIAL SECTOR - CONTRIBUTION TO HOURLY LOAD BY END-USE

(NOTE: These are the load shape inputs to the MODEL.)

TIME	INTERIOR LIGHTING % OF HOUR	EXTERIOR LIGHTING % OF HOUR	REFRIGERATION % OF HOUR	A/C % OF HOUR		OTHER END-USES % OF HOUR	SNI LOAD (%)	CALCULATED SNI HOURLY COINCIDENCE FACTOR (% pk)	(INPUTS) ACTUAL SNI LOAD (kW)	ACTUAL SNI HOURLY COINCIDENCE FACTOR (% pk)
0	0.00%	38.00%	33.00%	0.00%	0.00%	29.00%	100%	41.54%	45,345	61.36%
1	0.00%	38.00%	38.00%	0.00%	0.00%	24.00%	100%	30.77%	33,589	45.45%
2	1.00%	37.00%	40.00%	0.00%	0.00%	22.00%	100%	29.23%	31,909	43.18%
3	2.00%	35.00%	45.00%	0.00%	0.00%	18.00%	100%	29.23%	31,909	43.18%
4	5.00%	28.00%	51.00%	0.00%	0.00%	16.00%	100%	29.23%	31,909	43.18%
5	24.00%	15.00%	45.00%	0.00%	0.00%	16.00%	100%	29.23%	31,909	43.18%
6	30.00%	10.00%	45.00%	0.00%	0.00%	15.00%	100%	41.54%	45,345	61.36%
7	37.00%	5.00%	36.00%	0.00%	0.00%	22.00%	100%	53.85%	58,780	79.55%
8	38.00%	1.00%	27.00%	3.00%	0.00%	31.00%	100%	72.31%	78,933	106.82%
9	40.00%	0.00%	20.00%	8.00%	0.00%	32.00%	100%	90.77%	99,087	134.09%
10	40.00%	0.00%	20.00%	8.00%	0.00%	32.00%	100%	95.38%	104,125	140.91%
11	40.00%	0.00%	20.00%	9.00%	0.00%	31.00%	100%	96.92%	105,804	143.18%
12	32.00%	0.00%	24.00%	12.00%	0.00%	32.00%	100%	100.00%	109,163	147.73%
13	35.00%	0.00%	23.00%	14.00%	0.00%	28.00%	100%	89.23%	97,407	131.82%
14	40.00%	0.00%	22.00%	14.00%	0.00%	24.00%	100%	87.69%	95,728	129.55%
15	40.00%	0.00%	20.00%	12.00%	0.00%	28.00%	100%	90.77%	99,087	134.09%
16	40.00%	0.00%	19.00%	11.00%	0.00%	30.00%	100%	92.31%	100,766	136.36%
17	40.00%	0.00%	18.00%	10.00%	0.00%	32.00%	100%	87.69%	95,728	129.55%
18	35.00%	7.00%	17.00%	10.00%	0.00%	31.00%	100%	73.85%	80,613	109.09%
19	20.00%	24.00%	18.00%	5.00%	0.00%	33.00%	100%	64.62%	70,536	95.45%
20	15.00%	30.00%	24.00%	0.00%	0.00%	31.00%	100%	67.69%	73,895	100.00%
21	7.00%	40.00%	24.00%	0.00%	0.00%	29.00%	100%	58.46%	63,819	86.36%
22	1.00%	38.00%	28.00%	0.00%	0.00%	33.00%	100%	50.77%	55,421	75.00%
23	1.00%	39.00%	29.00%	0.00%	0.00%	31.00%	100%	35.38%	38,627	52.27%
	23.46%	16.04%	28.58%	4.83%	0.00%	27.08%	24		1,679,435	

TABLE 4T

SNI INDUSTRIAL SECTOR HOURLY LOAD SHAPES IN kW

TIME	MOTORS & DRIVES (kW)	LIGHTING (kW)	A/C (kW)	PROCESS HEAT (kW)	ELECTRO-LYTIC (kW)	OTHER END-USES (kW)	SNI LOAD (kW)	SNI LOAD (% PK)
Formula:	(% of daily sector consumption at hour * sector kWh at hour Y)							
0	82,101	1,565	0	0	341	1,279	85,286	55.92%
1	82,223	1,560	0	0	342	1,281	85,406	56.00%
2	80,611	1,605	0	0	335	1,257	83,808	54.95%
3	79,906	1,605	0	0	332	1,246	83,088	54.48%
4	78,662	1,672	0	0	328	1,228	81,890	53.69%
5	79,365	1,560	0	976	334	1,252	83,488	54.74%
6	91,600	1,560	0	1,281	385	1,444	96,271	63.12%
7	110,741	1,560	0	1,342	463	1,738	115,844	75.95%
8	129,895	2,006	2,013	1,403	552	2,069	137,936	90.44%
9	129,828	2,173	2,517	1,464	554	2,079	138,615	90.89%
10	134,252	2,811	2,684	1,525	576	2,160	144,009	94.42%
11	142,213	2,811	2,886	1,708	610	2,288	152,516	100.00%
12	119,663	2,811	3,020	1,708	519	1,946	129,666	85.02%
13	130,095	2,811	3,271	1,684	562	2,108	140,531	92.14%
14	133,430	2,811	3,168	1,647	575	2,157	143,808	94.29%
15	133,424	2,811	3,020	1,586	574	2,154	143,568	94.13%
16	123,815	2,811	2,852	1,525	534	2,003	133,540	87.56%
17	116,666	2,762	2,802	1,464	504	1,892	126,112	82.69%
18	100,662	2,439	2,425	1,208	435	1,632	108,801	71.34%
19	102,391	2,318	0	1,098	431	1,618	107,856	70.72%
20	101,420	2,231	0	0	423	1,565	105,658	69.28%
21	95,623	2,028	0	0	399	1,496	99,746	65.40%
22	90,245	1,684	0	0	378	1,409	93,913	61.58%
23	91,066	1,652	0	0	378	1,418	94,513	61.97%
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	2,560,093	51,677	30,677	21,621	10,863	40,736	2,715,670	
	94.26%	1.91%	1.13%	0.80%	0.40%	1.50%	100.00%	
Percent End Use Consumption(SNI)	94.3%	1.9%	1.1%	0.8%	0.4%	1.5%		

TABLE 5T

SNI INDUSTRIAL END-USE (%) CONTRIBUTION TO HOURLY DEMAND

TIME	MOTORS & DRIVES (%)	LIGHTING (%)	A/C (%)	PROCESS HEAT (%)	ELECTR-OLYTIC (%)	OTHER END-USES (%)	SNI LOAD (kW)	SNI % OF DAILY LOAD	SNI RES LOAD (% PK)
0	96.3%	1.8%	0.0%	0.0%	0.4%	1.5%	85,286	3.14%	55.92%
1	96.3%	1.8%	0.0%	0.0%	0.4%	1.5%	85,406	3.14%	56.00%
2	96.2%	1.9%	0.0%	0.0%	0.4%	1.5%	83,808	3.09%	54.95%
3	96.2%	1.9%	0.0%	0.0%	0.4%	1.5%	83,088	3.06%	54.48%
4	96.1%	2.0%	0.0%	0.0%	0.4%	1.5%	81,890	3.02%	53.69%
5	95.1%	1.9%	0.0%	1.2%	0.4%	1.5%	83,488	3.07%	54.74%
6	95.1%	1.6%	0.0%	1.3%	0.4%	1.5%	96,271	3.54%	63.12%
7	95.6%	1.3%	0.0%	1.2%	0.4%	1.5%	115,844	4.27%	75.96%
8	94.2%	1.5%	1.5%	1.0%	0.4%	1.5%	137,936	5.08%	90.44%
9	93.7%	1.6%	1.8%	1.1%	0.4%	1.5%	138,615	5.10%	90.89%
10	93.2%	2.0%	1.9%	1.1%	0.4%	1.5%	144,009	5.30%	94.42%
11	93.2%	1.8%	1.9%	1.1%	0.4%	1.5%	152,516	5.62%	100.00%
12	92.3%	2.2%	2.3%	1.3%	0.4%	1.5%	129,666	4.77%	85.02%
13	92.6%	2.0%	2.3%	1.2%	0.4%	1.5%	140,531	5.17%	92.14%
14	92.8%	2.0%	2.2%	1.1%	0.4%	1.5%	143,808	5.30%	94.29%
15	92.9%	2.0%	2.1%	1.1%	0.4%	1.5%	143,568	5.29%	94.13%
16	92.7%	2.1%	2.1%	1.1%	0.4%	1.5%	133,540	4.92%	87.56%
17	92.5%	2.2%	2.2%	1.2%	0.4%	1.5%	126,112	4.64%	82.69%
18	92.5%	2.2%	2.2%	1.1%	0.4%	1.5%	108,801	4.01%	71.34%
19	94.9%	2.1%	0.0%	1.0%	0.4%	1.5%	107,856	3.97%	70.72%
20	96.0%	2.1%	0.0%	0.0%	0.4%	1.5%	105,658	3.89%	69.28%
21	96.1%	2.0%	0.0%	0.0%	0.4%	1.5%	99,746	3.67%	65.40%
22	96.1%	2.0%	0.0%	0.0%	0.4%	1.5%	93,913	3.46%	61.58%
23	96.4%	1.7%	0.0%	0.0%	0.4%	1.5%	94,513	3.48%	61.97%
							2,715,870		

TABLE 5T

SNI COMMERCIAL END-USE (%) CONTRIBUTION TO HOURLY DEMAND

TIME	INTERIOR LIGHTING (%)	EXTERIOR LIGHTING (%)	REFRIGER-ATION (%)	A/C (%)	(%)	OTHER END-USES (%)	SNI LOAD (KW)	SNI % OF DAILY LOAD	SNI RES LOAD (% PK)
0	0.0%	38.0%	33.0%	0.0%	0.0%	29.0%	45,345	2.70%	41.54%
1	0.0%	38.0%	38.0%	0.0%	0.0%	24.0%	33,589	2.00%	30.77%
2	1.0%	37.0%	40.0%	0.0%	0.0%	22.0%	31,909	1.90%	29.23%
3	2.0%	35.0%	45.0%	0.0%	0.0%	18.0%	31,909	1.90%	29.23%
4	5.0%	28.0%	51.0%	0.0%	0.0%	16.0%	31,909	1.90%	29.23%
5	24.0%	15.0%	45.0%	0.0%	0.0%	16.0%	31,909	1.90%	29.23%
6	30.0%	10.0%	45.0%	0.0%	0.0%	15.0%	45,345	2.70%	41.54%
7	[illegible]	[illegible]	[illegible]	0.0%	0.0%	22.0%	58,780	3.50%	53.85%
8	[illegible]	[illegible]	[illegible]	3.0%	0.0%	31.0%	78,933	4.70%	72.31%
9	40.0%	0.0%	20.0%	8.0%	0.0%	32.0%	99,087	5.90%	90.77%
10	40.0%	0.0%	20.0%	8.0%	0.0%	32.0%	104,125	6.20%	95.38%
11	40.0%	0.0%	20.0%	9.0%	0.0%	31.0%	105,804	6.30%	96.92%
12	32.0%	0.0%	24.0%	12.0%	0.0%	32.0%	109,163	6.50%	100.00%
13	35.0%	0.0%	23.0%	14.0%	0.0%	28.0%	97,407	5.80%	89.23%
14	40.0%	0.0%	22.0%	14.0%	0.0%	24.0%	95,728	5.70%	87.69%
15	40.0%	0.0%	20.0%	12.0%	0.0%	28.0%	99,087	5.90%	90.77%
16	40.0%	0.0%	19.0%	11.0%	0.0%	30.0%	100,766	6.00%	92.31%
17	40.0%	0.0%	18.0%	10.0%	0.0%	32.0%	95,728	5.70%	87.69%
18	35.0%	7.0%	17.0%	10.0%	0.0%	31.0%	80,613	4.80%	73.85%
19	20.0%	24.0%	18.0%	5.0%	0.0%	33.0%	70,536	4.20%	64.62%
20	15.0%	30.0%	24.0%	0.0%	0.0%	31.0%	73,895	4.40%	67.69%
21	7.0%	40.0%	24.0%	0.0%	0.0%	29.0%	63,819	3.80%	58.46%
22	1.0%	38.0%	28.0%	0.0%	0.0%	33.0%	55,421	3.30%	50.77%
23	1.0%	39.0%	29.0%	0.0%	0.0%	31.0%	38,627	2.30%	35.38%
							1,679,435		

TABLE 6T

SNI INDUSTRIAL SECTOR CUSTOMER AVERAGE
DIVERSIFIED DEMAND PER CUSTOMER BY END-USE

TIME	MOTORS & DRIVES (kW)	LIGHTING (kW)	A/C (kW)	PROCESS HEAT (kW)	ELECTR-OLYTIC (kW)	OTHER END-USES (kW)	TOTAL DEMAND FOR CUST. W/ALL END-USES (kW)
0	15.45	0.29	0.00	0.00	0.06	0.24	16.0
1	15.47	0.29	0.00	0.00	0.06	0.24	16.0
2	15.17	0.30	0.00	0.00	0.06	0.24	15.7
3	15.04	0.30	0.00	0.00	0.06	0.23	15.6
4	14.80	0.31	0.00	0.00	0.06	0.23	15.4
5	14.94	0.29	0.00	0.16	0.06	0.24	15.7
6	17.24	0.29	0.00	0.24	0.07	0.27	18.1
7	20.84	0.29	0.00	0.25	0.09	0.33	21.8
8	24.44	0.38	0.38	0.26	0.10	0.39	25.9
9	24.43	0.41	0.47	0.28	0.10	0.39	26.0
10	25.26	0.53	0.51	0.29	0.11	0.41	27.1
11	26.76	0.53	0.54	0.32	0.11	0.43	28.7
12	22.52	0.53	0.57	0.32	0.10	0.37	24.4
13	24.48	0.53	0.62	0.32	0.11	0.40	26.4
14	25.11	0.53	0.60	0.31	0.11	0.41	27.0
15	25.11	0.53	0.57	0.30	0.11	0.41	27.0
16	23.30	0.53	0.54	0.29	0.10	0.38	25.1
17	21.95	0.52	0.53	0.26	0.09	0.36	23.7
18	19.13	0.46	0.46	0.23	0.08	0.31	20.6
19	19.27	0.44	0.00	0.21	0.08	0.30	20.3
20	19.09	0.42	0.00	0.00	0.08	0.30	19.8
21	18.03	0.38	0.00	0.00	0.08	0.28	18.7
22	16.98	0.35	0.00	0.00	0.07	0.27	17.6
23	17.14	0.31	0.00	0.00	0.07	0.27	17.7
	481.959	9.767	5.778	4.071	2.045	7.669	511.28

TABLE 7T(1)

1992 MOTORS & DRIVES
SNI INDUSTRIAL SECTOR
HOURLY DSM IMPACT BY END-USE

TIME	MD'S (kW) (SAME LOAD SHAPE AS 1990)	MD'S (kW)	MD'S (kW)	MD'S (kW)	MD'S (kW)	MD'S (kW)	MD'S (kW)	MD'S (kW)	TOTAL IMPACT FOR PROGRAM W DSM (kW)
Measure:	HE- 1-10HP	HE- 10-30HP	HE- >30HP	ASD >30HP	COGGED VB	SB 10-30HP	SB >30HP		
Energy Savings:	8.0%	5.5%	3.9%	30.0%	2.0%	5.0%	5.0%		5.0%
Demand Reductions:	8.0%	5.5%	3.9%	10.0%	2.0%	5.0%	5.0%		4.9%
Equip. Cost/ Part.	$130.00	$440.00	$1,226.00	$6,995.00	$14.00	$328.00	$503.00		$184.24
Likely Meas Part %	36.0%	7.3%	1.0%	0.5%	40.0%	13.7%	1.5%	0.0%	
0	14.214	14.600	14.847	10.815	15.141	14.678	14.678	15.450	14.673
1	14.235	14.622	14.870	10.831	15.164	14.699	14.699	15.473	14.695
2	13.956	14.335	14.578	10.619	14.866	14.411	14.411	15.170	14.407
3	13.834	14.210	14.450	10.526	14.736	14.285	14.285	15.037	14.280
4	13.619	13.989	14.226	10.362	14.507	14.063	14.063	14.803	14.058
5	13.740	14.114	14.353	10.455	14.637	14.189	14.189	14.935	14.184
6	15.859	16.290	16.565	12.066	16.893	16.376	16.376	17.238	16.371
7	19.173	19.694	20.027	14.588	20.423	19.798	19.798	20.840	19.791
8	22.488	23.099	23.490	17.111	23.955	23.221	23.221	24.444	23.214
9	22.477	23.086	23.479	17.102	23.943	23.210	23.210	24.431	23.202
10	23.243	23.874	24.279	17.685	24.759	24.001	24.001	25.264	23.993
11	24.621	25.290	25.719	18.734	26.227	25.424	25.424	26.762	25.416
12	20.717	21.280	21.641	15.763	22.068	21.393	21.393	22.519	21.386
13	22.523	23.135	23.527	17.137	23.992	23.258	23.258	24.482	23.250
14	23.101	23.728	24.130	17.577	24.607	23.854	23.854	25.109	23.846
15	23.099	23.727	24.129	17.576	24.606	23.853	23.853	25.108	23.845
16	21.436	22.019	22.391	15.310	22.834	22.135	22.135	23.300	22.128
17	20.199	20.747	21.099	15.368	21.516	20.857	20.857	21.955	20.850
18	17.602	18.081	18.387	13.393	18.750	18.176	18.176	19.133	18.171
19	17.727	18.208	18.517	13.488	18.883	18.305	18.305	19.268	18.299
20	17.559	18.036	18.341	13.360	18.704	18.131	18.131	19.086	18.125
21	16.590	17.041	17.329	12.623	17.672	17.131	17.131	18.032	17.125
22	15.624	16.049	16.321	11.888	16.643	16.134	16.134	16.983	16.129
23	15.766	16.195	16.469	11.996	16.794	16.280	16.280	17.137	16.275

TABLE 7T(2)

1992 LIGHTING
SNI INDUSTRIAL SECTOR
HOURLY DSM IMPACT BY END-USE

TIME	LIGHTING (kW)	LIGHTING (kW)	LIGHTING (kW)	LIGHTING (kW)	LIGHTING (kW)	LIGHTING (kW)	LIGHTING (kW)	LIGHTING (kW)	TOTAL IMPACT FOR PROGRAM W DSM (kW)
Technology:	T-8 SYSTEM	MIRROR REFL.	HE-F40	HE MAG BAL	EL BAL	MV-HPS	MV-MH	MV-LPS	
Energy Savings:	34.9%	49.7%	15.0%	8.0%	23.4%	40.0%	30.0%	65.2%	29.5%
Demand Reductions:	34.9%	49.7%	15.0%	8.0%	23.4%	40.0%	30.0%	65.2%	29.5%
Equip. Cost/ Part.	$27	$27	$1	$13	$61	$79	$104	$222	$26.96
Likely Meas Part %	15.5%	23.2%	38.7%	6.0%	2.6%	9.8%	2.8%	1.4%	
0	0.192	0.148	0.250	0.271	0.226	0.177	0.206	0.102	0.208
1	0.191	0.148	0.250	0.270	0.225	0.176	0.206	0.102	0.207
2	0.197	0.152	0.257	0.278	0.231	0.181	0.211	0.105	0.213
3	0.197	0.152	0.257	0.278	0.231	0.181	0.211	0.105	0.213
4	0.205	0.158	0.267	0.289	0.241	0.189	0.220	0.109	0.222
5	0.191	0.148	0.250	0.270	0.225	0.176	0.206	0.102	0.207
6	0.191	0.148	0.250	0.270	0.225	0.176	0.206	0.102	0.207
7	0.191	0.148	0.250	0.270	0.225	0.176	0.206	0.102	0.207
8	0.246	0.190	0.321	0.347	0.289	0.227	0.264	0.131	0.266
9	0.266	0.206	0.348	0.376	0.313	0.245	0.286	0.142	0.288
10	0.344	0.266	0.450	0.487	0.405	0.317	0.370	0.184	0.373
11	0.344	0.266	0.450	0.487	0.405	0.317	0.370	0.184	0.373
12	0.344	0.266	0.450	0.487	0.405	0.317	0.370	0.184	0.373
13	0.344	0.266	0.450	0.487	0.405	0.317	0.370	0.184	0.373
14	0.344	0.266	0.450	0.487	0.405	0.317	0.370	0.184	0.373
15	0.344	0.266	0.450	0.487	0.405	0.317	0.370	0.184	0.373
16	0.344	0.266	0.450	0.487	0.405	0.317	0.370	0.184	0.373
17	0.341	0.263	0.445	0.482	0.401	0.314	0.366	0.182	0.369
18	0.302	0.233	0.394	0.426	0.355	0.278	0.324	0.161	0.327
19	0.284	0.219	0.371	0.401	0.334	0.262	0.305	0.152	0.308
20	0.273	0.211	0.357	0.386	0.322	0.252	0.294	0.146	0.296
21	0.249	0.192	0.324	0.351	0.292	0.229	0.267	0.133	0.269
22	0.231	0.178	0.301	0.326	0.272	0.213	0.248	0.123	0.250
23	0.202	0.156	0.264	0.286	0.238	0.186	0.218	0.108	0.219

TABLE 7T(3)

1992 AIR CONDITIONING SNI INDUSTRIAL SECTOR HOURLY DSM IMPACT BY END-USE									
TIME	A/C (kW)	A/C (kW)	A/C (kW)	A/C (kW)	A/C (kW)	A/C (kW)	A/C (kW)	A/C (kW)	TOTAL IMPACT FOR PROGRAM W DSM (kW)
Technology:	6 - 10 SEER								
Energy Savings:	40.0%								40.0%
Demand Reductions:	40.0%								40.0%
Equip. Cost/ Part.	$2,625								$2,625.00
Likely Meas Part %	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.227	0.379	0.379	0.379	0.379	0.379	0.379	0.379	0.227
9	0.284	0.474	0.474	0.474	0.474	0.474	0.474	0.474	0.284
10	0.303	0.505	0.505	0.505	0.505	0.505	0.505	0.505	0.303
11	0.326	0.543	0.543	0.543	0.543	0.543	0.543	0.543	0.326
12	0.341	0.568	0.568	0.568	0.568	0.568	0.568	0.568	0.341
13	0.369	0.616	0.616	0.616	0.616	0.616	0.616	0.616	0.369
14	0.360	0.600	0.600	0.600	0.600	0.600	0.600	0.600	0.360
15	0.341	0.568	0.568	0.568	0.568	0.568	0.568	0.568	0.341
16	0.322	0.537	0.537	0.537	0.537	0.537	0.537	0.537	0.322
17	0.316	0.527	0.527	0.527	0.527	0.527	0.527	0.527	0.316
18	0.277	0.461	0.461	0.461	0.461	0.461	0.461	0.461	0.277
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE 7T(4)

1992 PROCESS HEATING
SNI INDUSTRIAL SECTOR
HOURLY DSM IMPACT BY END-USE

TIME	PROCESS HTG. (kW)	PROCESS HTG. (kW)	PROCESS HTG. (kW)	PROCESS HTG. (kW)	PROCESS HTG. (kW)	PROCESS HTG. (kW)	PROCESS HTG. (kW)	PROCESS HTG. (kW)	TOTAL IMPACT FOR PROGRAM W DSM (kW)
Technology:									
Energy Savings:	0.0%								0.0%
Demand Reductions:	0.0%								0.0%
Equip. Cost/ Part.	$0								$0.00
Likely Meas Part %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.184	0.184	0.184	0.184	0.184	0.184	0.184	0.184	0.000
6	0.241	0.241	0.241	0.241	0.241	0.241	0.241	0.241	0.000
7	0.253	0.253	0.253	0.253	0.253	0.253	0.253	0.253	0.000
8	0.264	0.264	0.264	0.264	0.264	0.264	0.264	0.264	0.000
9	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.000
10	0.287	0.287	0.287	0.287	0.287	0.287	0.287	0.287	0.000
11	0.321	0.321	0.321	0.321	0.321	0.321	0.321	0.321	0.000
12	0.321	0.321	0.321	0.321	0.321	0.321	0.321	0.321	0.000
13	0.317	0.317	0.317	0.317	0.317	0.317	0.317	0.317	0.000
14	0.310	0.310	0.310	0.310	0.310	0.310	0.310	0.310	0.000
15	0.298	0.298	0.298	0.298	0.298	0.298	0.298	0.298	0.000
16	0.287	0.287	0.287	0.287	0.287	0.287	0.287	0.287	0.000
17	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.276	0.000
18	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.000
19	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.207	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE 7T(5)

1992 ELECTROLYTIC PROCESSES
SNI INDUSTRIAL SECTOR
HOURLY DSM IMPACT BY END-USE

TIME	ELECTR-OLYTIC (kW)	ELECTR-OLYTIC (kW)	ELECTR-OLYTIC (kW)	ELECTR-OLYTIC (kW)	ELECTR-OLYTIC (kW)	ELECTR-OLYTIC (kW)	ELECTR-OLYTIC (kW)	ELECTR-OLYTIC (kW)	TOTAL IMPACT FOR PROGRAM W DSM (kW)
Technology:									
Energy Savings:	0.0%								0.0%
Demand Reductions:	0.0%								0.0%
Equip. Cost/ Part.	$0								$0.00
Likely Meas Part %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
0	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.000
1	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.064	0.000
2	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.000
3	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.000
4	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.000
5	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.000
6	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.072	0.000
7	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.000
8	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.000
9	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.104	0.000
10	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.108	0.000
11	0.115	0.115	0.115	0.115	0.115	0.115	0.115	0.115	0.000
12	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.098	0.000
13	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.000
14	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.000
15	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.106	0.000
16	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.101	0.000
17	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.095	0.000
18	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.000
19	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.000
20	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.080	0.000
21	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.075	0.000
22	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.000
23	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.000

TABLE 7T(6)

OTHER
SNI INDUSTRIAL SECTOR
HOURLY DSM IMPACT BY END-USE

TIME	OTHER (kW)	OTHER (kW)	OTHER (kW)	OTHER (kW)	OTHER (kW)	OTHER (kW)	OTHER (kW)	OTHER (kW)	TOTAL IMPACT FOR PROGRAM W DSM (kW)
Technology:	COMP ADJ	REF MAINT	HE REFR	LOW/NO COST					
Energy Savings:	10.0%	10.0%	9.9%	15.0%					13.0%
Demand Reductions:	0.0%	0.0%	9.9%	15.0%					9.6%
Equip. Cost/ Part.	$10	$10	$400	$45					$54.40
Likely Meas Part %	20.0%	14.0%	6.0%	60.0%	0.0%	0.0%	0.0%	0.0%	
0	0.217	0.217	0.217	0.205	0.241	0.241	0.241	0.241	0.209
1	0.217	0.217	0.217	0.205	0.241	0.241	0.241	0.241	0.210
2	0.213	0.213	0.213	0.201	0.237	0.237	0.237	0.237	0.206
3	0.211	0.211	0.211	0.199	0.235	0.235	0.235	0.235	0.204
4	0.208	0.208	0.208	0.196	0.231	0.231	0.231	0.231	0.201
5	0.212	0.212	0.212	0.200	0.236	0.236	0.236	0.236	0.205
6	0.245	0.245	0.245	0.231	0.272	0.272	0.272	0.272	0.236
7	0.294	0.294	0.295	0.278	0.327	0.327	0.327	0.327	0.285
8	0.350	0.350	0.351	0.331	0.389	0.389	0.389	0.389	0.339
9	0.352	0.352	0.353	0.333	0.391	0.391	0.391	0.391	0.340
10	0.366	0.366	0.366	0.346	0.406	0.406	0.406	0.406	0.354
11	0.387	0.387	0.388	0.366	0.431	0.431	0.431	0.431	0.375
12	0.329	0.329	0.330	0.311	0.366	0.366	0.366	0.366	0.318
13	0.357	0.357	0.357	0.337	0.397	0.397	0.397	0.397	0.345
14	0.365	0.365	0.366	0.345	0.406	0.406	0.406	0.406	0.353
15	0.365	0.365	0.365	0.344	0.405	0.405	0.405	0.405	0.353
16	0.339	0.339	0.340	0.320	0.377	0.377	0.377	0.377	0.328
17	0.320	0.320	0.321	0.303	0.356	0.356	0.356	0.356	0.310
18	0.279	0.279	0.279	0.264	0.310	0.310	0.310	0.310	0.270
19	0.274	0.274	0.274	0.259	0.304	0.304	0.304	0.304	0.265
20	0.268	0.268	0.269	0.254	0.298	0.298	0.298	0.298	0.259
21	0.253	0.253	0.254	0.239	0.282	0.282	0.282	0.282	0.245
22	0.239	0.239	0.239	0.225	0.265	0.265	0.265	0.265	0.231
23	0.240	0.240	0.240	0.227	0.267	0.267	0.267	0.267	0.232

TABLE 8T(TOTAL IMPACT)

SNI INDUSTRIAL SECTOR
HOURLY DSM IMPACT BY END-USE

TIME	MOTORS & DRIVES (kW)	LIGHTING (kW)	A/C (kW)	PROCESS HEAT (kW)	ELECTRO-LYTIC (kW)	OTHER END-USES (kW)	TOTAL DEMAND FOR CUST W/ALL END-USES (kW)
Technology:							
Energy Savings:	5.0%	29.5%	40.0%	0.0%	0.0%	13.0%	
Demand Reductions:	4.9%	29.5%	40.0%	0.0%	0.0%	9.6%	
0	14.673	0.208	0.000	0.000	0.000	0.209	15.09
1	14.695	0.207	0.000	0.000	0.000	0.210	15.11
2	14.407	0.213	0.000	0.000	0.000	0.206	14.82
3	14.280	0.213	0.000	0.000	0.000	0.204	14.69
4	14.058	0.222	0.000	0.000	0.000	0.201	14.48
5	14.184	0.207	0.000	0.000	0.000	0.205	14.59
6	16.371	0.207	0.000	0.000	0.000	0.236	16.81
7	19.791	0.207	0.000	0.000	0.000	0.285	20.28
8	23.214	0.266	0.227	0.000	0.000	0.339	24.04
9	23.202	0.268	0.284	0.000	0.000	0.340	24.11
10	23.993	0.373	0.303	0.000	0.000	0.354	25.02
11	25.416	0.373	0.326	0.000	0.000	0.375	26.48
12	21.386	0.373	0.341	0.000	0.000	0.318	22.41
13	23.250	0.373	0.369	0.000	0.000	0.346	24.33
14	23.846	0.373	0.360	0.000	0.000	0.353	24.93
15	23.845	0.373	0.341	0.000	0.000	0.353	24.91
16	22.128	0.373	0.322	0.000	0.000	0.328	23.15
17	20.850	0.369	0.316	0.000	0.000	0.310	21.84
18	18.171	0.327	0.277	0.000	0.000	0.270	19.04
19	18.299	0.308	0.000	0.000	0.000	0.265	18.87
20	18.125	0.296	0.000	0.000	0.000	0.259	18.68
21	17.125	0.269	0.000	0.000	0.000	0.245	17.63
22	16.129	0.250	0.000	0.000	0.000	0.231	16.60
23	16.275	0.219	0.000	0.000	0.000	0.232	16.72

FORMULAS		PROGRAM IMPACT PER YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
			Industrial Sector													
	0)	Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a)	Customers by year:	5,580	5,859	6,152	6,459	6,782	7,121	7,477	7,851	8,244	8,656	9,089	9,543	10,020	10,521
	1b)	% Cust. w/ End-Use:	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%
	1c)	Total Cust. w/ End-Use:	5,468	5,742	6,029	6,330	6,647	6,979	7,328	7,694	8,079	8,483	8,907	9,352	9,820	10,311
	2)	End-Use Tech Saturation %:	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%
1C*2	3)	Eligible Target Market	5,359	5,627	5,908	6,203	6,514	6,839	7,181	7,540	7,917	8,313	8,729	9,165	9,624	10,105
	4)	Interaction Adjustment Factor:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3*4	5)	MTP Participation:	5,359	5,627	5,908	6,203	6,514	6,839	7,181	7,540	7,917	8,313	8,729	9,165	9,624	10,105
	5a)	Program Energy Savings	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
5a*14c*4	6)	MTP Energy Reduction(MWH):	40,941	42,988	45,138	47,395	49,765	52,253	54,865	57,609	60,489	63,514	66,689	70,024	73,525	77,201
	6a)	Program Demand Savings	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%
5*6a*kW@Peak	7)	MTP Demand Reduction(MW):	5.0	5.3	5.6	5.8	6.1	6.4	6.8	7.1	7.5	7.8	8.2	8.6	9.1	9.5
	8a)	Replacement Factor (%):	5.0%	7.9%	10.8%	13.7%	16.6%	19.5%	22.4%	25.3%	28.2%	31.1%	33.9%	36.8%	39.7%	42.6%
	8b)	Economic Attractiveness (%):	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%
6*8a*8b	9)	Max Econ. Pot.Impact(MWH)	1,535	2,545	3,653	4,864	6,188	7,632	9,205	10,916	12,775	14,793	16,981	19,350	21,914	24,686
	10)	Max Econ. Pot.Impact(MW)	0.2	0.3	0.4	0.6	0.8	0.9	1.1	1.3	1.6	1.8	2.1	2.4	2.7	3.0
	11)	Market Penetration Rate:				2.55%	3.26%	4.15%	5.29%	6.70%	8.47%	10.65%	13.30%	16.49%	20.28%	24.67%
	12)	Cummulative Participants:				7	17	32	54	86	132	197	286	408	572	788
	13)	Annual Participants:				7	10	15	22	32	46	65	89	122	164	215
12*kWH/Part	14a)	DSM Impact(MWH):				51	128	244	414	659	1,009	1,502	2,185	3,119	4,370	6,017
12*kWD/Part	14b)	DSM Impact(MW):				0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.3	0.4	0.5	0.7
	14c)	Base Usage MWH				942,149	989,257	1,038,720	1,090,656	1,145,188	1,202,448	1,262,570	1,325,699	1,391,984	1,461,583	1,534,662
14c-6	14d)	Energy Usage w MTP Impact				894,754	939,492	986,467	1,035,790	1,087,580	1,141,959	1,199,057	1,259,009	1,321,960	1,388,058	1,457,461
14c-9	14e)	Energy Usage w Economic Potential Impact				937,285	983,068	1,031,087	1,081,450	1,134,272	1,189,672	1,247,777	1,308,718	1,372,633	1,439,669	1,509,976
14c-14a	14f)	Energy Usage w DSM Impact				942,098	989,128	1,038,476	1,090,242	1,144,530	1,201,439	1,261,068	1,323,513	1,388,865	1,457,213	1,528,645
		Economic Analysis														
	15)	LRMC Energy/Capacity $	$0.08													
14a-15	16)	Annual Energy Cost Savings:				$4,070	$10,277	$19,520	$33,080	$52,702	$80,710	$120,137	$174,827	$249,483	$349,615	$481,330
	17)	NPV Energy Savings (i=12%)	2,060,815													
	18)	Equipment Cost/ Participant:	$184.24													
13*18	19)	Total Equipment Cost:				$1,227	$1,871	$2,786	$4,087	$5,914	$8,442	$11,885	$16,485	$22,503	$30,183	$39,703
19*OA390	20)	Taxes and Duties on Equipment:	10%			$123	$187	$279	$409	$591	$844	$1,188	$1,649	$2,250	$3,018	$3,970
19-20	21)	Economic Equipment Cost:				$1,104	$1,684	$2,507	$3,679	$5,323	$7,598	$10,696	$14,837	$20,253	$27,164	$35,733
	22)	Administrative Expenses:	20%			$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
21+22	23)	Annual Program Costs				$21,104	$21,684	$22,507	$23,679	$25,323	$27,598	$30,696	$34,837	$40,253	$47,164	$55,733
	24)	NPV Program Costs (i=12%)	280,765													
17/24	25)	Benefit Cost Ratio	7.3													
	26)	Program Cash Flows				($17,034)	($11,407)	($2,987)	$9,402	$27,379	$53,112	$89,441	$139,990	$209,230	$302,450	$425,598
	27)	NPV Program Cash Flows (i=12%)	1,780,050													
	28)	IRR	74.28%													

FORMULAS	MOTOR & DRIVES PROGRAM IMPACT PER YEAR	2005	2006	2007	2008	2009	2010
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	11,047	11,600	12,180	12,789	13,428	14,100
	1b) % Cust. w/ End-Use:	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%
	1c) Total Cust. w/ End-Use:	10,826	11,368	11,936	12,533	13,160	13,818
	2) End-Use Tech Saturation %:	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%
1C*2	3) Eligible Target Market	10,610	11,140	11,697	12,282	12,896	13,541
	4) Interaction Adjustment Factor:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3*4	5) MTP Participation:	10,610	11,140	11,697	12,282	12,896	13,541
	5a) Program Energy Savings	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
5a*14c*4	6) MTP Energy Reduction(MWH):	81,061	85,114	89,370	93,838	98,530	103,457
	6a) Program Demand Savings	4.9%	4.9%	4.9%	4.9%	4.9%	4.9%
5*6a*kW@Peak	7) MTP Demand Reduction(MW):	10.0	10.5	11.0	11.6	12.1	12.7
	8a) Replacement Factor (%):	45.5%	48.4%	51.3%	54.2%	57.1%	60.0%
	8b) Economic Attractiveness (%):	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)	27,680	30,912	34,399	38,156	42,203	46,560
	10) Max Econ. Pot.Impact(MW)	3.4	3.8	4.2	4.7	5.2	5.7
	11) Market Penetration Rate:	29.66%	35.19%	41.14%	47.37%	53.68%	59.88%
	12) Cummulative Participants:	1,065	1,414	1,843	2,356	2,956	3,639
	13) Annual Participants:	277	349	429	513	600	684
12*kWH/Part	14a) DSM Impact(MWH):	8,137	10,804	14,080	18,002	22,582	27,805
12*kWD/Part	14b) DSM Impact(MW):	1.0	1.3	1.7	2.2	2.8	3.4
	14c) Base Usage MWH	1,611,395	1,691,965	1,776,563	1,865,391	1,958,661	2,056,594
14c-6	14d) Energy Usage w MTP Impact	1,530,334	1,606,850	1,687,193	1,771,553	1,860,130	1,953,137
14c-9	14e) Energy Usage w Economic Potential Impact	1,583,715	1,661,052	1,742,164	1,827,235	1,916,458	2,010,034
14c-14a	14f) Energy Usage w DSM Impact	1,603,258	1,681,160	1,762,483	1,847,389	1,936,078	2,028,789
	Economic Analysis						
	15) LRMC Energy/Capacity $						
14a-15	16) Annual Energy Cost Savings:	$650,934	$864,342	$1,126,383	$1,440,153	$1,806,583	$2,224,410
	17) NPV Energy Savings (i=12%)						
	18) Equipment Cost/ Participant:						
13*18	19) Total Equipment Cost:	$51,123	$64,327	$78,987	$94,579	$110,453	$125,945
19*OA390	20) Taxes and Duties on Equipment:	$5,112	$6,433	$7,899	$9,458	$11,045	$12,594
19-20	21) Economic Equipment Cost:	$46,011	$57,894	$71,088	$85,121	$99,407	$113,350
	22) Administrative Expenses:	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
21+22	23) Annual Program Costs	$66,011	$77,894	$91,088	$105,121	$119,407	$133,350
	24) NPV Program Costs (i=12%)						
17/24	25) Benefit Cost Ratio						
	26) Program Cash Flows	$584,923	$786,447	$1,035,295	$1,335,032	$1,687,176	$2,091,059
	27) NPV Program Cash Flows (i=12%)						
	28) IRR						

Inital Penetration Rate	2.00%	Sat	7.7%
Penetration Rate T2	60.00%	Sat	5.0%
Initial Year T1	1	Annua	0.0%
Final Year T2	18		
Constant A:	3.896965843		
Constant B:	-0.25278149		

LIGHTING PROGRAM IMPACT PER YEAR

Estimated Energy and Demand Savings for Lighting

Industrial Sector

FORMULAS	PROGRAM IMPACT PER YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	5,580	5,859	6,152	6,459	6,782	7,121	7,477	7,851	8,244	8,656	9,089	9,543	10,020	10,521
	1b) % Cust. w/ End-Use:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	1c) Total Cust. w/ End-Use:	5,580	5,859	6,152	6,459	6,782	7,121	7,477	7,851	8,244	8,656	9,089	9,543	10,020	10,521
	2) End-Use Tech Saturation %:	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%
1c*2	3) Eligible Target Market	5,524	5,800	6,090	6,395	6,714	7,050	7,403	7,773	8,161	8,569	8,998	9,448	9,920	10,416
	4) Interaction Adjustment Factor:	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
3*4	5) MTP Participation:	4,972	5,220	5,481	5,755	6,043	6,345	6,662	6,995	7,345	7,712	8,098	8,503	8,928	9,375
	5a) Program Energy Savings	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%
5a*14c*4	6) MTP Energy Reduction(MWH):	4,489	4,713	4,949	5,196	5,456	5,729	6,015	6,316	6,632	6,964	7,312	7,677	8,061	8,464
	6a) Program Demand Savings	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%
5*6a*kW@Peak	7) MTP Demand Reduction(MW):	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0	1.1	1.1	1.2
	8a) Replacement Factor (%):	43.0%	45.8%	48.6%	51.3%	54.1%	56.9%	59.7%	62.5%	65.2%	68.0%	70.8%	73.6%	76.3%	79.1%
	8b) Economic Attractiveness (%):	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)	1,351	1,510	1,682	1,867	2,067	2,282	2,513	2,761	3,028	3,315	3,623	3,954	4,308	4,688
	10) Max Econ. Pot.Impact(MW)	0.19	0.21	0.23	0.26	0.28	0.31	0.34	0.38	0.42	0.45	0.50	0.54	0.59	0.64
	11) Market Penetration Rate:				1.37%	1.87%	2.56%	3.50%	4.75%	6.43%	8.65%	11.54%	15.22%	19.83%	25.41%
	12) Cummulative Participants:				10	24	46	79	127	197	299	444	648	928	1,301
	13) Annual Participants:				10	15	22	33	48	70	102	145	204	280	373
12*kWH/Part	14a) DSM Impact(MWH):				9	22	42	71	114	178	270	401	585	838	1,175
12*kWD/Part	14b) DSM Impact(MW):				0.001	0.003	0.006	0.010	0.016	0.024	0.037	0.055	0.080	0.115	0.161
	14c) Base Usage MWH				19,568	20,546	21,574	22,652	23,785	24,974	26,223	27,534	28,911	30,356	31,874
14c-6	14d) Energy Usage w MTP Impact				14,372	15,090	15,845	16,637	17,469	18,342	19,259	20,222	21,233	22,295	23,410
14c-9	14e) Energy Usage w Economic Potential Impact				17,701	18,479	19,292	20,140	21,024	21,946	22,908	23,911	24,957	26,048	27,186
14c-14a	14f) Energy Usage w DSM Impact				19,559	20,524	21,532	22,581	23,671	24,796	25,953	27,133	28,326	29,519	30,700
	Economic Analysis														
	15) LRMC Energy/Capacity $	$0.08													
14a-15	16) Annual Energy Cost Savings:				$698	$1,753	$3,333	$5,683	$9,154	$14,236	$21,591	$32,090	$46,810	$67,001	$93,964
	17) NPV Energy Savings (i=12%)	398,447													
	18) Equipment Cost/ Participant:	$126.96													
13*18	19) Total Equipment Cost:				$1,226	$1,856	$2,777	$4,131	$6,101	$8,931	$12,929	$18,453	$25,875	$35,490	$47,392
19*OA390	20) Taxes and Duties on Equipment:	40%			$490	$742	$1,111	$1,652	$2,440	$3,573	$5,172	$7,381	$10,350	$14,196	$18,957
19-20	21) Economic Equipment Cost:				$736	$1,113	$1,666	$2,479	$3,661	$5,359	$7,757	$11,072	$15,525	$21,294	$28,435
	22) Administrative Expenses:	10%			$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$1,107	$1,552	$2,129	$2,843
21+22	23) Annual Program Costs				$10,736	$11,113	$11,666	$12,479	$13,661	$15,359	$17,757	$12,179	$17,077	$23,424	$31,278
	24) NPV Program Costs (i=12%)	157,898													
17/24	25) Benefit Cost Ratio	2.5													
	26) Program Cash Flows				($10,038)	($9,360)	($8,333)	($6,795)	($4,506)	($1,123)	$3,834	$19,910	$29,733	$43,578	$62,685
	27) NPV Program Cash Flows (i=12%)	240,548													
	28) IRR	37.28%													

FORMULAS	LIGHTING PROGRAM IMPACT PER YEAR	2005	2006	2007	2008	2009	2010
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	11,047	11,600	12,180	12,789	13,428	14,100
	1b) % Cust. w/ End-Use:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	1c) Total Cust. w/ End-Use:	11,047	11,600	12,180	12,789	13,428	14,100
	2) End-Use Tech Saturation %:	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%
1C*2	3) Eligible Target Market	10,937	11,484	12,058	12,661	13,294	13,959
	4) Interaction Adjustment Factor:	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
3*4	5) MTP Participation:	9,843	10,335	10,852	11,395	11,965	12,563
	5a) Program Energy Savings	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%
5a*14c*4	6) MTP Energy Reduction(MWH):	8,888	9,332	9,799	10,288	10,803	11,343
	6a) Program Demand Savings	29.5%	29.5%	29.5%	29.5%	29.5%	29.5%
5*6a*kW@Peak	7) MTP Demand Reduction(MW):	1.2	1.3	1.3	1.4	1.5	1.6
	8a) Replacement Factor (%):	81.9%	84.7%	87.5%	90.2%	93.0%	95.8%
	8b) Economic Attractiveness (%):	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)	5,096	5,532	5,999	6,499	7,034	7,607
	10) Max Econ. Pot.Impact(MW)	0.70	0.76	0.82	0.89	0.97	1.04
	11) Market Penetration Rate:	31.94%	39.26%	47.09%	55.08%	62.81%	69.93%
	12) Cummulative Participants:	1,784	2,387	3,110	3,946	4,874	5,873
	13) Annual Participants:	483	603	724	835	929	998
12*kWH/Part	14a) DSM Impact(MWH):	1,611	2,155	2,808	3,563	4,401	5,303
12*kWD/Part	14b) DSM Impact(MW):	0.221	0.296	0.385	0.489	0.604	0.728
	14c) Base Usage MWH	33,468	35,141	36,898	38,743	40,680	42,714
14c-6	14d) Energy Usage w MTP Impact	24,580	25,809	27,100	28,455	29,877	31,371
14c-9	14e) Energy Usage w Economic Potential Impact	28,372	29,609	30,899	32,244	33,646	35,108
14c-14a	14f) Energy Usage w DSM Impact	31,857	32,986	34,090	35,180	36,279	37,412
	Economic Analysis						
	15) LRMC Energy/Capacity $						
14a-15	16) Annual Energy Cost Savings:	$128,847	$172,390	$224,674	$285,020	$352,095	$424,216
	17) NPV Energy Savings (i=12%)						
	18) Equipment Cost/ Participant:						
13*18	19) Total Equipment Cost:	$61,315	$76,535	$91,901	$106,072	$117,899	$126,768
19*OA390	20) Taxes and Duties on Equipment:	$24,526	$30,614	$36,760	$42,429	$47,160	$50,707
19-20	21) Economic Equipment Cost:	$36,789	$45,921	$55,140	$63,643	$70,739	$76,061
	22) Administrative Expenses:	$3,679	$4,592	$5,514	$6,364	$7,074	$7,606
21+22	23) Annual Program Costs	$40,468	$50,513	$60,654	$70,007	$77,813	$83,667
	24) NPV Program Costs (i=12%)						
17/24	25) Benefit Cost Ratio						
	26) Program Cash Flows	$88,379	$121,876	$164,019	$215,013	$274,282	$340,550
	27) NPV Program Cash Flows (i=12%)						
	28) IRR						

Inital Penetration Rate	1.00%	Saturation in	7.7%
Penetration Rate T2	70.00%	Saturation in	5.0%
Initial Year T1	1	Annual Inc. in	-2.1%
Final Year T2	18		
Constant A:	4.598348393		
Constant B:	-0.32014222		

Estimated Energy and Demand Savings for Air Conditioning DSM Measures by Year.
Industrial Sector

FORMUL	AIR CONDITIONING PROGRAM IMPACT PER YEAR		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	0) Annual Cust Escalation Rate:		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:		5,580	5,859	6,152	6,459	6,782	7,121	7,477	7,851	8,244	8,656	9,089	9,543	10,020
	1b) % Cust. w/ End-Use:		21.9%	22.6%	23.3%	24.1%	24.9%	25.7%	26.5%	27.3%	28.2%	29.1%	30.1%	31.0%	32.0%
	1c) Total Cust. w/ End-Use:		1,221	1,324	1,435	1,555	1,686	1,827	1,980	2,146	2,327	2,522	2,733	2,963	3,211
	2) End-Use Tech Saturation %:		85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
1C*2	3) Eligible Target Market		1,038	1,125	1,219	1,322	1,433	1,553	1,683	1,824	1,978	2,144	2,323	2,518	2,730
	4) Interaction Adjustment Factor:		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3*4	5) MTP Participation:		1,038	1,125	1,219	1,322	1,433	1,553	1,683	1,824	1,978	2,144	2,323	2,518	2,730
	5a) Program Energy Savings		40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
5a*14c*4	6) MTP Energy Reduction(MWH):		3,359	3,640	3,946	4,277	4,636	5,025	5,447	5,904	6,399	6,936	7,518	8,149	8,833
	6a) Program Demand Savings		40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
5*6a*kW	7) MTP Demand Reduction(MW):		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	8a) Replacement Factor (%):		12.0%	14.5%	17.1%	19.6%	22.1%	24.6%	27.2%	29.7%	32.2%	34.7%	37.3%	39.8%	42.3%
	8b) Economic Attractiveness (%):		90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)		363	476	606	754	922	1,114	1,331	1,577	1,855	2,168	2,521	2,918	3,364
	10) Max Econ. Pot.Impact(MW)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	11) Market Penetration Rate:					5.84%	6.87%	8.06%	9.44%	11.03%	12.85%	14.92%	17.25%	19.87%	22.77%
	12) Cummulative Participants:					4	10	18	29	44	64	91	125	170	227
	13) Annual Participants:					4	6	8	11	15	20	26	34	45	58
12*kWH/	14a) DSM Impact(MWH):					14	33	60	95	144	208	293	405	549	736
12*kWD/	14b) DSM Impact(MW):					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	14c) Base Usage MWH					10,693	11,590	12,562	13,617	14,759	15,998	17,340	18,795	20,373	22,082
14c-6	14d) Energy Usage w MTP Impact					6,416	6,954	7,537	8,170	8,856	9,599	10,404	11,277	12,224	13,249
14c-9	14e) Energy Usage w Economic Potential Impact					9,939	10,668	11,449	12,285	13,182	14,143	15,172	16,274	17,455	18,718
14c-14a	14f) Energy Usage w DSM Impact					10,679	11,557	12,503	13,521	14,616	15,790	17,047	18,391	19,823	21,347
	Economic Analysis														
	15) LRMC Energy/Capacity $	$0.08													
14a-15	16) Annual Energy Cost Savings:					$1,098	$2,645	$4,762	$7,634	$11,496	$16,646	$23,453	$32,373	$43,952	$58,842
	17) NPV Energy Savings (i=12%)	328,512													
	18) Equipment Cost/ Participant:	$1,312.50													
13*18	19) Total Equipment Cost:					$5,570	$7,842	$10,734	$14,561	$19,582	$26,111	$34,515	$45,222	$58,709	$75,497
19*OA39	20) Taxes and Duties on Equipment:	40%				$2,228	$3,137	$4,293	$5,824	$7,833	$10,444	$13,806	$18,089	$23,484	$30,199
19-20	21) Economic Equipment Cost:					$3,342	$4,705	$6,440	$8,737	$11,749	$15,666	$20,709	$27,133	$35,226	$45,298
	22) Administrative Expenses:					$4,898	$4,898	$4,898	$4,898	$4,898	$0	$0	$0	$0	$0
21+22	23) Annual Program Costs					$8,239	$9,603	$11,338	$13,634	$16,647	$15,666	$20,709	$27,133	$35,226	$45,298
	24) NPV Program Costs (i=12%)	255,827													
17/24	25) Benefit Cost Ratio	1.3													
	26) Program Cash Flows					($7,141)	($6,958)	($6,576)	($6,000)	($5,151)	$980	$2,745	$5,240	$8,726	$13,544
	27) NPV Program Cash Flows (i=12%)	72,686													
	28) IRR	27.27%													

FORMUL	AIR CONDITIONING PROGRAM IMPACT PER YEAR	2004	2005	2006	2007	2008	2009	2010
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	10,521	11,047	11,600	12,180	12,789	13,428	14,100
	1b) % Cust. w/ End-Use:	33.1%	34.2%	35.3%	36.4%	37.6%	38.8%	40.0%
	1c) Total Cust. w/ End-Use:	3,481	3,773	4,090	4,433	4,805	5,208	5,645
	2) End-Use Tech Saturation %:	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
1C*2	3) Eligible Target Market	2,959	3,207	3,476	3,768	4,084	4,427	4,798
	4) Interaction Adjustment Factor:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3*4	5) MTP Participation:	2,959	3,207	3,476	3,768	4,084	4,427	4,798
	5a) Program Energy Savings	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
5a*14c*4	6) MTP Energy Reduction(MWH):	9,574	10,377	11,248	12,192	13,215	14,324	15,526
	6a) Program Demand Savings	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
5*6a*kW	7) MTP Demand Reduction(MW):	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	8a) Replacement Factor (%):	44.8%	47.4%	49.9%	52.4%	54.9%	57.5%	60.0%
	8b) Economic Attractiveness (%):	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)	3,864	4,424	5,051	5,752	6,535	7,409	8,383
	10) Max Econ. Pot.Impact(MW)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	11) Market Penetration Rate:	25.96%	29.42%	33.14%	37.08%	41.21%	45.46%	49.77%
	12) Cummulative Participants:	301	393	508	650	823	1,031	1,280
	13) Annual Participants:	73	92	115	142	173	209	249
12*kWH/	14a) DSM Impact(MWH):	973	1,271	1,643	2,103	2,662	3,337	4,142
12*kWD/	14b) DSM Impact(MW):	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	14c) Base Usage MWH	23,935	25,944	28,121	30,480	33,038	35,811	38,816
14c-6	14d) Energy Usage w MTP Impact	14,361	15,566	16,872	18,288	19,823	21,486	23,289
14c-9	14e) Energy Usage w Economic Potential I	20,072	21,520	23,070	24,729	26,504	28,402	30,432
14c-14a	14f) Energy Usage w DSM Impact	22,963	24,672	26,477	28,378	30,376	32,473	34,673
	Economic Analysis							
	15) LRMC Energy/Capacity $							
14a-15	16) Annual Energy Cost Savings:	$77,801	$101,692	$131,477	$168,204	$212,989	$266,990	$331,390
	17) NPV Energy Savings (i=12%)							
	18) Equipment Cost/ Participant:							
13*18	19) Total Equipment Cost:	$96,125	$121,130	$151,015	$186,214	$227,067	$273,798	$326,517
19*OA39	20) Taxes and Duties on Equipment:	$38,450	$48,452	$60,406	$74,485	$90,827	$109,519	$130,607
19-20	21) Economic Equipment Cost:	$57,675	$72,678	$90,609	$111,728	$136,240	$164,279	$195,910
	22) Administrative Expenses:	$0	$0	$0	$0	$0	$0	$0
21+22	23) Annual Program Costs	$57,675	$72,678	$90,609	$111,728	$136,240	$164,279	$195,910
	24) NPV Program Costs (i=12%)							
17/24	25) Benefit Cost Ratio							
	26) Program Cash Flows	$20,126	$29,014	$40,868	$56,476	$76,749	$102,711	$135,480
	27) NPV Program Cash Flows (i=12%)							
	28) IRR							

OTHER PROGRAM IMPACT PER YEAR

Estimated Energy and Demand Savings for Other DSM Measures by Year:

Industrial Sector

FORMULAS	OTHER PROGRAM IMPACT PER YEAR		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	0) Annual Cust Escalation Rate:		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:		5,580	5,859	6,152	6,459	6,782	7,121	7,477	7,851	8,244	8,656	9,089	9,543	10,020	10,521
	1b) % Cust. w/ End-Use:		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	1c) Total Cust. w/ End-Use:		5,580	5,859	6,152	6,459	6,782	7,121	7,477	7,851	8,244	8,656	9,089	9,543	10,020	10,521
	2) End-Use Tech Saturation %:		95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%
1c*2	3) Eligible Target Market		5,301	5,566	5,844	6,136	6,443	6,765	7,103	7,459	7,832	8,223	8,634	9,066	9,519	9,995
	4) Interaction Adjustment Factor:		90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
3*4	5) MTP Participation:		4,771	5,009	5,260	5,523	5,799	6,089	6,393	6,713	7,048	7,401	7,771	8,159	8,567	8,996
	5a) Program Energy Savings		13.0%	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%
5a*14c*4	6) MTP Energy Reduction(MWH):		99,838	104,830	110,072	115,575	121,354	127,422	133,793	140,482	147,507	154,882	162,626	170,757	179,295	188,260
	6a) Program Demand Savings		9.6%	9.6%	9.6%	9.6%	9.6%	9.6%	9.6%	9.6%	9.6%	9.6%	9.6%	9.6%	9.6%	9.6%
5*6a*kW@Peak	7) MTP Demand Reduction(MW):		9	10	10	11	11	12	12	13	13	14	15	16	16	17
	8a) Replacement Factor (%):		10.0%	13.7%	17.4%	21.0%	24.7%	28.4%	32.1%	35.8%	39.4%	43.1%	46.8%	50.5%	54.2%	57.8%
	8b) Economic Attractiveness (%):		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)		99,838	104,830	110,072	115,575	121,354	127,422	133,793	140,482	147,507	154,882	162,626	170,757	179,295	188,260
	10) Max Econ. Pot.Impact(MW)		9.10	9.56	10.03	10.53	11.06	11.61	12.20	12.81	13.45	14.12	14.82	15.56	16.34	17.16
	11) Market Penetration Rate:					7.44%	9.09%	11.05%	13.38%	16.10%	19.26%	22.87%	26.93%	31.42%	36.29%	41.45%
	12) Cummulative Participants:					41	85	145	229	341	490	684	934	1,249	1,638	2,111
	13) Annual Participants:					41	44	61	83	112	149	194	250	315	390	473
12*kWH/Part	14a) DSM Impact(MWH):					854	1,770	3,043	4,786	7,134	10,251	14,320	19,544	26,131	34,283	44,181
12*kWD/Part	14b) DSM Impact(MW):					0	0	0	0	1	1	1	2	2	3	4
	14c) Base Usage MWH					988,279	1,037,693	1,089,577	1,144,056	1,201,259	1,261,322	1,324,388	1,390,607	1,460,138	1,533,145	1,609,802
14c-6	14d) Energy Usage w MTP Impact					872,704	916,339	962,156	1,010,263	1,060,777	1,113,815	1,169,506	1,227,982	1,289,381	1,353,850	1,421,542
14c-9	14e) Energy Usage w Economic Potential Impact					872,704	916,339	962,156	1,010,263	1,060,777	1,113,815	1,169,506	1,227,982	1,289,381	1,353,850	1,421,542
14c-14a	14f) Energy Usage w DSM Impact					987,425	1,035,923	1,086,534	1,139,271	1,194,125	1,251,071	1,310,068	1,371,063	1,434,007	1,498,862	1,565,621
	Economic Analysis															
	15) LRMC Energy/Capacity $	$0.08														
14a-15	16) Annual Energy Cost Savings:					$68,334	$141,617	$243,463	$382,853	$570,739	$820,076	$1,145,633	$1,563,533	$2,090,470	$2,742,640	$3,534,494
	17) NPV Energy Savings (i=12%)	13,766,303														
	18) Equipment Cost/ Participant:	$54.40														
13*18	19) Total Equipment Cost:					$2,220	$4,602	$7,911	$12,440	$18,545	$26,647	$37,225	$50,804	$67,926	$89,116	$114,846
19*OA390	20) Taxes and Duties on Equipment:	25%				$555	$1,150	$1,978	$3,110	$4,636	$6,662	$9,306	$12,701	$16,981	$22,279	$28,712
19-20	21) Economic Equipment Cost:					$1,665	$3,451	$5,933	$9,330	$13,909	$19,985	$27,919	$38,103	$50,944	$66,837	$86,135
	22) Administrative Expenses:	10%				$167	$345	$593	$933	$1,391	$1,999	$2,792	$3,810	$5,094	$6,684	$8,613
21+22	23) Annual Program Costs					$1,832	$3,796	$6,526	$10,263	$15,300	$21,984	$30,711	$41,913	$56,039	$73,521	$94,748
	24) NPV Program Costs (i=12%)	369,029														
17/24	25) Benefit Cost Ratio	37.3														
	26) Program Cash Flows					$66,502	$137,821	$236,936	$372,590	$555,440	$798,093	$1,114,922	$1,521,620	$2,034,432	$2,669,118	$3,439,746
	27) NPV Program Cash Flows (i=12%)	13,397,275														
	28) IRR	-100.00%														

FORMULAS	OTHER PROGRAM IMPACT PER YEAR	2005	2006	2007	2008	2009	2010
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	11,047	11,600	12,180	12,789	13,428	14,100
	1b) % Cust. w/ End-Use:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	1c) Total Cust. w/ End-Use:	11,047	11,600	12,180	12,789	13,428	14,100
	2) End-Use Tech Saturation %:	95.0%	95.0%	95.0%	95.0%	95.0%	95.0%
1c*2	3) Eligible Target Market	10,495	11,020	11,571	12,149	12,757	13,395
	4) Interaction Adjustment Factor:	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
3*4	5) MTP Participation:	9,446	9,918	10,414	10,934	11,481	12,055
	5a) Program Energy Savings	13.0%	13.0%	13.0%	13.0%	13.0%	13.0%
5a*14c*4	6) MTP Energy Reduction(MWH):	197,673	207,557	217,934	228,831	240,273	252,286
	6a) Program Demand Savings	9.6%	9.6%	9.6%	9.6%	9.6%	9.6%
5*6a*kW@Peak	7) MTP Demand Reduction(MW):	18	19	20	21	22	23
	8a) Replacement Factor (%):	61.5%	65.2%	68.9%	72.6%	76.2%	79.9%
	8b) Economic Attractiveness (%):	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)	197,673	207,557	217,934	228,831	240,273	252,286
	10) Max Econ. Pot.Impact(MW)	18.02	18.92	19.87	20.86	21.90	23.00
	11) Market Penetration Rate:	46.81%	52.24%	57.62%	62.83%	67.75%	72.31%
	12) Cummulative Participants:	2,674	3,333	4,088	4,939	5,885	6,921
	13) Annual Participants:	563	658	755	852	946	1,036
12*kWH/Part	14a) DSM Impact(MWH):	55,969	69,743	85,544	103,364	123,155	144,843
12*kWD/Part	14b) DSM Impact(MW):	5	6	8	9	11	13
	14c) Base Usage MWH	1,690,292	1,774,807	1,863,547	1,956,724	2,054,561	2,157,289
14c-6	14d) Energy Usage w MTP Impact	1,492,619	1,567,250	1,645,613	1,727,893	1,814,288	1,905,002
14c-9	14e) Energy Usage w Economic Potential Impact	1,492,619	1,567,250	1,645,613	1,727,893	1,814,288	1,905,002
14c-14a	14f) Energy Usage w DSM Impact	1,634,323	1,705,064	1,778,003	1,853,360	1,931,406	2,012,446
	Economic Analysis						
	15) LRMC Energy/Capacity $						
14a-15	16) Annual Energy Cost Savings:	$4,477,541	$5,579,422	$6,843,508	$8,269,128	$9,852,391	$11,587,419
	17) NPV Energy Savings (i=12%)						
	18) Equipment Cost/ Participant:						
13*18	19) Total Equipment Cost:	$145,488	$181,292	$222,366	$268,688	$320,133	$376,509
19*OA390	20) Taxes and Duties on Equipment:	$36,372	$45,323	$55,591	$67,172	$80,033	$94,127
19-20	21) Economic Equipment Cost:	$109,116	$135,969	$166,774	$201,516	$240,100	$282,382
	22) Administrative Expenses:	$10,912	$13,597	$16,677	$20,152	$24,010	$28,238
21+22	23) Annual Program Costs	$120,028	$149,566	$183,452	$221,668	$264,110	$310,620
	24) NPV Program Costs (i=12%)						
17/24	25) Benefit Cost Ratio						
	26) Program Cash Flows	$4,357,513	$5,429,856	$6,660,056	$8,047,461	$9,588,281	$11,276,799
	27) NPV Program Cash Flows (i=12%)						
	28) IRR						

Inital Penetration Rat	5.00%
Penetration Rate T2	68.00%
Initial Year T1	1
Final Year T2	18
Constant A:	2.9558235
Constant B:	-0.217542

SUMMARY TABLE OF INDUSTRIAL ENERGY SAVINGS (MWH) PROGRAM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
MOTOR & DRIVES	50.9	128.5	244.0	413.5	658.8	1,008.9	1,501.7	2,185.3	3,118.5	4,370.2	6,016.6	8,136.7
LIGHTING	8.7	21.9	41.7	71.0	114.4	177.9	269.9	401.1	585.1	837.5	1,174.5	1,610.6
AIR CONDITIONING	13.7	33.1	59.5	95.4	143.7	208.1	293.2	404.7	549.4	735.5	972.5	1,271.1
PROCESS HEATING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ELECTROLYTIC PROCESSES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (Includes Low Cost/ No Cost Measures)	887.7	1,839.7	3,162.7	4,973.4	7,414.1	10,653.1	14,882.2	20,310.8	27,155.9	35,627.9	45,914.3	58,164.8
TOTAL ENERGY SAVINGS (GWH)	0.96	2.02	3.51	5.55	8.33	12.05	16.95	23.30	31.41	41.57	54.08	69.18
TOTAL ANNUAL ENERGY CONSUM PTION (GWH)	3,213	3,377	3,542	3,706	3,870	4,035	4,199	4,363	4,528	4,692	4,856	5,021
PERCENT SECTOR ENERGY CONS UMPTION OF TOTAL (%)	40.4%	40.4%	40.4%	40.4%	40.4%	40.4%	40.4%	40.4%	40.4%	40.4%	40.4%	40.4%
TOTAL ANNUAL SECTOR ENERGY CONSUMPTION (GWH)	1,298	1,364	1,431	1,497	1,564	1,630	1,696	1,763	1,829	1,896	1,962	2,028
PERCENT ENERGY SAVINGS	0.07%	0.15%	0.25%	0.37%	0.53%	0.74%	1.00%	1.32%	1.72%	2.19%	2.76%	3.41%

SUMMARY TABLE OF INDUSTRIAL DEMAND SAVINGS (MW) PROGRAM	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
MOTOR & DRIVES	0.01	0.02	0.03	0.05	0.08	0.12	0.18	0.27	0.38	0.54	0.74	1.00
LIGHTING	0.00	0.00	0.01	0.01	0.02	0.02	0.04	0.06	0.08	0.11	0.16	0.22
AIR CONDITIONING	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PROCESS HEATING	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ELECTROLYTIC PROCESSES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OTHER (Includes Low Cost/ No Cost Measures)	0.08	0.16	0.28	0.44	0.65	0.93	1.31	1.78	2.38	3.12	4.03	5.10
TOTAL DEMAND SAVINGS (MW)	0.09	0.18	0.31	0.50	0.75	1.08	1.53	2.11	2.85	3.78	4.93	6.32
ANNUAL MAXIMUM SYSTEM DEMA ND (MW)	643	676	709	742	775	808	841	874	907	940	973	1,005
PERCENT SECTOR DEMAND CONT RIBUTION TO PEAK (%)	28.4%	28.4%	28.4%	28.4%	28.4%	28.4%	28.4%	28.4%	28.4%	28.4%	28.4%	28.4%
SECTOR DEMAND CONTRIBUTION TO PEAK (GW)	183	192	201	211	220	229	239	248	258	267	276	286
PERCENT DEMAND REDUCTION (%)	0.05%	0.09%	0.16%	0.24%	0.34%	0.47%	0.64%	0.85%	1.11%	1.42%	1.78%	2.21%

These are DSM measures excluding Load Management measures.

SUMMARY TABLE OF INDUSTRIAL E PROGRAM	2006	2007	2008	2009	2010	Percent
MOTOR & DRIVES	10,804.3	14,079.8	18,001.9	22,582.3	27,805.1	14.8%
LIGHTING	2,154.9	2,808.4	3,562.8	4,401.2	5,302.7	2.8%
AIR CONDITIONING	1,643.5	2,102.5	2,662.4	3,337.4	4,142.4	2.2%
PROCESS HEATING	0.0	0.0	0.0	0.0	0.0	0.0%
ELECTROLYTIC PROCESSES	0.0	0.0	0.0	0.0	0.0	0.0%
OTHER (Includes Low Cost/ No Cost	72,478.7	88,899.6	107,418.9	127,986.0	150,524.7	80.2%
TOTAL ENERGY SAVINGS (GWH)	87.08	107.89	131.65	158.31	187.77	100.0%
TOTAL ANNUAL ENERGY CONSUM	5,185	5,350	5,514	5,678	5,843	
PERCENT SECTOR ENERGY CONS	40.4%	40.4%	40.4%	40.4%	40.4%	
TOTAL ANNUAL SECTOR ENERGY C	2,095	2,161	2,228	2,294	2,358	
PERCENT ENERGY SAVINGS	4.16%	4.99%	5.91%	6.90%	7.96%	

SUMMARY TABLE OF INDUSTRIAL D PROGRAM	2006	2007	2008	2009	2010
MOTOR & DRIVES	1.33	1.73	2.22	2.78	3.42
LIGHTING	0.30	0.39	0.49	0.60	0.73
AIR CONDITIONING	0.00	0.00	0.00	0.00	0.00
PROCESS HEATING	0.00	0.00	0.00	0.00	0.00
ELECTROLYTIC PROCESSES	0.00	0.00	0.00	0.00	0.00
OTHER (Includes Low Cost/ No Cost	6.36	7.80	9.42	11.23	13.20
TOTAL DEMAND SAVINGS (MW)	7.98	9.92	12.13	14.61	17.36
ANNUAL MAXIMUM SYSTEM DEMA	1,038	1,071	1,104	1,137	1,170
PERCENT SECTOR DEMAND CONT	28.4%	28.4%	28.4%	28.4%	28.4%
SECTOR DEMAND CONTRIBUTION	295	304	314	323	332
PERCENT DEMAND REDUCTION (%)	2.71%	3.26%	3.87%	4.52%	5.22%
These are DSM measures excluding					

Table 9T

Guatemala Industrial Sector
Motors and Drives

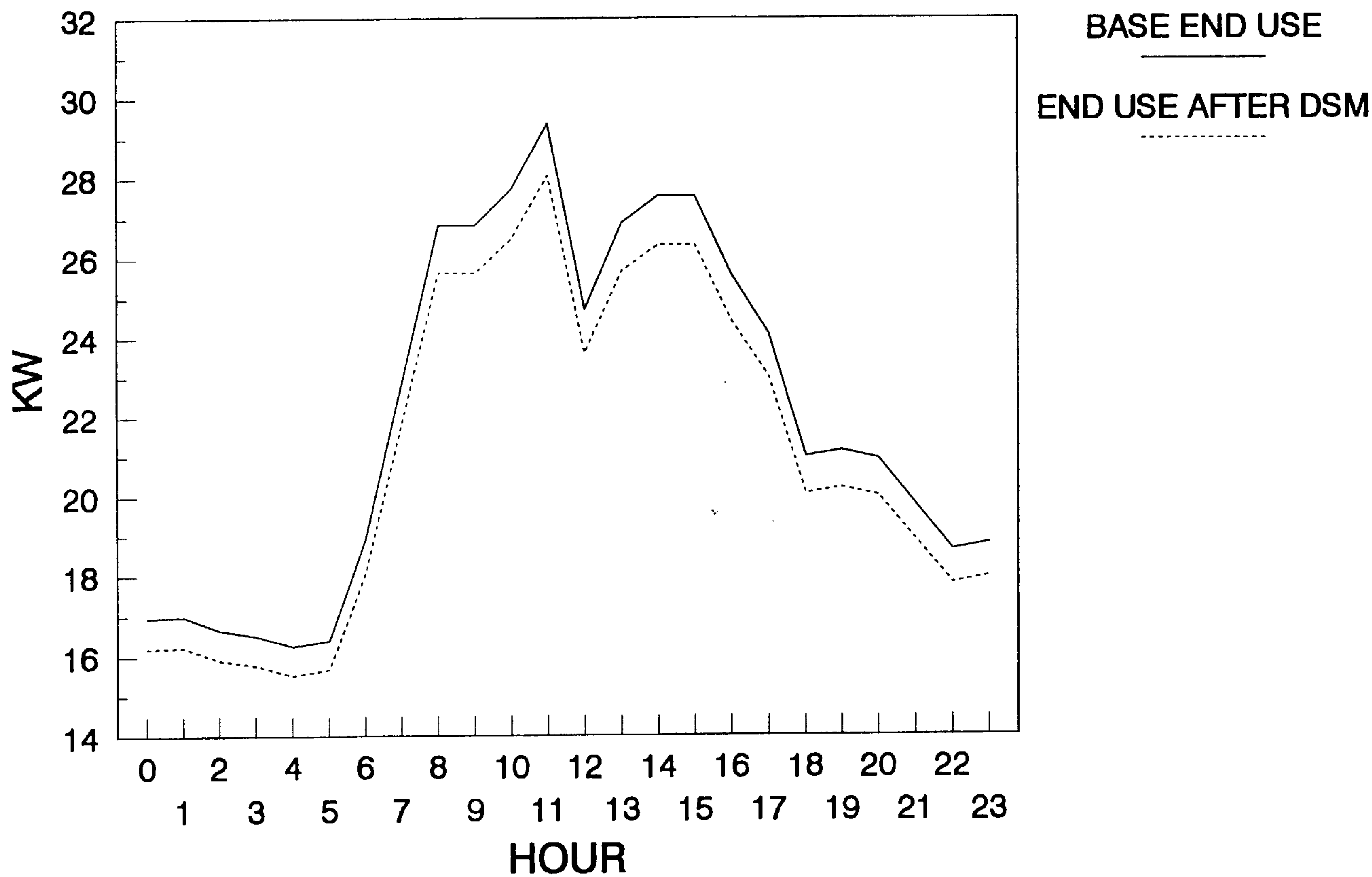


Table 10T

Guatemala Industrial Sector
Lighting

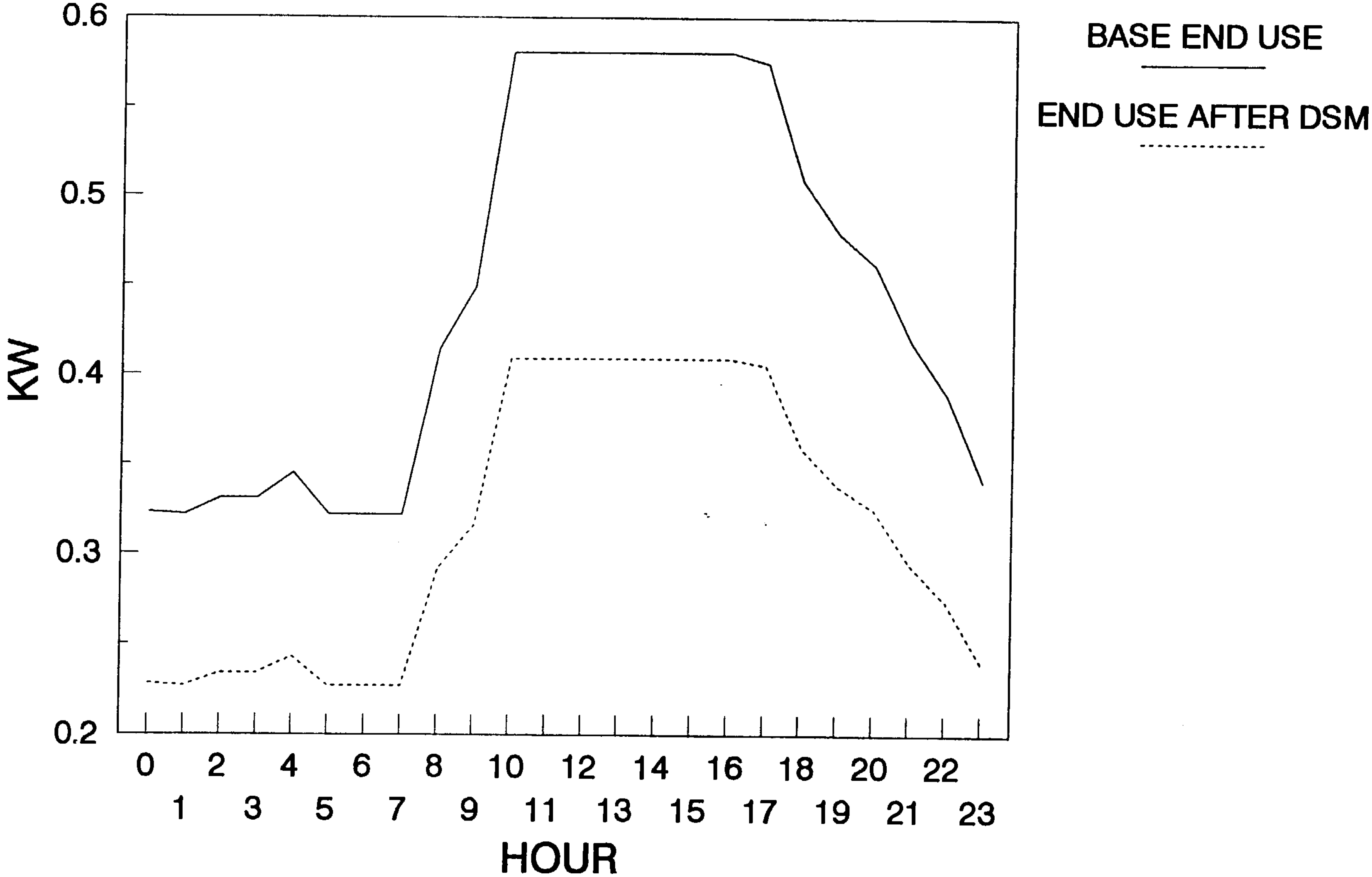


Table 11T

Guatemala Industrial Sector
Air Conditioning

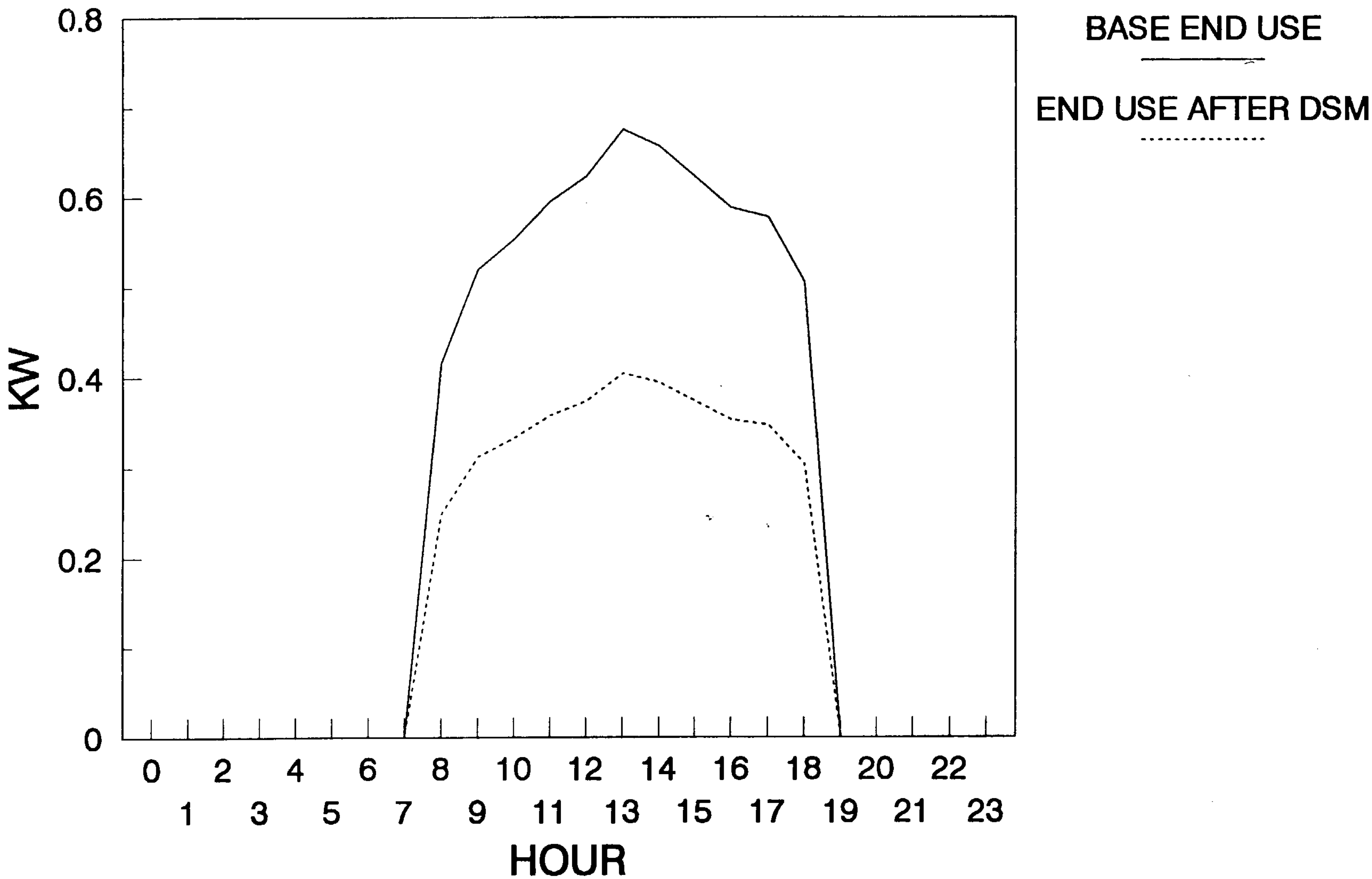
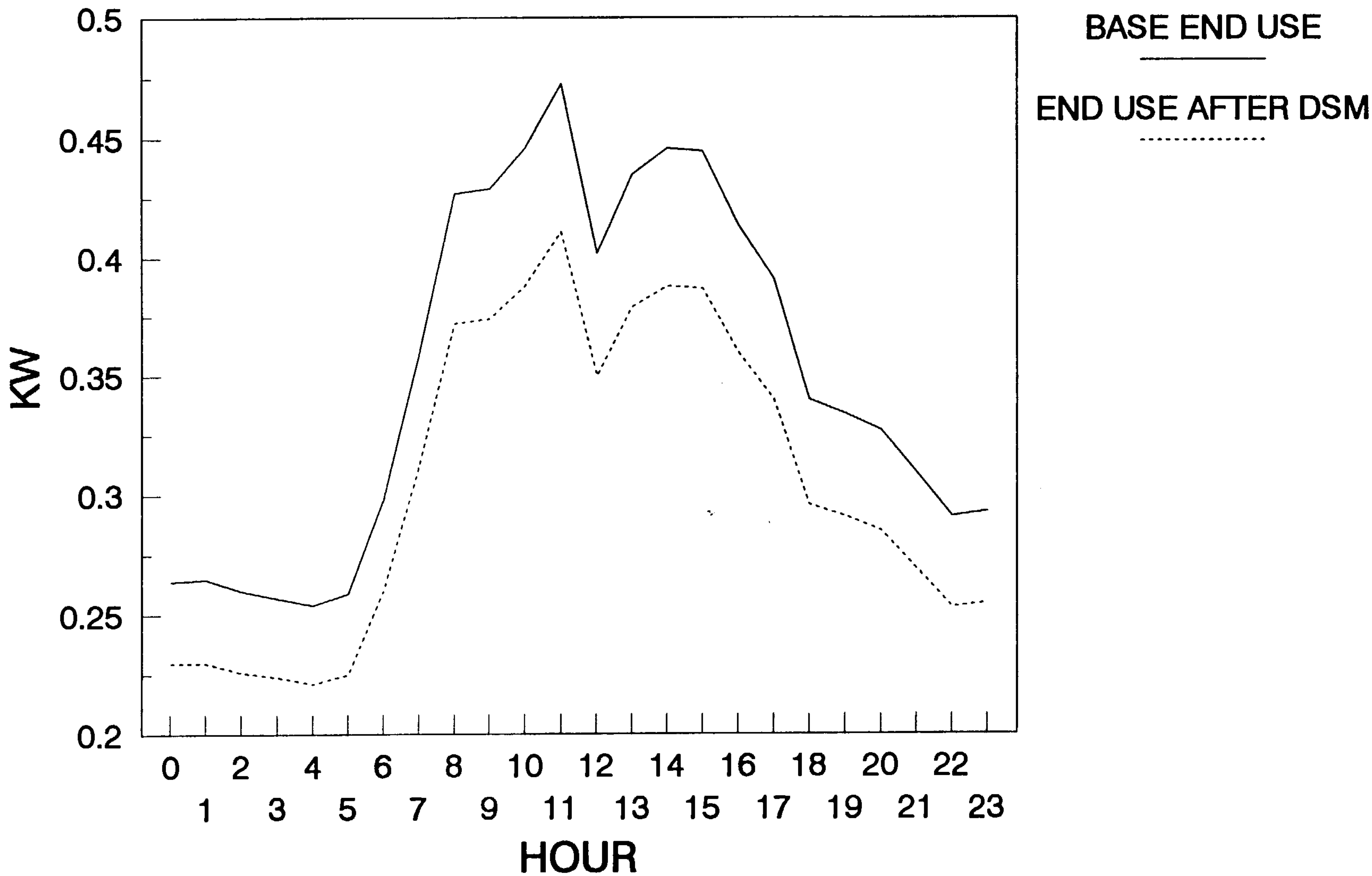


Table 12T
Guatemala Industrial Sector
Other End-Uses



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APPENDIX D

DEMAND-SIDE MANAGEMENT IMPACT MODEL
Commercial Sector

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Guatemala -- Total DSM Energy and Demand Savings in the Commercial Sector - 2010

	Guat. Mkt. Pen.	MWh Usage	% Savings /Inst.	Overall GWh Saved	Overall % Savings	Maximum MW	Peak Coinc. Factor	Peak Coinc. MW	% Savings /Inst.	Peak MW Saved	Peak % Savings
Commercial Sector		1,315,000				367	0.67	246			
Lighting		526,000									
Interior Lighting DSM Program	50.0%	394,500	31.5%	36.76	2.80%			27.5	30.6%	2.26	0.90%
Exterior Lighting DSM Program	50.0%	131,500	42.1%	18.17	1.38%			54.9	42.1%	6.91	2.80%
Other		394,500									
Air Conditioning DSM Program	15.0%	131,500	46.1%	1.63	0.12%			0.0	46.1%	0.00	0.00%
Refrigeration DSM Program	50.0%	263,000	10.0%	7.95	0.60%			43.9	10.0%	1.21	0.50
Low Cost/No Cost Measures	50.0%		13.1%	17.64	1.34%				12.9%	2.28	0.90%
Total				82.16	62.0%					12.67	5.20%

Commercial
Program:
Application:

1	Reference	C-1	C-2	C-3	C-4	C-5	C-6	C-7
2	Sector	Commercial	Commercial	Commercial	Commercial	Commercial	Commercial	Commercial
3	Subsector	All	All	All	All	All	All	All
4	End Use	Lighting	Lighting	Lighting	Lighting	Lighting	Lighting	Lighting
5	Measure	Compact Fluor.	MV to HPS	MV to MH	High Eff Fl	T-8 System.	Mirror Reflect	EE Mag Ballasts
6	Application	retrofit	new	new	retrofit	new	new	retrofit
7	Base Case	Incand 75W	MV 250W	MV 250W	fluor 40W	4 x F40	4 x F40	4 x F4
8	Demand (W)	75	287.5	287.5	40	175	175	175
9	Energy (kWH/Yr)	280.8	1259.25	1259.25	149.76	655.2	655.2	655.2
10	Equip. Cost (US$)	0.5	71.05	71.05	1.48	25.92	25.92	25.92
11	Labor Cost (US$/h)	2.5	2.5	2.5	2.5	2.5	2.5	2.5
12	Instal. Time (h)	0.17	1	1	0.25	0.5	0.5	0.5
13	Total Cost	0.925	73.55	73.55	2.105	27.17	27.17	27.17
	Replacement	CFL 18 W	HPS 150W	MH 175W	Red. Wattage F40	4 x T-8 32W/	2 x F40	4 x F40
14	Demand (W)	22	150	175	34	114	88	161
15	Energy (kWH)	82	657	767	127	427	329	603
16	Equip. Cost (US$)	22.5	149.71	175	2.5	52	50	34.92
17	Labor Cost (US$/h)	2.5	2.5	2.5	2.5	2.5	2.5	2.5
18	Instal. Time (h)	0.17	1	1	0.25	1	1.5	1
19	Total Cost	22.925	152.21	177.5	3.125	54.5	53.75	11.70
20	Operating time (h/y)	3744	4380	4380	3744	3744	3744	3744
	Applicable Tariff							
21	Energy Cost (US$/kWh)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
22	Demand Cost (US$/kW/y)	2.88	2.88	2.88	2.88	2.88	2.88	2.88
23	% savings	70.7%	47.8%	39.1%	15.0%	34.9%	49.7%	8.0%
24	Energy Savings (kWh/y)	198	602	493	22	228	326	52
25	Demand Savings (W)	53	138	113	6	61	87	14
26	Total Savings (US$/y)	16	48	39	2	18	26	4
27	Cost of Measure (US$)	15	96	161	1.02	84.26	54	12
28	Simple Payback (y)	1.0	2.0	4.1	0.6	4.6	2.1	2.8
29	Cost Conserved Energy	$0.036	$0.021	$0.044	$0.006	$0.049	$0.022	$0.034
30	Discount Rate	0.12	0.12	0.12	0.12	0.12	0.12	0.12
31	Capital Recovery Fact.	0.46	0.13	0.13	0.13	0.13	0.13	0.15
32	Life of Equipment (years)	2.7	20.0	20.0	20.0	20.0	20.0	14.0

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Commercial
Program:
Application:

1	Reference	C-8	C-9	C-10	C-11	C-12	C-13	C-14
2	Sector	Commercial	Commercial	Commercial	Commercial	Commercial	Commercial	Commercial
3	Subsector	All	All	All	All	All	All	All
4	End Use	Lighting	Lighting	Lighting	Air Conditioning	Air Conditioning	General	General
5	Measure	El. Ballasts	Timers	Occ. Sensors	Window Unit	DX Unit	EMS	Energy Audit
6	Application	retrofit	new	new	replacement	replacement	new	new
7	Base Case	4 x F40	200W installe	200W installe	18000 BTUH	60000 BTUH	10 kW Load	Under Eval
8	Demand (W)	175	200	200	2880	9600	10000	20000
9	Energy (kWH/Yr)	655.2	748.8	748.8	3591.36	11971.2	6554	13108
10	Equip. Cost (US$)	25.92	-	-	800	2900	(Watts)	
11	Labor Cost (US$/h)	2.5	-	-	2.5	2.5		
12	Instal. Time (h)	0.5	-	-	2	2		
13	Total Cost	27.17	-	-	805	2905		
	Replacement	4 x F40	Timer	Occ. Sensor	18000 BTUH	60000 BTUH	EMS System	E. Audit/ Low
14	Demand (W)	134	180	180	1600	4800	8500	17000
15	Energy (kWH)	502	674	524	1995	5986	5570.9	11141.8
16	Equip. Cost (US$)	65	34.95	56.31	1500	6500	5000	0
17	Labor Cost (US$/h)	2.5	2.5	2.5	2.5	2.5	2.5	5
18	Instal. Time (h)	1	1	1	2	0.5	24	10
19	Total Cost	30.80	37.45	58.81	1505	6501.25	5060	50
20	Operating time (h/y)	3744	3744	3744	1247	1247	8760	8760
	Applicable Tariff							
21	Energy Cost (US$/kWh)	0.07	0.07	0.07	0.07	0.07	0.07	0.07
22	Demand Cost (US$/kW/y)	2.88	2.88	2.88	2.88	2.88	2.88	2.88
23	% savings	23.4%	10.0%	10.0%	44.4%	50.0%	15.0%	15.0%
24	Energy Savings (kWh/y)	154	75	225	1596	5986	13140	1966
25	Demand Savings (W)	41	20	20	1280	4800	1500	3000
26	Total Savings (US$/y)	12	6	17	158	592	988	244
27	Cost of Measure (US$)	31	37	59	700	3596	5060	0
28	Simple Payback (y)	2.5	6.2	3.5	4.4	6.1	5.1	0.0
29	Cost Conserved Energy	$0.027	$0.089	$0.057	$0.078	$0.106	$0.068	$0.000
30	Discount Rate	0.12	0.12	0.12	0.12	0.12	0.12	0.12
31	Capital Recovery Fact.	0.13	0.18	0.22	0.18	0.18	0.18	1.12
32	Life of Equipment (years)	20.0	10.0	7.0	10.0	10.0	10.0	1.0

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Commercial
Program:
Application:

1	Reference	C-15	C-16	C-17
2	Sector	Commercial	Commercial	Commercial
3	Subsector	All	All	All
4	End Use	Refrigeration	Refrigeration	Mot (1-10 HP)
5	Measure	Unit Maint	High Eff Refr.	High Eff Motors
6	Application	maint/adjust		new
7	Base Case	5HP system	5HP system	3HP Motor E=80%
8	Demand (W)	3497	3497	2098
9	Energy (kWH/Yr)	24507	24507	7855
10	Equip. Cost (US$)	0	200	382
11	Labor Cost (US$/h)	2.5	2.5	2.5
12	Instal. Time (h)	0	1	1
13	Total Cost	0	202.5	384.5
	Replacement	Maintenance	High Eff Refr.	3HP Motor E=87%
14	Demand (W)	3147	3147	1929
15	Energy (kWH)	22054	22054	7855
16	Equip. Cost (US$)	0	800	480
17	Labor Cost (US$/h)	2.5	2.5	2.5
18	Instal. Time (h)	1.5	1	1
19	Total Cost	3.75	802.5	482.5
20	Operating time (h/y)	7008	7008	2471
	Applicable Tariff			
21	Energy Cost (US$/kWh)	0.07	0.07	0.07
22	Demand Cost (US$/kW/y)	2.88	2.88	2.88
23	% savings	10.0%	10.0%	8.1%
24	Energy Savings (kWh/y)	2453	2453	418
25	Demand Savings (W)	350	350	169
26	Total Savings (US$/y)	187	187	36
27	Cost of Measure (US$)	4	600	98
28	Simple Payback (y)	0.0	3.2	2.8
29	Cost Conserved Energy	$0.000	$0.058	$0.034
30	Discount Rate	0.12	0.12	0.12
31	Capital Recovery Fact.	0.24	0.24	0.15
32	Life of Equipment (years)	6.3	6.3	15.0

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TABLE 1

1990 COMMERCIAL SECTOR ENERGY CONSUMPTION

	EEGSA	INDE	TOTAL
1)1990 Commercial	-----	----	-----
Sector Energy Use:	426,145 MWH	76,006 MWH	502,151 MWH
2) % of Total:	84.9%	15.1%	

AUGUST 1991

COMMERCIAL HOURLY LOAD IN KW

TIME OF DAY	EEGSA SYSTEM COM LOAD (kW)	EEGSA COM LOAD AS % OF DAILY USE*	EEGSA COM LOAD (%) OF PEAK	INDE SYSTEM COM LOAD (kW)	INDE COM LOAD AS % OF DAILY USE*	INDE COM LOAD (%) OF PEAK	SNI COM LOAD (kW)	SNI COM LOAD (%) OF PEAK
----	----	------	-----	----	-----	-----	----	-----
	(Input)			(Output)	(Input)			
0	31,523	2.7%	61.4%	5,622	2.7%	71.1%	37,145	61.4%
1	23,350	2.0%	45.5%	4,165	2.0%	52.6%	27,515	45.5%
2	22,183	1.9%	43.2%	3,956	1.9%	50.0%	26,139	43.2%
3	22,183	1.9%	43.2%	3,956	1.9%	50.0%	26,139	43.2%
4	22,183	1.9%	43.2%	3,956	1.9%	50.0%	26,139	43.2%
5	22,183	1.9%	43.2%	3,956	1.9%	50.0%	26,139	43.2%
6	31,523	2.7%	61.4%	5,622	2.7%	71.1%	37,145	61.4%
7	40,863	3.5%	79.5%	7,288	3.5%	92.1%	48,151	79.5%
8	54,873	4.7%	106.8%	9,787	4.7%	123.7%	64,661	106.8%
9	68,884	5.9%	134.1%	12,286	5.9%	155.3%	81,170	134.1%
10	72,386	6.2%	140.9%	12,911	6.2%	163.2%	85,297	140.9%
11	73,554	6.3%	143.2%	13,119	6.3%	165.8%	86,673	143.2%
12	75,889	6.5%	147.7%	13,535	6.5%	171.1%	89,424	147.7%
13	67,716	5.8%	131.8%	12,078	5.8%	152.6%	79,794	131.8%
14	66,549	5.7%	129.5%	11,869	5.7%	150.0%	78,418	129.5%
15	68,884	5.9%	134.1%	12,286	5.9%	155.3%	81,170	134.1%
16	70,051	6.0%	136.4%	12,494	6.0%	157.9%	82,545	136.4%
17	66,549	5.7%	129.5%	11,869	5.7%	150.0%	78,418	129.5%
18	56,041	4.8%	109.1%	9,995	4.8%	126.3%	66,036	109.1%
19	49,036	4.2%	95.5%	8,746	4.2%	110.5%	57,782	95.5%
20	51,371	4.4%	100.0%	9,162	4.4%	115.8%	60,533	100.0%
21	44,366	3.8%	86.4%	7,913	3.8%	100.0%	52,279	86.4%
22	38,528	3.3%	75.0%	6,872	3.3%	86.8%	45,400	75.0%
23	26,853	2.3%	52.3%	4,789	2.3%	60.5%	31,642	52.3%
	---------	------		---------	------		--------	
Daily kWh:	1,167,521	100.0%	(Input)>	208,236 208,236	100.0%		1,375,756	

Daily Commercial Energy Consumption for Typical Day in August 1991: .... 1,376 MWH

Daily Commercial Energy Consumption for Typical Day in August 1991, as a % of 1991 Annual kWh. 0.26%

Annual Commercial Energy Consumption for 1990: 502,151 MWH

Annual Commercial Energy Consumption for 1991: (Assumes an annual growth rate of 6% in 1991) 532,260 MWH

(*) = Consumption as % of daily energy consumption.

(**) = INDE consumption was estimated at the same % as EEGSA.

TABLE 2

TYPICAL DAY
1990 COMMERCIAL SECTOR ENERGY CONSUMPTION

	EEGSA (MWH)	INDE (MWH)	TOTAL (MWH)
Annual Usage	426,145	76,006	502,151 (INPUTS)
Avg. Weekday Usage	1,425	254	1,679

NOTE: The above variables will change the spreadsheet below.

1990 TYPICAL DAY
COMMERCIAL HOURLY LOAD IN KW

TIME	EEGSA LOAD (kW)	EEGSA LOAD AS % OF DAILY USE*	INDE LOAD (kW)	INDE LOAD AS % OF DAILY USE*	SNI LOAD (kW)	SNI LOAD AS % OF DAILY USE*	SNI LOAD AS % OF DAILY PEAK
0	38,481	2.7%	6,863	2.7%	45,345	2.7%	41.5%
1	28,505	2.0%	5,084	2.0%	33,589	2.0%	30.8%
2	27,079	1.9%	4,830	1.9%	31,909	1.9%	29.2%
3	27,079	1.9%	4,830	1.9%	31,909	1.9%	29.2%
4	27,079	1.9%	4,830	1.9%	31,909	1.9%	29.2%
5	27,079	1.9%	4,830	1.9%	31,909	1.9%	29.2%
6	38,481	2.7%	6,863	2.7%	45,345	2.7%	41.5%
7	49,883	3.5%	8,897	3.5%	58,780	3.5%	53.8%
8	66,986	4.7%	11,947	4.7%	78,933	4.7%	72.3%
9	84,089	5.9%	14,998	5.9%	99,087	5.9%	90.8%
10	88,365	6.2%	15,760	6.2%	104,125	6.2%	95.4%
11	89,790	6.3%	18,015	6.3%	105,804	6.3%	96.9%
12	92,640	8.5%	16,523	6.5%	109,163	6.5%	100.0%
13	82,664	5.8%	14,744	5.8%	97,407	5.8%	89.2%
14	81,238	5.7%	14,489	5.7%	95,728	5.7%	87.7%
15	84,089	5.9%	14,998	5.9%	99,087	5.9%	90.8%
16	85,514	6.0%	15,252	8.0%	100,766	6.0%	92.3%
17	81,238	5.7%	14,489	5.7%	95,728	5.7%	87.7%
18	68,411	4.8%	12,202	4.8%	80,613	4.8%	73.8%
19	59,860	4.2%	10,676	4.2%	70,536	4.2%	64.6%
20	62,710	4.4%	11,165	4.4%	73,895	4.4%	67.7%
21	54,159	3.8%	9,660	3.8%	63,819	3.8%	58.5%
22	47,033	3.3%	8,389	3.3%	55,421	3.3%	50.8%
23	32,780	2.3%	5,847	2.3%	38,627	2.3%	35.4%
Daily kWh:	1,425,234		254,201		1,679,435		

Daily Commercial Energy Consumption for Typical Day in 1990: .... 1,679 MWH

Daily Commercial Energy Consumption for Typical Day in 1990, as a % of 1990 Annual kWh 0.334%

Annual Commercial Energy Consumption for 1990 .... 502,151 MWH

(*) = Hourly consumption as % of daily energy consumption.

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TABLE 3T

SNI COMMERCIAL SECTOR END-USE MODEL

	(MWH)	
Total SNI 1990 Consumption:	502,151	(Input)
Total 1990 SNI Consumption:	502,151	(Calculated)
Total 1990 SNI Consumption as % of SNI:	100.00%	
Average Weekday 1990 SNI Consumption:	1,679	
Number of SNI Customers in 1990:	99,501	(Input)

CONSUMPTION BY END-USE	(Inputs) % of Total Sector kWh	Annual Usage (MWh)
Interior Lighting: (SNI)	30.00%	150,645
Exterior Lighting: (SNI)	10.00%	50,215
Refrigeration: (SNI)	20.00%	100,430
Air Conditioning: (SNI)	10.00%	50,215
		0
Other End-Use Energy Consumption:(SNI)	30.00%	150,645
Total SNI Annual Consumption:		502,151

	INTERIOR LIGHTING	EXTERIOR LIGHTING	REFRIGER-ATION	A/C		OTHER END-USES
Annual MWh	150,645	50,215	100,430	50,215	0	150,645
# Cust w/Appl	99,501	99,501	59,701	14,925	99,501	99,501
# of Days	299	299	299	299	299	299
Avg kWh/Cust/Day	5.06	1.69	5.63	11.25	0.00	5.06
Avg kWh/Cust/Yr:	1,514	505	1,682	3,364	0	1,514
Coincident KWD/Cust:	0.096	0.192	0.256	0.000	0.000	0.198

TABLE 3T — SNI COMMERCIAL SECTOR - CONTRIBUTION TO HOURLY LOAD BY END-USE

(NOTE: These are the load shape inputs to the MODEL.)

TIME	INTERIOR LIGHTING % OF HOUR	EXTERIOR LIGHTING % OF HOUR	REFRIGERATION % OF HOUR	A/C % OF HOUR		OTHER END-USES % OF HOUR	SNI LOAD (%)	CALCULATED SNI HOURLY COINCIDENCE FACTOR (% pk)	(INPUTS) ACTUAL SNI LOAD (kW)	ACTUAL SNI HOURLY COINCIDENCE FACTOR (% pk)
---	-------	-------	-------	-------	-------	-------	---	---	---	---
0	0.00%	38.00%	33.00%	0.00%	0.00%	29.00%	100%	41.54%	45,345	61.36%
1	0.00%	38.00%	38.00%	0.00%	0.00%	24.00%	100%	30.77%	33,589	45.45%
2	1.00%	37.00%	40.00%	0.00%	0.00%	22.00%	100%	29.23%	31,909	43.18%
3	2.00%	35.00%	45.00%	0.00%	0.00%	18.00%	100%	29.23%	31,909	43.18%
4	5.00%	28.00%	51.00%	0.00%	0.00%	16.00%	100%	29.23%	31,909	43.18%
5	24.00%	15.00%	45.00%	0.00%	0.00%	16.00%	100%	29.23%	31,909	43.18%
6	30.00%	10.00%	45.00%	0.00%	0.00%	15.00%	100%	41.54%	45,345	61.36%
7	37.00%	5.00%	36.00%	0.00%	0.00%	22.00%	100%	53.85%	58,780	79.55%
8	38.00%	1.00%	27.00%	3.00%	0.00%	31.00%	100%	72.31%	78,933	106.82%
9	40.00%	0.00%	20.00%	8.00%	0.00%	32.00%	100%	90.77%	99,087	134.09%
10	40.00%	0.00%	20.00%	8.00%	0.00%	32.00%	100%	95.38%	104,125	140.91%
11	40.00%	0.00%	20.00%	9.00%	0.00%	31.00%	100%	96.92%	105,804	143.18%
12	32.00%	0.00%	24.00%	12.00%	0.00%	32.00%	100%	100.00%	109,163	147.73%
13	35.00%	0.00%	23.00%	14.00%	0.00%	28.00%	100%	89.23%	97,407	131.82%
14	40.00%	0.00%	22.00%	14.00%	0.00%	24.00%	100%	87.69%	95,728	129.55%
15	40.00%	0.00%	20.00%	12.00%	0.00%	28.00%	100%	90.77%	99,087	134.09%
16	40.00%	0.00%	19.00%	11.00%	0.00%	30.00%	100%	92.31%	100,766	136.36%
17	40.00%	0.00%	18.00%	10.00%	0.00%	32.00%	100%	87.69%	95,728	129.55%
18	35.00%	7.00%	17.00%	10.00%	0.00%	31.00%	100%	73.85%	80,613	109.09%
19	20.00%	24.00%	18.00%	5.00%	0.00%	33.00%	100%	64.62%	70,536	95.45%
20	15.00%	30.00%	24.00%	0.00%	0.00%	31.00%	100%	67.69%	73,895	100.00%
21	7.00%	40.00%	24.00%	0.00%	0.00%	29.00%	100%	58.46%	63,819	86.36%
22	1.00%	38.00%	28.00%	0.00%	0.00%	33.00%	100%	50.77%	55,421	75.00%
23	1.00%	39.00%	29.00%	0.00%	0.00%	31.00%	100%	35.38%	38,627	52.27%
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	23.46%	16.04%	28.58%	4.83%	0.00%	27.08%	24		1,679,435	

TABLE 4T

SNI COMMERCIAL SECTOR HOURLY LOAD SHAPES IN kW								
TIME	INTERIOR LIGHTING (kW)	EXTERIOR LIGHTING (kW)	REFRIGER-ATION (kW)	A/C (kW)		OTHER END-USES (kW)	SNI LOAD (kW)	SNI LOAD (% PK)
Formula:	(% of daily sector consumption at hour * sector kWh at hour Y)							
0	0	17,231	14,964	0	0	13,150	45,345	41.54%
1	0	12,764	12,764	0	0	8,061	33,589	30.77%
2	319	11,606	12,764	0	0	7,020	31,909	29.23%
3	636	11,166	14,359	0	0	5,744	31,909	29.23%
4	1,595	8,935	16,274	0	0	5,105	31,909	29.23%
5	7,656	4,766	14,359	0	0	5,105	31,909	29.23%
6	13,603	4,534	20,405	0	0	6,602	45,345	41.54%
7	21,749	2,939	21,161	0	0	12,932	58,760	53.85%
8	29,995	789	21,312	2,368	0	24,469	78,933	72.31%
9	39,635	0	19,617	7,927	0	31,706	99,087	90.77%
10	41,650	0	20,625	8,330	0	33,320	104,125	95.38%
11	42,322	0	21,161	9,522	0	32,799	105,804	96.92%
12	34,932	0	26,199	13,100	0	34,932	109,163	100.00%
13	34,093	0	22,404	13,637	0	27,274	97,407	89.23%
14	38,291	0	21,060	13,402	0	22,975	95,728	87.69%
15	39,635	0	19,617	11,890	0	27,744	99,067	90.77%
16	40,306	0	19,146	11,084	0	30,230	100,766	92.31%
17	38,291	0	17,231	9,573	0	30,633	95,728	87.69%
18	28,215	5,643	13,704	8,061	0	24,990	80,613	73.85%
19	14,107	16,929	12,697	3,527	0	23,277	70,536	64.62%
20	11,084	22,169	17,735	0	0	22,907	73,895	67.69%
21	4,467	25,527	15,316	0	0	18,507	63,819	58.46%
22	554	21,060	15,518	0	0	18,289	55,421	50.77%
23	366	15,065	11,202	0	0	11,974	38,627	35.38%
	483,526	181,345	422,193	112,421	0	479,949	1,679,435	
	28.79%	10.80%	25.14%	6.69%	0.00%	28.58%	100.00%	

Percent End Use Consumption(SNI)	30.0%	10.0%	20.0%	10.0%	0.0%	30.0%

TABLE 5T

SNI COMMERCIAL END-USE (%) CONTRIBUTION TO HOURLY DEMAND

TIME	INTERIOR LIGHTING (%)	EXTERIOR LIGHTING (%)	REFRIGER-ATION (%)	A/C (%)	(%)	OTHER END-USES (%)	SNI LOAD (kW)	SNI % OF DAILY LOAD	SNI RES LOAD (% PK)
0	0.0%	38.0%	33.0%	0.0%	0.0%	29.0%	45,345	2.70%	41.54%
1	0.0%	38.0%	38.0%	0.0%	0.0%	24.0%	33,589	2.00%	30.77%
2	1.0%	37.0%	40.0%	0.0%	0.0%	22.0%	31,909	1.90%	29.23%
3	2.0%	35.0%	45.0%	0.0%	0.0%	18.0%	31,909	1.90%	29.23%
4	5.0%	28.0%	51.0%	0.0%	0.0%	16.0%	31,909	1.90%	29.23%
5	24.0%	15.0%	45.0%	0.0%	0.0%	16.0%	31,909	1.90%	29.23%
6	30.0%	10.0%	45.0%	0.0%	0.0%	15.0%	45,345	2.70%	41.54%
7	37.0%	5.0%	36.0%	0.0%	0.0%	22.0%	58,780	3.50%	53.85%
8	38.0%	1.0%	27.0%	3.0%	0.0%	31.0%	78,933	4.70%	72.31%
9	40.0%	0.0%	20.0%	8.0%	0.0%	32.0%	99,087	5.90%	90.77%
10	40.0%	0.0%	20.0%	8.0%	0.0%	32.0%	104,125	6.20%	95.38%
11	40.0%	0.0%	20.0%	9.0%	0.0%	31.0%	105,804	6.30%	96.92%
12	32.0%	0.0%	24.0%	12.0%	0.0%	32.0%	109,163	6.50%	100.00%
13	35.0%	0.0%	23.0%	14.0%	0.0%	28.0%	97,407	5.80%	89.23%
14	40.0%	0.0%	22.0%	14.0%	0.0%	24.0%	95,728	5.70%	87.69%
15	40.0%	0.0%	20.0%	12.0%	0.0%	28.0%	99,087	5.90%	90.77%
16	40.0%	0.0%	19.0%	11.0%	0.0%	30.0%	100,766	6.00%	92.31%
17	40.0%	0.0%	18.0%	10.0%	0.0%	32.0%	95,728	5.70%	87.69%
18	35.0%	7.0%	17.0%	10.0%	0.0%	31.0%	80,613	4.80%	73.85%
19	20.0%	24.0%	18.0%	5.0%	0.0%	33.0%	70,536	4.20%	64.62%
20	15.0%	30.0%	24.0%	0.0%	0.0%	31.0%	73,895	4.40%	67.69%
21	7.0%	40.0%	24.0%	0.0%	0.0%	29.0%	63,819	3.80%	58.46%
22	1.0%	38.0%	28.0%	0.0%	0.0%	33.0%	55,421	3.30%	50.77%
23	1.0%	39.0%	29.0%	0.0%	0.0%	31.0%	38,627	2.30%	35.38%
							1,679,435		

TABLE 6T

SNI COMMERCIAL SECTOR CUSTOMER AVERAGE DIVERSIFIED DEMAND PER CUSTOMER BY END-USE

TIME	INTERIOR LIGHTING (kW)	EXTERIOR LIGHTING (kW)	REFRIG-ERATION (kW)	A/C (kW)		OTHER END-USES (kW)	TOTAL DEMAND FOR CUST. W/ALL END-USES (kW)
0	0.00	0.12	0.10	0.00	0.00	0.09	0.31
1	0.00	0.11	0.11	0.00	0.00	0.07	0.29
2	0.00	0.10	0.11	0.00	0.00	0.06	0.27
3	0.01	0.09	0.12	0.00	0.00	0.05	0.26
4	0.01	0.08	0.14	0.00	0.00	0.04	0.27
5	0.07	0.05	0.14	0.00	0.00	0.05	0.30
6	0.13	0.04	0.20	0.00	0.00	0.07	0.44
7	0.21	0.03	0.21	0.00	0.00	0.13	0.57
8	0.32	0.01	0.23	0.03	0.00	0.26	0.83
9	0.41	0.00	0.21	0.08	0.00	0.33	1.04
10	0.44	0.00	0.22	0.09	0.00	0.35	1.11
11	0.45	0.00	0.23	0.10	0.00	0.35	1.14
12	0.35	0.00	0.26	0.13	0.00	0.35	1.09
13	0.33	0.00	0.22	0.13	0.00	0.27	0.96
14	0.39	0.00	0.21	0.14	0.00	0.23	0.97
15	0.43	0.00	0.21	0.13	0.00	0.30	1.06
16	0.44	0.00	0.21	0.12	0.00	0.33	1.09
17	0.42	0.00	0.19	0.11	0.00	0.34	1.06
18	0.35	0.07	0.17	0.10	0.00	0.31	1.01
19	0.17	0.20	0.15	0.04	0.00	0.28	0.84
20	0.10	0.19	0.15	0.00	0.00	0.20	0.64
21	0.04	0.22	0.13	0.00	0.00	0.16	0.54
22	0.00	0.17	0.12	0.00	0.00	0.14	0.44
23	0.00	0.14	0.10	0.00	0.00	0.11	0.35
	5.067	1.604	4.133	1.198	0.000	4.858	

TABLE 7T(1)

1992 INTERIOR LIGHTING
SNI COMMERCIAL SECTOR
HOURLY DSM IMPACT BY END-USE

TIME	INT LIGHT (kW) (SAME LOAD SHAPE AS 1990)	INT LIGHT (kW) (SAME LOAD SHAPE AS 1990)	INT LIGHT (kW) (SAME LOAD SHAPE AS 1990)	INT LIGHT (kW)	INT LIGHT (kW)	INT LIGHT (kW)	INT LIGHT (kW)	INT LIGHT (kW)	TOTAL IMPACT FOR PROGRAM W DSM (kW)
Measure:	34W – F40	T–8 System	Reflectors	EE Mag Bal.	El Bal.	I – CF	Timer	Occ. Sens.	
Energy Savings:	15.0%	34.9%	49.7%	8.0%	23.4%	70.7%	10.0%	30.0%	31.5%
Demand Reductions:	15.0%	34.9%	49.7%	8.0%	23.4%	70.7%	10.0%	10.0%	30.6%
Equip. Cost/ Part.	$3.13	$54.50	$54.00	$40.00	$88.00	$15.00	$37.00	$59.00	$32.55
Likely Meas Part %	32.9%	13.2%	19.7%	2.2%	5.1%	11.9%	10.5%	4.5%	
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.002	0.002	0.001	0.002	0.002	0.001	0.002	0.002	0.002
3	0.005	0.003	0.003	0.005	0.004	0.002	0.005	0.004	0.004
4	0.011	0.009	0.007	0.012	0.010	0.004	0.012	0.009	0.009
5	0.062	0.047	0.036	0.067	0.055	0.021	0.065	0.051	0.050
6	0.111	0.085	0.066	0.121	0.100	0.038	0.118	0.092	0.090
7	0.181	0.138	0.107	0.195	0.163	0.062	0.191	0.149	0.146
8	0.269	0.206	0.159	0.292	0.243	0.093	0.285	0.222	0.217
9	0.353	0.270	0.209	0.382	0.318	0.122	0.373	0.290	0.284
10	0.377	0.288	0.223	0.408	0.339	0.130	0.399	0.310	0.303
11	0.387	0.296	0.229	0.418	0.348	0.133	0.409	0.318	0.312
12	0.296	0.227	0.175	0.320	0.267	0.102	0.313	0.244	0.238
13	0.284	0.218	0.168	0.308	0.256	0.098	0.301	0.234	0.229
14	0.331	0.253	0.196	0.358	0.298	0.114	0.350	0.272	0.266
15	0.361	0.277	0.214	0.391	0.326	0.125	0.383	0.298	0.291
16	0.372	0.285	0.220	0.403	0.335	0.128	0.394	0.306	0.300
17	0.361	0.276	0.213	0.390	0.325	0.124	0.382	0.297	0.291
18	0.300	0.229	0.177	0.324	0.270	0.103	0.317	0.247	0.241
19	0.142	0.109	0.084	0.154	0.128	0.049	0.150	0.117	0.114
20	0.082	0.062	0.048	0.088	0.074	0.028	0.086	0.067	0.066
21	0.032	0.025	0.019	0.035	0.029	0.011	0.034	0.026	0.026
22	0.004	0.003	0.002	0.004	0.003	0.001	0.004	0.003	0.003
23	0.003	0.002	0.002	0.003	0.003	0.001	0.003	0.002	0.002

1992 EXTERIOR LIGHTING
SNI COMMERCIAL SECTOR
HOURLY DSM IMPACT BY END-USE

TIME	EXT LIGHT (kW)	EXT LIGHT (kW)	EXT LIGHT (kW)	EXT LIGHT (kW)	EXT LIGHT (kW)	EXT LIGHT (kW)	EXT LIGHT (kW)	EXT LIGHT (kW)	TOTAL IMPACT FOR PROGRAM W DSM (kW)
Technology:	MV - HPS	MV - MH	I - CF						
Energy Savings:	40.0%	30.0%	70.7%						46.1%
Demand Reductions:	40.0%	30.0%	70.7%						46.1%
Equip. Cost/ Part.	$81	$104	$15						$67.80
Likely Meas Part %	80.00%	0.0%	20.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
0	0.071	0.083	0.035	0.119	0.119	0.119	0.119	0.119	0.064
1	0.066	0.077	0.032	0.109	0.109	0.109	0.109	0.109	0.059
2	0.060	0.070	0.029	0.100	0.100	0.100	0.100	0.100	0.054
3	0.056	0.065	0.027	0.093	0.093	0.093	0.093	0.093	0.050
4	0.045	0.053	0.022	0.075	0.075	0.075	0.075	0.075	0.040
5	0.027	0.032	0.013	0.045	0.045	0.045	0.045	0.045	0.024
6	0.026	0.031	0.013	0.044	0.044	0.044	0.044	0.044	0.024
7	0.017	0.020	0.008	0.029	0.029	0.029	0.029	0.029	0.015
8	0.005	0.006	0.002	0.008	0.008	0.008	0.008	0.008	0.004
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.042	0.049	0.021	0.070	0.070	0.070	0.070	0.070	0.038
19	0.120	0.140	0.059	0.200	0.200	0.200	0.200	0.200	0.108
20	0.115	0.134	0.056	0.192	0.192	0.192	0.192	0.192	0.103
21	0.129	0.151	0.063	0.215	0.215	0.215	0.215	0.215	0.116
22	0.100	0.117	0.049	0.167	0.167	0.167	0.167	0.167	0.090
23	0.082	0.096	0.040	0.137	0.137	0.137	0.137	0.137	0.074

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TABLE 7T(3)

1992 AIR CONDITIONING SNI COMMERCIAL SECTOR HOURLY DSM IMPACT BY END-USE									
TIME	A/C (kW)	A/C (kW)	A/C (kW)	A/C (kW)	A/C (kW)	A/C (kW)	A/C (kW)	A/C (kW)	TOTAL IMPACT FOR PROGRAM W DSM (kW)
Technology:	HE Window A/C	HE DX A/C							
Energy Savings:	44.0%	50.0%							46.1%
Demand Reductions:	44.0%	50.0%							46.1%
Equip. Cost/ Part.	$700	$3,596							$1,713.60
Likely Meas Part %	65.0%	35.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.014	0.013	0.025	0.025	0.025	0.025	0.025	0.025	0.013
9	0.046	0.041	0.083	0.083	0.083	0.083	0.083	0.083	0.045
10	0.050	0.044	0.089	0.089	0.089	0.089	0.089	0.089	0.048
11	0.057	0.051	0.102	0.102	0.102	0.102	0.102	0.102	0.055
12	0.073	0.065	0.131	0.131	0.131	0.131	0.131	0.131	0.070
13	0.075	0.067	0.134	0.134	0.134	0.134	0.134	0.134	0.072
14	0.076	0.068	0.136	0.136	0.136	0.136	0.136	0.136	0.073
15	0.071	0.064	0.128	0.128	0.128	0.128	0.128	0.128	0.069
16	0.067	0.060	0.120	0.120	0.120	0.120	0.120	0.120	0.065
17	0.059	0.053	0.106	0.106	0.106	0.106	0.106	0.106	0.057
18	0.056	0.050	0.101	0.101	0.101	0.101	0.101	0.101	0.054
19	0.023	0.021	0.042	0.042	0.042	0.042	0.042	0.042	0.023
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE 7T(4)

1992 REFRIGERATION
SNI COMMERCIAL SECTOR
HOURLY DSM IMPACT BY END-USE

TIME	REFRIG. (kW)	REFRIG. (kW)	REFRIG. (kW)	REFRIG. (kW)	REFRIG. (kW)	REFRIG. (kW)	REFRIG. (kW)	REFRIG. (kW)	TOTAL IMPACT FOR PROGRAM W DSM (kW)
Technology:	Maint- Adj	HE Refrig.							
Energy Savings:	10.0%	10.0%							10.0%
Demand Reductions:	10.0%	10.0%							10.0%
Equip. Cost/ Part.	$0	$400							$120.00
Likely Meas Part %	70.0%	30.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
0	0.093	0.093	0.103	0.103	0.103	0.103	0.103	0.103	0.093
1	0.098	0.098	0.109	0.109	0.109	0.109	0.109	0.109	0.098
2	0.097	0.097	0.108	0.108	0.108	0.108	0.108	0.108	0.097
3	0.107	0.107	0.119	0.119	0.119	0.119	0.119	0.119	0.107
4	0.123	0.123	0.137	0.137	0.137	0.137	0.137	0.137	0.123
5	0.122	0.122	0.136	0.136	0.136	0.136	0.136	0.136	0.122
6	0.177	0.177	0.197	0.197	0.197	0.197	0.197	0.197	0.177
7	0.186	0.186	0.207	0.207	0.207	0.207	0.207	0.207	0.186
8	0.203	0.203	0.225	0.225	0.225	0.225	0.225	0.225	0.203
9	0.187	0.187	0.207	0.207	0.207	0.207	0.207	0.207	0.187
10	0.199	0.199	0.222	0.222	0.222	0.222	0.222	0.222	0.199
11	0.205	0.205	0.227	0.227	0.227	0.227	0.227	0.227	0.205
12	0.235	0.235	0.261	0.261	0.261	0.261	0.261	0.261	0.235
13	0.198	0.198	0.220	0.220	0.220	0.220	0.220	0.220	0.198
14	0.193	0.193	0.214	0.214	0.214	0.214	0.214	0.214	0.193
15	0.191	0.191	0.213	0.213	0.213	0.213	0.213	0.213	0.191
16	0.187	0.187	0.208	0.208	0.208	0.208	0.208	0.208	0.187
17	0.172	0.172	0.191	0.191	0.191	0.191	0.191	0.191	0.172
18	0.154	0.154	0.171	0.171	0.171	0.171	0.171	0.171	0.154
19	0.135	0.135	0.150	0.150	0.150	0.150	0.150	0.150	0.135
20	0.138	0.138	0.154	0.154	0.154	0.154	0.154	0.154	0.138
21	0.116	0.116	0.129	0.129	0.129	0.129	0.129	0.129	0.116
22	0.111	0.111	0.123	0.123	0.123	0.123	0.123	0.123	0.111
23	0.092	0.092	0.102	0.102	0.102	0.102	0.102	0.102	0.092

SNI COMMERCIAL SECTOR
HOURLY DSM IMPACT BY END-USE

TIME	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	(kW)	TOTAL IMPACT FOR PROGRAM W DSM (kW)
----	--------	--------	--------	--------	--------	--------	--------	--------	--------
Technology:									
Energy Savings:	0.0%								0.0%
Demand Reductions:	0.0%								0.0%
Equip. Cost/ Part.	$0								$0.00
Likely Meas Part %	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE 7T(6)

OTHER
SNI COMMERCIAL SECTOR
HOURLY DSM IMPACT BY END-USE

TIME	OTHER (kW)	OTHER (kW)	OTHER (kW)	OTHER (kW)	OTHER (kW)	OTHER (kW)	OTHER (kW)	OTHER (kW)	TOTAL IMPACT FOR PROGRAM W DSM (kW)
Technology:	EMS	LOW/NO COST	HE MOT						
Energy Savings:	23.0%	15.0%	6.1%						
Demand Reductions:	15.0%	15.0%	6.1%						13.1%
Equip. Cost/ Part	$2,560	$0	$98						12.9%
Likely Meas Part %	2.0%	68.0%	30.0%	0.0%	0.0%	0.0%	0.0%	0.0%	$80.60
0	0.070	0.077	0.084	0.091	0.091	0.091	0.091	0.091	0.079
1	0.053	0.059	0.064	0.069	0.069	0.069	0.069	0.069	0.060
2	0.048	0.050	0.054	0.059	0.059	0.059	0.059	0.059	0.051
3	0.037	0.041	0.044	0.048	0.048	0.048	0.048	0.048	0.041
4	0.033	0.036	0.039	0.043	0.043	0.043	0.043	0.043	0.037
5	0.037	0.041	0.044	0.048	0.048	0.048	0.048	0.048	0.042
6	0.050	0.056	0.060	0.066	0.066	0.066	0.066	0.066	0.057
7	0.097	0.107	0.116	0.126	0.126	0.126	0.126	0.126	0.110
8	0.199	0.220	0.238	0.256	0.258	0.256	0.258	0.258	0.225
9	0.255	0.282	0.305	0.332	0.332	0.332	0.332	0.332	0.288
10	0.273	0.301	0.326	0.355	0.355	0.355	0.355	0.355	0.308
11	0.271	0.300	0.324	0.353	0.353	0.353	0.353	0.353	0.306
12	0.268	0.296	0.320	0.348	0.348	0.348	0.348	0.348	0.306
13	0.206	0.226	0.246	0.268	0.268	0.268	0.268	0.268	0.302
14	0.180	0.198	0.215	0.233	0.233	0.233	0.233	0.233	0.233
15	0.229	0.253	0.274	0.298	0.298	0.298	0.298	0.298	0.203
16	0.253	0.279	0.302	0.328	0.328	0.328	0.328	0.328	0.259
17	0.261	0.289	0.312	0.339	0.339	0.339	0.339	0.339	0.285
18	0.240	0.265	0.287	0.312	0.312	0.312	0.312	0.312	0.295
19	0.212	0.234	0.253	0.276	0.276	0.276	0.276	0.276	0.271
20	0.153	0.169	0.182	0.198	0.198	0.198	0.198	0.198	0.240
21	0.120	0.133	0.144	0.156	0.156	0.156	0.156	0.156	0.172
22	0.111	0.123	0.133	0.145	0.145	0.145	0.145	0.145	0.136
23	0.084	0.093	0.100	0.109	0.109	0.109	0.109	0.109	0.126
									0.095

TABLE 6T(TOTAL IMPACT)

SNI COMMERCIAL SECTOR
HOURLY DSM IMPACT BY END-USE

TIME	INT LIGHT (kW)	EXT LIGHT (kW)	A/C (kW)	REFRIG. (kW)	(kW)	OTHER END-USES (kW)	TOTAL DEMAND FOR CUST. W/ALL END-USES (kW)
Technology:							
Energy Savings:	31.5%	42.1%	46.1%	10.0%	0.0%	13.1%	
Demand Reductions:	30.6%	42.1%	46.1%	10.0%	0.0%	12.9%	
0	0.000	0.069	0.000	0.093	0.000	0.079	0.241
1	0.000	0.063	0.000	0.098	0.000	0.060	0.222
2	0.002	0.058	0.000	0.097	0.000	0.051	0.208
3	0.004	0.054	0.000	0.107	0.000	0.041	0.206
4	0.009	0.043	0.000	0.123	0.000	0.037	0.213
5	0.050	0.026	0.000	0.122	0.000	0.042	0.240
6	0.090	0.025	0.000	0.177	0.000	0.057	0.349
7	0.146	0.017	0.000	0.186	0.000	0.110	0.458
8	0.217	0.005	0.013	0.203	0.000	0.225	0.663
9	0.284	0.000	0.045	0.187	0.000	0.288	0.804
10	0.303	0.000	0.048	0.199	0.000	0.308	0.859
11	0.312	0.000	0.055	0.205	0.000	0.306	0.878
12	0.238	0.000	0.070	0.235	0.000	0.302	0.846
13	0.229	0.000	0.072	0.198	0.000	0.233	0.732
14	0.266	0.000	0.073	0.193	0.000	0.203	0.735
15	0.291	0.000	0.069	0.191	0.000	0.259	0.810
16	0.300	0.000	0.065	0.187	0.000	0.285	0.837
17	0.291	0.000	0.057	0.172	0.000	0.295	0.815
18	0.241	0.041	0.054	0.154	0.000	0.271	0.762
19	0.114	0.116	0.023	0.135	0.000	0.240	0.628
20	0.066	0.111	0.000	0.138	0.000	0.172	0.488
21	0.026	0.125	0.000	0.116	0.000	0.136	0.403
22	0.003	0.096	0.000	0.111	0.000	0.126	0.336
23	0.002	0.080	0.000	0.092	0.000	0.095	0.269

Commercial Sector

FORMULAS	PROGRAM IMPACT PER YEAR		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	0) Annual Cust Escalation Rate:		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:		104,476	109,700	115,185	120,944	126,991	133,341	140,008	147,008	154,359	162,077	170,180
	1b) % Cust. w/ End-Use:		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	1c) Total Cust. w/ End-Use:		104,476	109,700	115,185	120,944	126,991	133,341	140,008	147,008	154,359	162,077	170,180
	2) End-Use Tech Saturation %:		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1c*2	3) Eligible Target Market		104,476	109,700	115,185	120,944	126,991	133,341	140,008	147,008	154,359	162,077	170,180
	4) Interaction Adjustment Factor		90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
3*4	5) MTP Participation:		94,028	98,730	103,666	108,850	114,292	120,007	126,007	132,307	138,923	145,869	153,162
	5a) Program Energy Savings		31.5%	31.5%	31.5%	31.5%	31.5%	31.5%	31.5%	31.5%	31.5%	31.5%	31.5%
5a*14c*4	6) MTP Energy Reduction(MW		44,865	47,109	49,464	51,937	54,534	57,261	60,124	63,130	66,286	69,601	73,081
	6a) Program Demand Savings		30.6%	30.6%	30.6%	30.6%	30.6%	30.6%	30.6%	30.6%	30.6%	30.6%	30.6%
5*6a*kW@Peak	7) MTP Demand Reduction(M		2.8	2.9	3.0	3.2	3.4	3.5	3.7	3.9	4.1	4.3	4.5
	8a) Replacement Factor (%):		10.0%	15.0%	20.0%	25.0%	40.0%	55.0%	70.0%	85.0%	100.0%	100.0%	100.0%
	8b) Economic Attractiveness (%):		65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)		2,916	4,593	6,430	8,440	14,179	20,471	27,356	34,879	43,086	45,240	47,503
	10) Max Econ. Pot.Impact(MW)		0.2	0.3	0.4	0.5	0.9	1.3	1.7	2.1	2.7	2.8	2.9
	11) Market Penetration Rate:					2.49%	3.11%	3.88%	4.83%	6.00%	7.43%	9.16%	11.25%
	12) Cummulative Participants:					440	924	1,665	2,769	4,385	6,706	8,687	11,204
	13) Annual Participants:					440	484	740	1,105	1,615	2,322	1,981	2,517
12*kWH/Part	14a DSM Impact(MWH):					210	441	794	1,321	2,092	3,200	4,145	5,346
12*kWD/Part	14b DSM Impact(MW):					0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.3
	14c) Base Usage MWH					183,110	192,266	201,879	211,973	222,572	233,700	245,385	257,655
14c-6	14d Energy Usage w MTP Impact					131,173	137,732	144,618	151,849	159,442	167,414	175,785	184,574
14c-9	14e Energy Usage w Economic Potential Impact					174,671	178,087	181,408	184,617	187,692	190,614	200,145	210,152
14c-14a	14f) Energy Usage w DSM Impact					182,900	191,825	201,085	210,652	220,480	230,500	241,240	252,309
	Economic Analysis												
14a-15	15) LRMC Energy/Capacity $	$0.08											
	16) Annual Energy Cost Savings:					$16,814	$35,288	$63,545	$105,711	$167,374	$255,996	$331,609	$427,681
	17) NPV Energy Savings (i=12%)	3,540,796											
	18) Equipment Cost/ Participant:	$32.55											
13*18	19) Total Equipment Cost:					$14,340	$15,756	$24,099	$35,961	$52,590	$75,581	$64,487	$81,936
19*Rate	20) Taxes and Duties on Equipme	40%				$5,736	$6,302	$9,640	$14,384	$21,036	$30,232	$25,795	$32,774
19*20	21) Economic Equipment Cost:					$8,604	$9,454	$14,459	$21,576	$31,554	$45,348	$38,692	$49,162
	22) Administrative Expenses:	10%				$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
21+22	23) Annual Program Costs					$28,604	$29,454	$34,459	$41,576	$51,554	$65,348	$58,692	$69,162
	24) NPV Program Costs (i=12%)	525,339											
17/24	25) Benefit Cost Ratio	6.7											
	26) Program Cash Flows					($11,790)	$5,835	$29,086	$64,134	$115,820	$190,647	$272,917	$358,520
	27) NPV Program Cash Flows (i=	3,015,457											
	28) IRR	187.6%											

FORMULAS	PROGRAM IMPACT PER YEAR	2002	2003	2004	2005	2006	2007	2008	2009	2010
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	178,690	187,624	197,005	206,855	217,198	228,058	239,461	251,434	264,006
	1b) % Cust. w/ End-Use:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	1c) Total Cust. w/ End-Use:	178,690	187,624	197,005	206,855	217,198	228,058	239,461	251,434	264,006
	2) End-Use Tech Saturation %:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1c*2	3) Eligible Target Market	178,690	187,624	197,005	206,855	217,198	228,058	239,461	251,434	264,006
	4) Interaction Adjustment Factor	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
3*4	5) MTP Participation:	160,821	168,862	177,305	186,170	195,478	205,252	215,515	226,291	237,605
	5a) Program Energy Savings	31.5%	31.5%	31.5%	31.5%	31.5%	31.5%	31.5%	31.5%	31.5%
5a*14c*4	6) MTP Energy Reduction(MW	76,735	80,572	84,600	88,830	93,272	97,935	102,832	107,974	113,372
	6a) Program Demand Savings	30.6%	30.6%	30.6%	30.6%	30.6%	30.6%	30.6%	30.6%	30.6%
5*6a*kW@Peak	7) MTP Demand Reduction(M	4.7	5.0	5.2	5.5	5.7	6.0	6.3	6.7	7.0
	8a) Replacement Factor (%):	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	8b) Economic Attractiveness (%):	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)	49,878	52,372	54,990	57,740	60,627	63,658	66,841	70,183	73,692
	10) Max Econ. Pot.Impact(MW)	3.1	3.2	3.4	3.6	3.7	3.9	4.1	4.3	4.5
	11) Market Penetration Rate:	13.75%	16.70%	20.13%	24.06%	28.49%	33.37%	38.64%	44.19%	49.88%
	12) Cummulative Participants:	14,375	18,328	23,198	29,117	36,197	44,522	54,127	64,994	77,042
	13) Annual Participants:	3,170	3,953	4,871	5,918	7,080	8,324	9,605	10,867	12,048
12*kWH/Part	14a DSM Impact(MWH):	6,859	8,745	11,069	13,893	17,271	21,243	25,826	31,011	36,760
12*kWD/Part	14b DSM Impact(MW):	0.4	0.5	0.7	0.9	1.1	1.3	1.6	1.9	2.3
	14c) Base Usage MWH	270,537	284,064	298,267	313,181	328,840	345,282	362,546	380,673	399,707
14c-6	14d Energy Usage w MTP Impact	193,802	203,493	213,667	224,351	235,568	247,347	259,714	272,700	286,335
14c-9	14e Energy Usage w Economic Po	220,660	231,693	243,277	255,441	268,213	281,624	295,705	310,490	326,015
14c-14a	14f) Energy Usage w DSM Impact	263,679	275,319	287,198	299,288	311,569	324,039	336,719	349,662	362,947
	Economic Analysis									
14a-15	15) LRMC Energy/Capacity $									
	16) Annual Energy Cost Savings:	$548,704	$699,604	$885,521	$1,111,438	$1,381,703	$1,699,462	$2,066,117	$2,480,914	$2,940,810
	17) NPV Energy Savings (i=12%)									
	18) Equipment Cost/ Participant:									
13*18	19) Total Equipment Cost:	$103,214	$128,696	$158,559	$192,674	$230,496	$271,002	$312,702	$353,761	$392,223
19*Rate	20) Taxes and Duties on Equipme	$41,286	$51,478	$63,424	$77,070	$92,198	$108,401	$125,081	$141,504	$156,889
19*20	21) Economic Equipment Cost:	$61,928	$77,218	$95,136	$115,604	$138,297	$162,601	$187,621	$212,256	$235,334
	22) Administrative Expenses:	$20,000	$20,000	$9,514	$11,560	$13,830	$16,260	$18,762	$21,226	$23,533
21+22	23) Annual Program Costs	$81,928	$97,218	$104,649	$127,165	$152,127	$178,861	$206,383	$233,482	$258,867
	24) NPV Program Costs (i=12%)									
17/24	25) Benefit Cost Ratio									
	26) Program Cash Flows	$466,775	$602,387	$780,872	$984,273	$1,229,576	$1,520,601	$1,859,733	$2,247,432	$2,681,942
	27) NPV Program Cash Flows (i=									
	28) IRR									

Inital Penetration Rate	2.00%	Saturation in 1990 =	7.7%
Penetration Rate T2	50.00%	Saturation in 2010 =	5.0%
Initial Year T1	1	Annual Inc. in Saturation =	0.0%
Final Year T2	18		
Constant A:	3.8964814711		
Constant B:	-0.228930606		

FORMULAS	PROGRAM IMPACT PER YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
		Commercial Sector										
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	104,476	109,700	115,185	120,944	126,991	133,341	140,008	147,008	154,359	162,077	170,180
	1b) % Cust. w/ End-Use:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	1c) Total Cust. w/ End-Use:	104,476	109,700	115,185	120,944	126,991	133,341	140,008	147,008	154,359	162,077	170,180
	2) End-Use Tech Saturation %:	91.0%	91.0%	91.0%	91.0%	91.0%	91.0%	91.0%	91.0%	91.0%	91.0%	91.0%
1c*2	3) Eligible Target Market	95,073	99,827	104,818	110,059	115,562	121,340	127,407	133,778	140,466	147,490	154,864
	4) Interaction Adjustment Factor	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3*4	5) MTP Participation:	95,073	99,827	104,818	110,059	115,562	121,340	127,407	133,778	140,466	147,490	154,864
	5a) Program Energy Savings	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%
5a*14c*4	6) MTP Energy Reduction(MW	22,138	23,245	24,407	25,628	26,909	28,255	29,667	31,151	32,708	34,344	36,061
	6a) Program Demand Savings	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%
5*6a*kW@Peak	7) MTP Demand Reduction(M	8.4	8.8	9.3	9.8	10.2	10.8	11.3	11.9	12.4	13.1	13.7
	8a) Replacement Factor (%):	20.0%	20.0%	20.0%	20.0%	40.0%	60.0%	80.0%	100.0%	100.0%	100.0%	100.0%
	8b) Economic Attractiveness (%):	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)	2,878	3,022	3,173	3,332	6,996	11,019	15,427	20,248	21,260	22,323	23,440
	10) Max Econ. Pot.Impact(MW)	1.09	1.15	1.21	1.27	2.66	4.19	5.87	7.70	8.09	8.49	8.92
	11) Market Penetration Rate:				2.49%	3.11%	3.88%	4.83%	6.00%	7.43%	9.16%	11.25%
	12) Cummulative Participants:				220	798	1,700	3,064	5,080	6,645	8,648	11,192
	13) Annual Participants:				220	578	902	1,364	2,016	1,565	2,003	2,545
12*kWH/Part	14a DSM Impact(MWH):				51	186	396	713	1,183	1,547	2,014	2,606
12*kWD/Part	14b DSM Impact(MW):				0.019	0.071	0.151	0.271	0.450	0.589	0.766	0.992
	14c) Base Usage MWH				55,543	58,321	61,237	64,298	67,513	70,889	74,434	78,155
14c-6	14d Energy Usage w MTP Impact				29,916	31,411	32,982	34,631	36,363	38,181	40,090	42,094
14c-9	14e Energy Usage w Economic Po tential Impact				52,212	51,324	50,217	48,871	47,265	49,629	52,110	54,716
14c-14a	14f) Energy Usage w DSM Impact				55,492	58,135	60,841	63,585	66,331	69,342	72,420	75,549
	Economic Analysis	$0.08										
14a-15	16) Annual Energy Cost Savings:				$4,099	$14,874	$31,668	$57,075	$94,625	$123,780	$161,090	$208,496
	17) NPV Energy Savings (i=12%)	1,743,410										
	18) Equipment Cost/ Participant:	$67.80										
	19) Total Equipment Cost:				$14,919	$39,218	$61,122	$92,472	$136,668	$106,111	$135,795	$172,540
13*18	20) Taxes and Duties on Equipme	40%			$5,967	$15,687	$24,449	$36,989	$54,667	$42,444	$54,318	$69,016
19*Rate	21) Economic Equipment Cost:				$8,951	$23,531	$36,673	$55,483	$82,001	$63,667	$81,477	$103,524
19*20	22) Administrative Expenses:				$8,451	$8,451	$8,451	$8,451	$8,451	$4,225	$4,225	$4,225
	23) Annual Program Costs				$17,402	$31,982	$45,124	$63,934	$90,452	$67,892	$85,702	$107,749
21+22	24) NPV Program Costs (i=12%)	859,874										
	25) Benefit Cost Ratio	2.0										
17/24	26) Program Cash Flows				($13,303)	($17,107)	($13,456)	($6,859)	$4,174	$55,887	$75,387	$100,747
	27) NPV Program Cash Flows (i=	883,535										
	28) IRR	58.1%										

FORMULAS	PROGRAM IMPACT PER YEAR	2002	2003	2004	2005	2006	2007	2008	2009	2010
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	178,690	187,624	197,005	206,855	217,198	228,058	239,461	251,434	264,006
	1b) % Cust. w/ End-Use:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	1c) Total Cust. w/ End-Use:	178,690	187,624	197,005	206,855	217,198	228,058	239,461	251,434	264,006
	2) End-Use Tech Saturation %:	91.0%	91.0%	91.0%	91.0%	91.0%	91.0%	91.0%	91.0%	91.3%
1c*2	3) Eligible Target Market	162,607	170,738	179,275	188,238	197,650	207,533	217,910	228,805	241,116
	4) Interaction Adjustment Factor	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3*4	5) MTP Participation:	162,607	170,738	179,275	188,238	197,650	207,533	217,910	228,805	241,116
	5a) Program Energy Savings	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%
5a*14c*4	6) MTP Energy Reduction(MW	37,864	39,757	41,745	43,832	46,024	48,325	50,741	53,278	56,145
	6a) Program Demand Savings	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%
5*6a*kW@Peak	7) MTP Demand Reduction(M	14.4	15.1	15.9	16.7	17.5	18.4	19.3	20.3	21.4
	8a) Replacement Factor (%):	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	8b) Economic Attractiveness (%):	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%	65.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)	24,612	25,842	27,134	28,491	29,915	31,411	32,982	34,631	36,494
	10) Max Econ. Pot.Impact(MW)	9.36	9.83	10.32	10.84	11.38	11.95	12.55	13.18	13.88
	11) Market Penetration Rate:	13.75%	16.70%	20.13%	24.06%	28.49%	33.37%	38.64%	44.19%	49.88%
	12) Cummulative Participants:	14,398	18,395	23,320	29,304	36,463	44,880	54,592	65,580	78,044
	13) Annual Participants:	3,206	3,997	4,925	5,984	7,159	8,417	9,712	10,987	12,464
12*kWH/Part	14a DSM Impact(MWH):	3,353	4,283	5,430	6,824	8,491	10,451	12,712	15,270	18,173
12*kWD/Part	14b DSM Impact(MW):	1.276	1.630	2.066	2.596	3.230	3.976	4.837	5.810	6.914
	14c) Base Usage MWH	82,063	86,166	90,474	94,998	99,748	104,735	109,972	115,471	121,684
14c-6	14d Energy Usage w MTP Impact	44,199	46,409	48,730	51,166	53,724	56,411	59,231	62,193	65,539
14c-9	14e Energy Usage w Economic Po	57,451	60,324	63,340	66,507	69,833	73,324	76,990	80,840	85,190
14c-14a	14f) Energy Usage w DSM Impact	78,710	81,883	85,044	88,175	91,257	94,285	97,260	100,200	103,511
	Economic Analysis									
14a-15	16) Annual Energy Cost Savings:	$268,213	$342,673	$434,411	$545,887	$679,246	$836,040	$1,016,962	$1,221,638	$1,453,830
	17) NPV Energy Savings (i=12%)									
	18) Equipment Cost/ Participant:									
	19) Total Equipment Cost:	$217,347	$271,006	$333,892	$405,730	$485,374	$570,671	$658,483	$744,944	$845,090
13*18	20) Taxes and Duties on Equipme	$86,939	$108,402	$133,557	$162,292	$194,150	$228,268	$263,393	$297,977	$338,036
19*Rate	21) Economic Equipment Cost:	$130,408	$162,604	$200,335	$243,438	$291,225	$342,403	$395,090	$446,966	$507,054
19*20	22) Administrative Expenses:	$4,225	$4,225	$0	$0	$0	$0	$0	$0	$0
	23) Annual Program Costs	$134,633	$166,829	$200,335	$243,438	$291,225	$342,403	$395,090	$446,966	$507,054
21+22	24) NPV Program Costs (i=12%)									
	25) Benefit Cost Ratio									
17/24	26) Program Cash Flows	$133,579	$175,844	$234,076	$302,449	$388,021	$493,638	$621,872	$774,672	$946,777
	27) NPV Program Cash Flows (i=									
	28) IRR									

Inital Penetration Rate	2.00%	Saturation in 1990 =	7.7%
Penetration Rate T2	50.00%	Saturation in 2010 =	5.0%
Initial Year T1	1	Annual Inc. in Saturation =	-2.1%
Final Year T2	18		
Constant A:	3.8964814711		
Constant B:	-0.228930606		

FORMULAS	PROGRAM IMPACT PER YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
		Commercial Sector										
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	104,476	109,700	115,185	120,944	126,991	133,341	140,008	147,008	154,359	162,077	170,180
	1b) % Cust. w/ End-Use:	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
	1c) Total Cust. w/ End-Use:	15,671	16,455	17,278	18,142	19,049	20,001	21,001	22,051	23,154	24,311	25,527
	2) End-Use Tech Saturation %:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1c*2	3) Eligible Target Market	15,671	16,455	17,278	18,142	19,049	20,001	21,001	22,051	23,154	24,311	25,527
	4) Interaction Adjustment Factor	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3*4	5) MTP Participation:	15,671	16,455	17,278	18,142	19,049	20,001	21,001	22,051	23,154	24,311	25,527
	5a) Program Energy Savings	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%
5a*14c*4	6) MTP Energy Reduction(MW	24,307	25,522	26,798	28,138	29,545	31,022	32,573	34,202	35,912	37,708	39,593
	6a) Program Demand Savings	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%
5*6a*kW@Peak	7) MTP Demand Reduction(M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	8a) Replacement Factor (%):	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
	8b) Economic Attractiveness (%):	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)	4,375	4,594	4,824	5,065	5,318	5,584	5,863	6,156	6,464	6,787	7,127
	10) Max Econ. Pot.Impact(MW)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	11) Market Penetration Rate:				0.62%	0.76%	0.93%	1.15%	1.41%	1.73%	2.13%	2.61%
	12) Cummulative Participants:			16	5	10	18	28	40	57	78	104
	13) Annual Participants:				5	6	8	10	13	16	21	27
12*kWH/Part	14a DSM Impact(MWH):				7	16	28	43	63	88	120	162
12*kWD/Part	14b DSM Impact(MW):				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	14c) Base Usage MWH				61,037	64,089	67,293	70,658	74,191	77,900	81,795	85,885
14c-6	14d Energy Usage w MTP Impact				32,899	34,544	36,271	38,084	39,989	41,988	44,088	46,292
14c-9	14e Energy Usage w Economic Po tential Impact				55,972	58,771	61,709	64,795	68,034	71,436	75,008	78,758
14c-14a	14f) Energy Usage w DSM Impact				61,030	64,072	67,265	70,615	74,128	77,812	81,675	85,723
	Economic Analysis											
14a-15	15) LRMC Energy/Capacity $	$0.08										
	16) Annual Energy Cost Savings:				$563	$1,292	$2,233	$3,448	$5,013	$7,028	$9,619	$12,947
	17) NPV Energy Savings (i=12%)	128,399										
	18) Equipment Cost/ Participant:	$514.08										
13*18	19) Total Equipment Cost:				$2,331	$3,022	$3,900	$5,031	$6,484	$8,349	$10,736	$13,786
19*Rate	20) Taxes and Duties on Equipme	20%			$466	$604	$780	$1,006	$1,297	$1,670	$2,147	$2,757
19*20	21) Economic Equipment Cost:				$1,865	$2,417	$3,120	$4,025	$5,187	$6,679	$8,589	$11,029
	22) Administrative Expenses:				$5,629	$5,629	$5,629	$5,629	$5,629	$0	$0	$0
21+22	23) Annual Program Costs				$7,494	$8,046	$8,749	$9,654	$10,816	$6,679	$8,589	$11,029
	24) NPV Program Costs (i=12%)	122,189										
17/24	25) Benefit Cost Ratio	1.1										
	26) Program Cash Flows				($6,931)	($6,754)	($6,516)	($6,206)	($5,804)	$349	$1,030	$1,918
	27) NPV Program Cash Flows (i=	6,210										
	28) IRR	14.38%										

FORMULAS	PROGRAM IMPACT PER YEAR	2002	2003	2004	2005	2006	2007	2008	2009	2010
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	178,690	187,624	197,005	206,855	217,198	228,058	239,461	251,434	264,006
	1b) % Cust. w/ End-Use:	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
	1c) Total Cust. w/ End-Use:	26,803	28,144	29,551	31,028	32,580	34,209	35,919	37,715	39,601
	2) End-Use Tech Saturation %:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
1c*2	3) Eligible Target Market	26,803	28,144	29,551	31,028	32,580	34,209	35,919	37,715	39,601
	4) Interaction Adjustment Factor	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3*4	5) MTP Participation:	26,803	28,144	29,551	31,028	32,580	34,209	35,919	37,715	39,601
	5a) Program Energy Savings	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%
5a*14c*4	6) MTP Energy Reduction(MW	41,573	43,651	45,834	48,125	50,532	53,058	55,711	58,497	61,422
	6a) Program Demand Savings	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%	46.1%
5*6a*kW@Peak	7) MTP Demand Reduction(M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	8a) Replacement Factor (%):	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
	8b) Economic Attractiveness (%):	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%	20.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)	7,483	7,857	8,250	8,663	9,096	9,550	10,028	10,529	11,056
	10) Max Econ. Pot.Impact(MW)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	11) Market Penetration Rate:	3.20%	3.91%	4.78%	5.83%	7.09%	8.60%	10.39%	12.51%	14.99%
	12) Cummulative Participants:	139	183	239	310	400	514	656	834	1,053
	13) Annual Participants:	34	44	56	71	90	114	142	177	219
12*kWH/Part	14a DSM Impact(MWH):	215	283	370	481	621	797	1,018	1,293	1,633
12*kWD/Part	14b DSM Impact(MW):	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	14c) Base Usage MWH	90,179	94,688	99,422	104,394	109,613	115,094	120,849	126,891	133,236
14c-6	14d Energy Usage w MTP Impact	48,607	51,037	53,589	56,268	59,082	62,036	65,137	68,394	71,814
14c-9	14e Energy Usage w Economic Po	82,696	86,831	91,172	95,731	100,518	105,543	110,821	116,362	122,180
14c-14a	14f) Energy Usage w DSM Impact	89,964	94,405	99,052	103,913	108,993	114,297	119,831	125,598	131,603
	Economic Analysis									
14a-15	15) LRMC Energy/Capacity $									
	16) Annual Energy Cost Savings:	$17,212	$22,666	$29,621	$38,463	$49,659	$63,767	$81,446	$103,450	$130,623
	17) NPV Energy Savings (i=12%)									
	18) Equipment Cost/ Participant:									
13*18	19) Total Equipment Cost:	$17,669	$22,596	$28,818	$36,634	$46,384	$58,452	$73,243	$91,164	$112,580
19*Rate	20) Taxes and Duties on Equipme	$3,534	$4,519	$5,764	$7,327	$9,277	$11,690	$14,649	$18,233	$22,516
19*20	21) Economic Equipment Cost:	$14,136	$18,077	$23,055	$29,307	$37,107	$46,762	$58,595	$72,931	$90,064
	22) Administrative Expenses:	$0	$0	$0	$0	$0	$0	$0	$0	$0
21+22	23) Annual Program Costs	$14,136	$18,077	$23,055	$29,307	$37,107	$46,762	$58,595	$72,931	$90,064
	24) NPV Program Costs (i=12%)									
17/24	25) Benefit Cost Ratio									
	26) Program Cash Flows	$3,076	$4,589	$6,567	$9,157	$12,552	$17,006	$22,851	$30,518	$40,559
	27) NPV Program Cash Flows (i=									
	28) IRR									

Inital Penetration Rate	0.50%	Saturation in 1990 =	21.2%
Penetration Rate T2	15.00%	Saturation in 2010 =	40.0%
Initial Year T1	1	Annual Inc. in Saturation =	3.2%
Final Year T2	18		
Constant A:	5.2943562091		
Constant B:	-0.209335516		

... Savings for Refrigeration DSM Measures by Year.

Commercial Sector

FORMULAS	PROGRAM IMPACT PER YEAR	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	104,476	109,700	115,185	120,944	126,991	133,341	140,008	147,008	154,359	162,077	170,180
	1b) % Cust. w/ End-Use:	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%
	1c) Total Cust. w/ End-Use:	62,686	65,820	69,111	72,566	76,195	80,005	84,005	88,205	92,615	97,246	102,108
	2) End-Use Tech Saturation %:	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
1c*2	3) Eligible Target Market	50,149	52,656	55,289	58,053	60,956	64,004	67,204	70,564	74,092	77,797	81,687
	4) Interaction Adjustment Factor	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3*4	5) MTP Participation:	50,149	52,656	55,289	58,053	60,956	64,004	67,204	70,564	74,092	77,797	81,687
	5a) Program Energy Savings	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
5a*14c*4	6) MTP Energy Reduction(MW	8,436	8,858	9,301	9,766	10,254	10,767	11,305	11,870	12,464	13,087	13,742
	6a) Program Demand Savings	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
5*6a*kW@Peak	7) MTP Demand Reduction(M	1.3	1.3	1.4	1.5	1.6	1.6	1.7	1.8	1.9	2.0	2.1
	8a) Replacement Factor (%):	10.0%	20.0%	30.0%	40.0%	50.0%	60.0%	70.0%	80.0%	90.0%	100.0%	100.0%
	8b) Economic Attractiveness (%):	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)	633	1,329	2,093	2,930	3,845	4,845	5,935	7,122	8,413	9,815	10,306
	10) Max Econ. Pot.Impact(MW)	0.10	0.20	0.32	0.45	0.59	0.74	0.90	1.08	1.28	1.49	1.57
	11) Market Penetration Rate:				1.90%	2.42%	3.08%	3.90%	4.94%	6.23%	7.83%	9.80%
	12) Cummulative Participants:				145	367	700	1,190	1,904	2,929	4,384	5,820
	13) Annual Participants:				145	222	333	491	714	1,025	1,454	1,437
12*kWH/Part	14a DSM Impact(MWH):				24	62	118	200	320	493	737	979
12*kWD/Part	14b DSM Impact(MW):				0.004	0.009	0.018	0.030	0.049	0.075	0.112	0.149
	14c) Base Usage MWH				97,659	102,542	107,669	113,052	118,705	124,640	130,872	137,416
14c-6	14d Energy Usage w MTP Impact				87,893	92,288	96,902	101,747	106,834	112,176	117,785	123,674
14c-9	14e Energy Usage w Economic Po tential Impact				94,729	98,696	102,824	107,117	111,583	116,227	121,057	127,110
14c-14a	14f) Energy Usage w DSM Impact				97,634	102,480	107,551	112,852	118,385	124,147	130,135	136,437
	Economic Analysis											
14a-15	15) LRMC Energy/Capacity $	$0.08										
	16) Annual Energy Cost Savings:				$1,951	$4,940	$9,416	$16,019	$25,625	$39,422	$58,996	$78,328
	17) NPV Energy Savings (i=12%)	699,646										
	18) Equipment Cost/ Participant:	$90.00										
13*18	19) Total Equipment Cost:				$13,044	$19,990	$29,939	$44,155	$64,238	$92,272	$130,898	$129,288
19*Rate	20) Taxes and Duties on Equipme	50%			$6,522	$9,995	$14,969	$22,077	$32,119	$46,136	$65,449	$64,644
19*20	21) Economic Equipment Cost:				$6,522	$9,995	$14,969	$22,077	$32,119	$46,136	$65,449	$64,644
	22) Administrative Expenses:				$7,020	$7,020	$7,020	$7,020	$7,020	$0	$0	$0
21+22	23) Annual Program Costs				$13,542	$17,015	$21,989	$29,097	$39,139	$46,136	$65,449	$64,644
	24) NPV Program Costs (i=12%)	552,431										
17/24	25) Benefit Cost Ratio	1.3										
	26) Program Cash Flows				($11,591)	($12,075)	($12,573)	($13,078)	($13,514)	($6,714)	($6,453)	$13,684
	27) NPV Program Cash Flows (i=	147,215										
	28) IRR	27.23%										

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FORMULAS	PROGRAM IMPACT PER YEAR	2002	2003	2004	2005	2006	2007	2008	2009	2010
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	178,690	187,624	197,005	206,855	217,198	228,058	239,461	251,434	264,006
	1b) % Cust. w/ End-Use:	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%
	1c) Total Cust. w/ End-Use:	107,214	112,574	118,203	124,113	130,319	136,835	143,677	150,860	158,403
	2) End-Use Tech Saturation %:	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
1c*2	3) Eligible Target Market	85,771	90,060	94,562	99,291	104,255	109,468	114,941	120,688	126,723
	4) Interaction Adjustment Factor	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
3*4	5) MTP Participation:	85,771	90,060	94,562	99,291	104,255	109,468	114,941	120,688	126,723
	5a) Program Energy Savings	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
5a*14c*4	6) MTP Energy Reduction(MW	14,429	15,150	15,908	16,703	17,538	18,415	19,336	20,303	21,318
	6a) Program Demand Savings	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
5*6a*kW@Peak	7) MTP Demand Reduction(M	2.2	2.3	2.4	2.5	2.7	2.8	2.9	3.1	3.2
	8a) Replacement Factor (%):	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	8b) Economic Attractiveness (%):	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%	75.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)	10,821	11,363	11,931	12,527	13,154	13,811	14,502	15,227	15,988
	10) Max Econ. Pot.Impact(MW)	1.65	1.73	1.82	1.91	2.00	2.10	2.21	2.32	2.43
	11) Market Penetration Rate:	12.21%	15.10%	18.53%	22.54%	27.12%	32.25%	37.85%	43.78%	49.91%
	12) Cummulative Participants:	7,666	10,012	12,957	16,598	21,022	26,293	32,440	39,446	47,246
	13) Annual Participants:	1,846	2,346	2,945	3,641	4,424	5,271	6,147	7,006	7,800
12*kWH/Part	14a DSM Impact(MWH):	1,290	1,684	2,180	2,792	3,536	4,423	5,457	6,636	7,948
12*kWD/Part	14b DSM Impact(MW):	0.196	0.256	0.332	0.425	0.538	0.673	0.831	1.010	1.210
	14c) Base Usage MWH	144,287	151,501	159,076	167,030	175,381	184,150	193,358	203,026	213,177
14c-6	14d Energy Usage w MTP Impact	129,858	136,351	143,168	150,327	157,843	165,735	174,022	182,723	191,859
14c-9	14e Energy Usage w Economic Po	133,465	140,138	147,145	154,503	162,228	170,339	178,856	187,799	197,189
14c-14a	14f) Energy Usage w DSM Impact	142,997	149,817	156,896	164,238	171,845	179,727	187,901	196,390	205,229
	Economic Analysis									
14a-15	15) LRMC Energy/Capacity $									
	16) Annual Energy Cost Savings:	$103,168	$134,745	$174,376	$223,374	$282,909	$353,846	$436,570	$530,857	$635,823
	17) NPV Energy Savings (i=12%)									
	18) Equipment Cost/ Participant:									
13*18	19) Total Equipment Cost:	$166,119	$211,173	$265,036	$327,673	$398,143	$474,392	$553,222	$630,551	$701,967
19*Rate	20) Taxes and Duties on Equipme	$83,059	$105,586	$132,518	$163,836	$199,072	$237,196	$276,611	$315,275	$350,983
19*20	21) Economic Equipment Cost:	$83,059	$105,586	$132,518	$163,836	$199,072	$237,196	$276,611	$315,275	$350,983
	22) Administrative Expenses:	$0	$0	$0	$0	$0	$0	$0	$0	$0
21+22	23) Annual Program Costs	$83,059	$105,586	$132,518	$163,836	$199,072	$237,196	$276,611	$315,275	$350,983
	24) NPV Program Costs (i=12%)									
17/24	25) Benefit Cost Ratio									
	26) Program Cash Flows	$20,109	$29,159	$41,858	$59,537	$83,837	$116,650	$159,959	$215,582	$284,840
	27) NPV Program Cash Flows (i=									
	28) IRR									

Inital Penetration Rate	1.50%	Saturation in 1990 =	2.6%
Penetration Rate T2	50.00%	Saturation in 2010 =	1.5%
Initial Year T1	1	Annual Inc. in Saturation =	-2.6%
Final Year T2	18		
Constant A:	4.1883329462		
Constant B:	-0.246152438		

... Energy and Demand Savings for Other DSM M...

Commercial Sector

FORMULAS	PROGRAM IMPACT PER YEAR		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	0) Annual Cust Escalation Rate:		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:		104,476	109,700	115,185	120,944	126,991	133,341	140,008	147,008	154,359	162,077	170,180
	1b) % Cust. w/ End-Use:		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	1c) Total Cust. w/ End-Use:		104,476	109,700	115,185	120,944	126,991	133,341	140,008	147,008	154,359	162,077	170,180
	2) End-Use Tech Saturation %:		80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
1c*2	3) Eligible Target Market		83,581	87,760	92,148	96,755	101,593	106,673	112,006	117,607	123,487	129,661	136,144
	4) Interaction Adjustment Factor		80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
3*4	5) MTP Participation:		66,865	70,208	73,718	77,404	81,274	85,338	89,605	94,085	98,790	103,729	108,916
	5a) Program Energy Savings		13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%
5a*14c*4	6) MTP Energy Reduction(MW		13,251	13,914	14,610	15,340	16,107	16,913	17,758	18,646	19,578	20,557	21,585
	6a) Program Demand Savings		12.9%	12.9%	12.9%	12.9%	12.9%	12.9%	12.9%	12.9%	12.9%	12.9%	12.9%
5*6a*kW@Peak	7) MTP Demand Reduction(M		1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.7	2.8
	8a) Replacement Factor (%):		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	8b) Economic Attractiveness (%):		93.0%	93.0%	93.0%	93.0%	93.0%	93.0%	93.0%	93.0%	93.0%	93.0%	93.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)		12,324	12,940	13,587	14,266	14,980	15,729	16,515	17,341	18,208	19,118	20,074
	10) Max Econ. Pot.Impact(MW)		2	2	2	2	2	2	2	2	2	2	3
	11) Market Penetration Rate:					1.70%	2.22%	2.88%	3.75%	4.85%	6.26%	8.05%	10.29%
	12) Cummulative Participants:					1,224	1,675	2,289	3,122	4,245	5,755	7,767	10,425
	13) Annual Participants:					1,224	451	614	832	1,124	1,509	2,012	2,659
12*kWH/Part	14a DSM Impact(MWH):					243	332	454	619	841	1,140	1,539	2,066
12*kWD/Part	14b DSM Impact(MW):					0.031	0.043	0.059	0.080	0.109	0.148	0.199	0.267
	14c) Base Usage MWH					146,488	153,813	161,503	169,578	178,057	186,960	196,308	206,124
14c-6	14d Energy Usage w MTP Impact					131,148	137,705	144,591	151,820	159,411	167,382	175,751	184,538
14c-9	14e Energy Usage w Economic Po tential Impact					132,222	138,833	145,775	153,063	160,716	168,752	177,190	186,049
14c-14a	14f) Energy Usage w DSM Impact					146,246	153,481	161,050	168,960	177,216	185,820	194,769	204,058
	Economic Analysis												
14a-15	15) LRMC Energy/Capacity $	$0.08											
	16) Annual Energy Cost Savings:					$97,915	$36,097	$49,113	$66,597	$89,916	$120,730	$160,963	$212,704
	17) NPV Energy Savings (i=12%)	1,788,648											
	18) Equipment Cost/ Participant:	$80.60											
13*18	19) Total Equipment Cost:					$98,650	$36,368	$49,481	$67,097	$90,591	$121,635	$162,171	$214,299
19*Rate	20) Taxes on Equipment:	10%				$9,865	$3,637	$4,948	$6,710	$9,059	$12,164	$16,217	$21,430
19*20	21) Economic Equipment Cost:					$88,785	$32,731	$44,533	$60,387	$81,532	$109,472	$145,954	$192,870
	22) Administrative Expenses:					$5,760	$5,760	$5,760	$5,760	$5,760	$0	$0	$0
21+22	23) Annual Program Costs					$94,545	$38,491	$50,293	$66,147	$87,291	$109,472	$145,954	$192,870
	24) NPV Program Costs (i=12%)	1,642,620											
17/24	25) Benefit Cost Ratio	1.1											
	26) Program Cash Flows					$3,371	($2,394)	($1,180)	$450	$2,625	$11,258	$15,010	$19,835
	27) NPV Program Cash Flows (i=	146,028											
	28) IRR												

FORMULAS	PROGRAM IMPACT PER YEAR	2002	2003	2004	2005	2006	2007	2008	2009	2010
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	178,690	187,624	197,005	206,855	217,198	228,058	239,461	251,434	264,006
	1b) % Cust. w/ End-Use:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	1c) Total Cust. w/ End-Use:	178,690	187,624	197,005	206,855	217,198	228,058	239,461	251,434	264,006
	2) End-Use Tech Saturation %:	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
1c*2	3) Eligible Target Market	142,952	150,099	157,604	165,484	173,759	182,446	191,569	201,147	211,205
	4) Interaction Adjustment Factor	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
3*4	5) MTP Participation:	114,361	120,079	126,083	132,387	139,007	145,957	153,255	160,918	168,964
	5a) Program Energy Savings	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%	13.1%
5a*14c*4	6) MTP Energy Reduction(MW	22,665	23,798	24,988	26,237	27,549	28,926	30,373	31,891	33,486
	6a) Program Demand Savings	12.9%	12.9%	12.9%	12.9%	12.9%	12.9%	12.9%	12.9%	12.9%
5*6a*kW@Peak	7) MTP Demand Reduction(M	2.9	3.1	3.2	3.4	3.6	3.7	3.9	4.1	4.3
	8a) Replacement Factor (%):	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	8b) Economic Attractiveness (%):	93.0%	93.0%	93.0%	93.0%	93.0%	93.0%	93.0%	93.0%	93.0%
6*8a*8b	9) Max Econ. Pot.Impact(MWH)	21,078	22,132	23,239	24,400	25,620	26,901	28,247	29,659	31,142
	10) Max Econ. Pot.Impact(MW)	3	3	3	3	3	3	4	4	4
	11) Market Penetration Rate:	13.07%	16.46%	20.52%	25.28%	30.71%	36.74%	43.22%	49.93%	56.65%
	12) Cummulative Participants:	13,900	18,379	24,059	31,120	39,703	49,873	61,595	74,725	89,017
	13) Annual Participants:	3,475	4,479	5,679	7,061	8,583	10,170	11,722	13,130	14,292
12*kWH/Part	14a DSM Impact(MWH):	2,755	3,642	4,768	6,168	7,868	9,884	12,207	14,809	17,642
12*kWD/Part	14b DSM Impact(MW):	0	0	1	1	1	1	2	2	2.3
	14c) Base Usage MWH	216,430	227,251	238,614	250,545	263,072	276,225	290,037	304,539	319,765
14c-6	14d Energy Usage w MTP Impact	193,765	203,454	213,626	224,308	235,523	247,299	259,664	272,647	286,280
14c-9	14e Energy Usage w Economic Po	195,352	205,119	215,375	226,144	237,451	249,324	261,790	274,880	288,624
14c-14a	14f) Energy Usage w DSM Impact	213,675	223,609	233,846	244,377	255,203	266,341	277,830	289,729	302,124
	Economic Analysis									
14a-15	15) LRMC Energy/Capacity $									
	16) Annual Energy Cost Savings:	$277,973	$358,338	$454,357	$564,915	$686,623	$813,580	$937,787	$1,050,372	$1,143,400
	17) NPV Energy Savings (i=12%)									
	18) Equipment Cost/ Participant:									
13*18	19) Total Equipment Cost:	$280,058	$361,026	$457,765	$569,152	$691,773	$819,682	$944,820	$1,058,250	$1,151,975
19*Rate	20) Taxes on Equipment:	$28,006	$36,103	$45,777	$56,915	$69,177	$81,968	$94,482	$105,825	$115,198
19*20	21) Economic Equipment Cost:	$252,052	$324,923	$411,989	$512,237	$622,596	$737,714	$850,338	$952,425	$1,036,778
	22) Administrative Expenses:	$0	$0	$0	$0	$0	$0	$0	$0	$0
21+22	23) Annual Program Costs	$252,052	$324,923	$411,989	$512,237	$622,596	$737,714	$850,338	$952,425	$1,036,778
	24) NPV Program Costs (i=12%)									
17/24	25) Benefit Cost Ratio									
	26) Program Cash Flows	$25,921	$33,415	$42,369	$52,678	$64,028	$75,866	$87,449	$97,947	$106,622
	27) NPV Program Cash Flows (i=									
	28) IRR									

Inital Penetration Rate	1.00%
Penetration Rate T2	50.00%
Initial Year T1	1
Final Year T2	18
Constant A:	4.5978464444
Constant B:	-0.270301168

SUMMARY TABLE OF COMMERCIAL ENERGY SAVINGS (MWH) PROGRAM	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
INTERIOR LIGHTING				210.2	441.1	794.3	1,321.4	2,092.2	3,199.9	4,145.1	5,346.0	6,858.8	8,745.1
EXTERIOR LIGHTING				51.2	185.9	395.8	713.4	1,182.8	1,547.2	2,013.6	2,606.2	3,352.7	4,283.4
AIR CONDITIONING				7.0	16.2	27.9	43.1	62.7	87.8	120.2	161.8	215.1	283.3
REFRIGERATION				24.4	61.7	117.7	200.2	320.3	492.8	737.4	979.1	1,289.6	1,684.3
********				0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OTHER (Includes Low Cost/ No Cost Measures)				242.6	332.0	453.7	618.6	841.4	1,140.5	1,539.2	2,066.2	2,754.8	3,642.5
TOTAL ENERGY SAVINGS (GW H)				0.54	1.04	1.79	2.90	4.50	6.47	8.56	11.16	14.47	18.64
TOTAL ANNUAL ENERGY CONSUMPTION (GWH)				3,213	3,377	3,542	3,706	3,870	4,035	4,199	4,363	4,528	4,692
PERCENT SECTOR ENERGY CONSUMPTION OF TOTAL (%)				22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%
TOTAL ANNUAL SECTOR ENERGY CONSUMPTION (GWH)				723	760	797	834	871	908	945	982	1,019	1,056
PERCENT ENERGY SAVINGS				0.1%	0.1%	0.2%	0.3%	0.5%	0.7%	0.9%	1.1%	1.4%	1.8%

SUMMARY TABLE OF COMMERCIAL DEMAND SAVINGS (MW) PROGRAM	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
INTERIOR LIGHTING				0.01	0.03	0.05	0.08	0.13	0.20	0.26	0.33	0.42	0.54
EXTERIOR LIGHTING				0.02	0.07	0.15	0.27	0.45	0.59	0.77	0.99	1.28	1.63
AIR CONDITIONING				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REFRIGERATION				0.00	0.01	0.02	0.03	0.05	0.07	0.11	0.15	0.20	0.26
********				0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OTHER (Includes Low Cost/ No Cost Measures)				0.03	0.04	0.06	0.08	0.11	0.15	0.20	0.27	0.36	0.47
TOTAL DEMAND SAVINGS (MW)				0.07	0.15	0.28	0.46	0.74	1.01	1.33	1.74	2.25	2.90
ANNUAL MAXIMUM SYSTEM DEMAND (MW)				643	676	709	742	775	808	841	874	907	940
PERCENT SECTOR DEMAND CONTRIBUTION TO PEAK (%)				21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%
SECTOR DEMAND CONTRIBUTION TO PEAK (MW)				135	142	149	156	163	170	177	183	190	197
PERCENT DEMAND REDUCTION (%)				0.0%	0.1%	0.2%	0.3%	0.5%	0.6%	0.8%	0.9%	1.2%	1.5%

SUMMARY TABLE OF COM PROGRAM	2004	2005	2006	2007	2008	2009	2010	Percent
INTERIOR LIGHTING	11,069.0	13,893.0	17,271.3	21,243.3	25,826.5	31,011.4	36,760.1	44.7%
EXTERIOR LIGHTING	5,430.1	6,823.6	8,490.6	10,450.5	12,712.0	15,270.5	18,172.9	22.1%
AIR CONDITIONING	370.3	480.8	620.7	797.1	1,018.1	1,293.1	1,632.8	2.0%
REFRIGERATION	2,179.7	2,792.2	3,536.4	4,423.1	5,457.1	6,635.7	7,947.8	9.7%
********	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0%
OTHER (Includes Low Cost/ No	4,768.1	6,167.5	7,868.5	9,884.0	12,207.1	14,809.2	17,641.8	21.5%
TOTAL ENERGY SAVINGS (GW	23.82	30.16	37.79	46.80	57.22	69.02	82.16	100.0%
TOTAL ANNUAL ENERGY CON	4,856	5,021	5,185	5,350	5,514	5,678	5,843	
PERCENT SECTOR ENERGY C	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	22.5%	
TOTAL ANNUAL SECTOR ENER	1,093	1,130	1,167	1,204	1,241	1,278	1,315	
PERCENT ENERGY SAVINGS	2.2%	2.7%	3.2%	3.9%	4.6%	5.4%	6.2%	

SUMMARY TABLE OF COM PROGRAM	2004	2005	2006	2007	2008	2009	2010
INTERIOR LIGHTING	0.68	0.86	1.06	1.31	1.59	1.91	2.26
EXTERIOR LIGHTING	2.07	2.60	3.23	3.98	4.84	5.81	6.91
AIR CONDITIONING	0.00	0.00	0.00	0.00	0.00	0.00	0.00
REFRIGERATION	0.33	0.42	0.54	0.67	0.83	1.01	1.21
********	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OTHER (Includes Low Cost/ No	0.62	0.80	1.02	1.28	1.58	1.92	2.28
TOTAL DEMAND SAVINGS (MW	3.70	4.68	5.85	7.24	8.84	10.65	12.67
ANNUAL MAXIMUM SYSTEM D	973	1,005	1,038	1,071	1,104	1,137	1,170
PERCENT SECTOR DEMAND C	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%	21.0%
SECTOR DEMAND CONTRIBUT	204	211	218	225	232	239	246
PERCENT DEMAND REDUCTIO	1.8%	2.2%	2.7%	3.2%	3.8%	4.5%	5.2%

Table 9T

Guatemala Commercial Sector
Interior Lighting

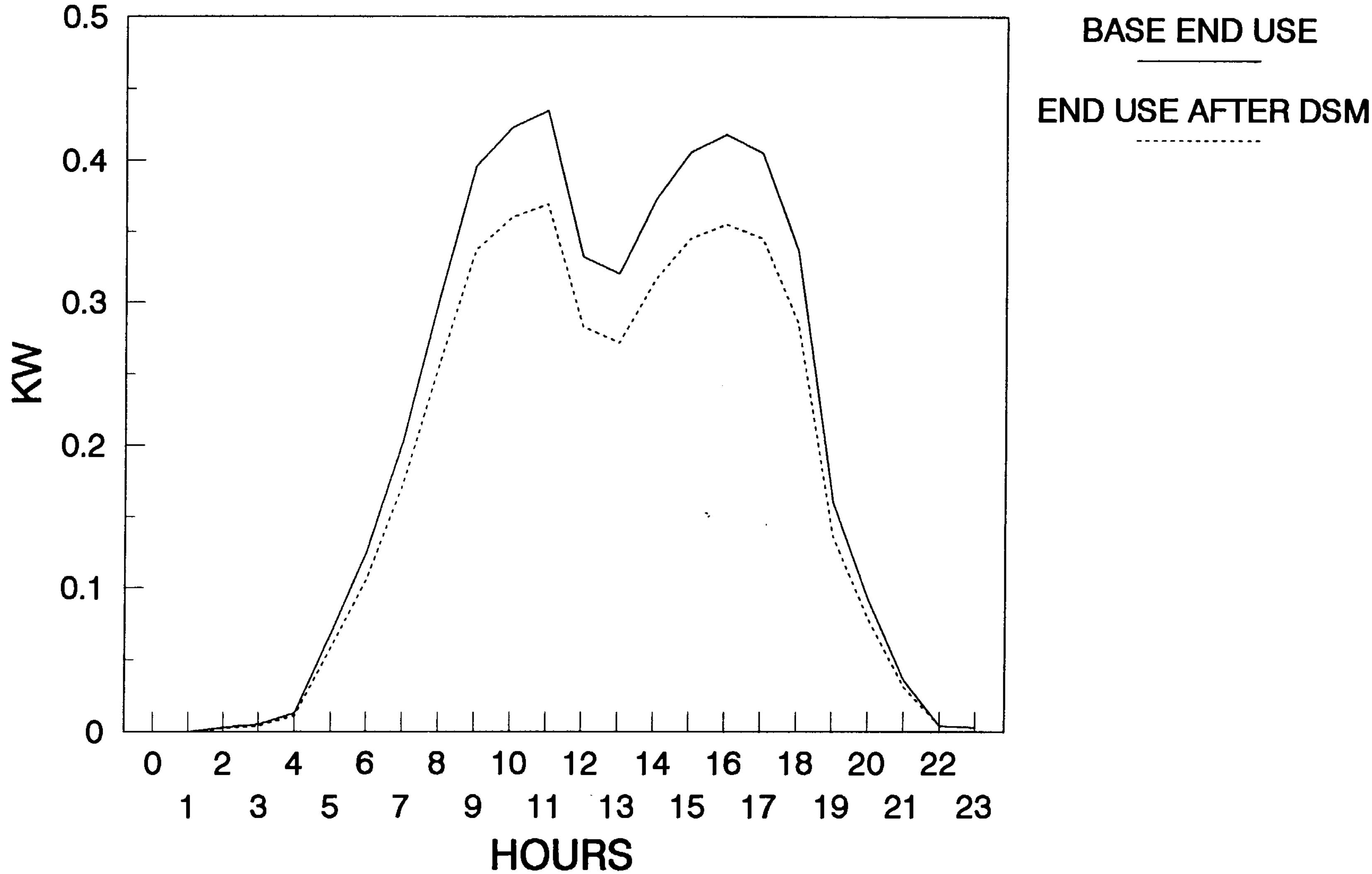

Table 10T

Guatemala Commercial Sector
Exterior Lighting

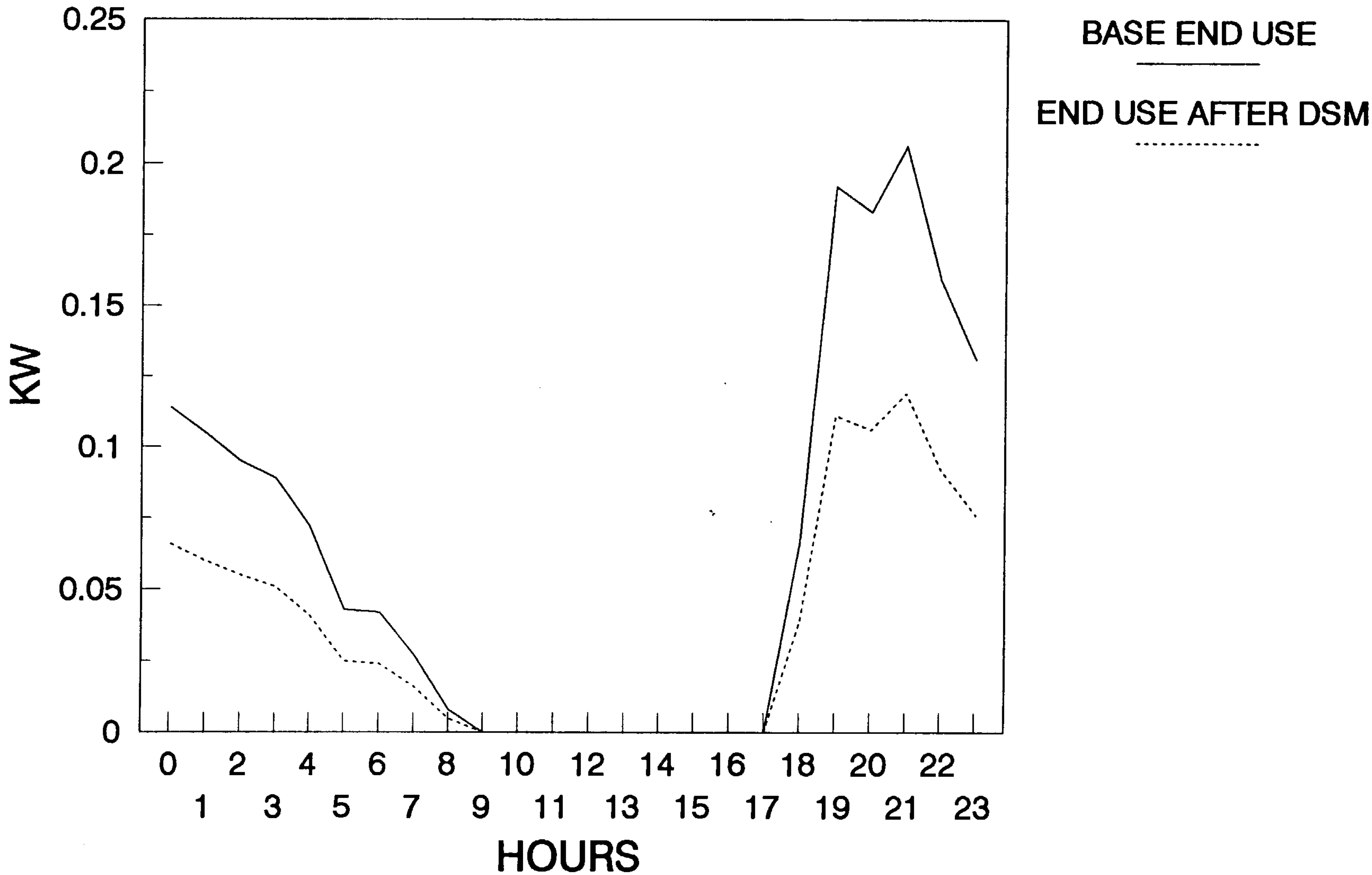

Table 11T

Guatemala Commercial Sector
Air Conditioning

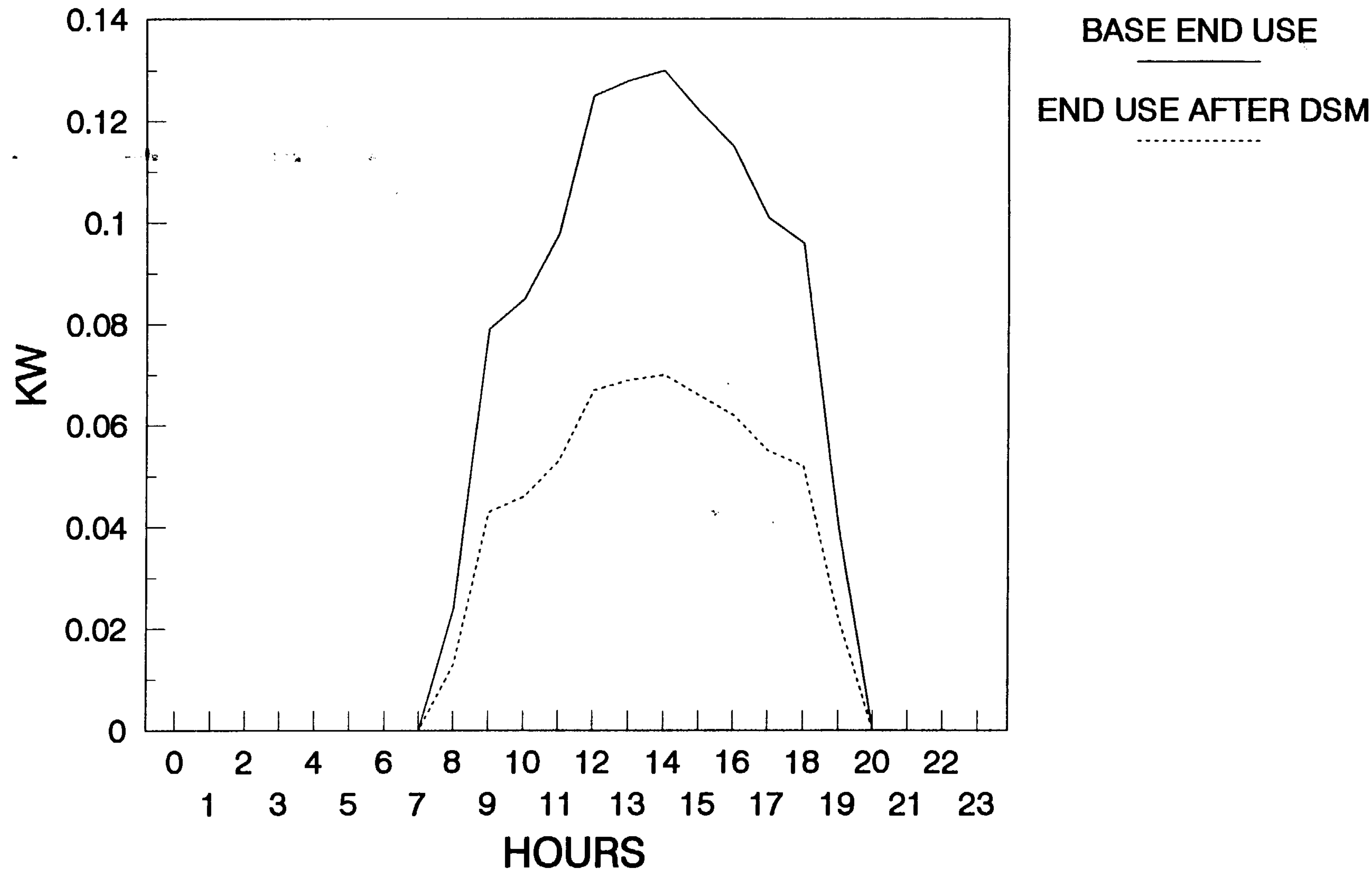

Table 12T

Guatemala Commercial Sector
Refrigeration

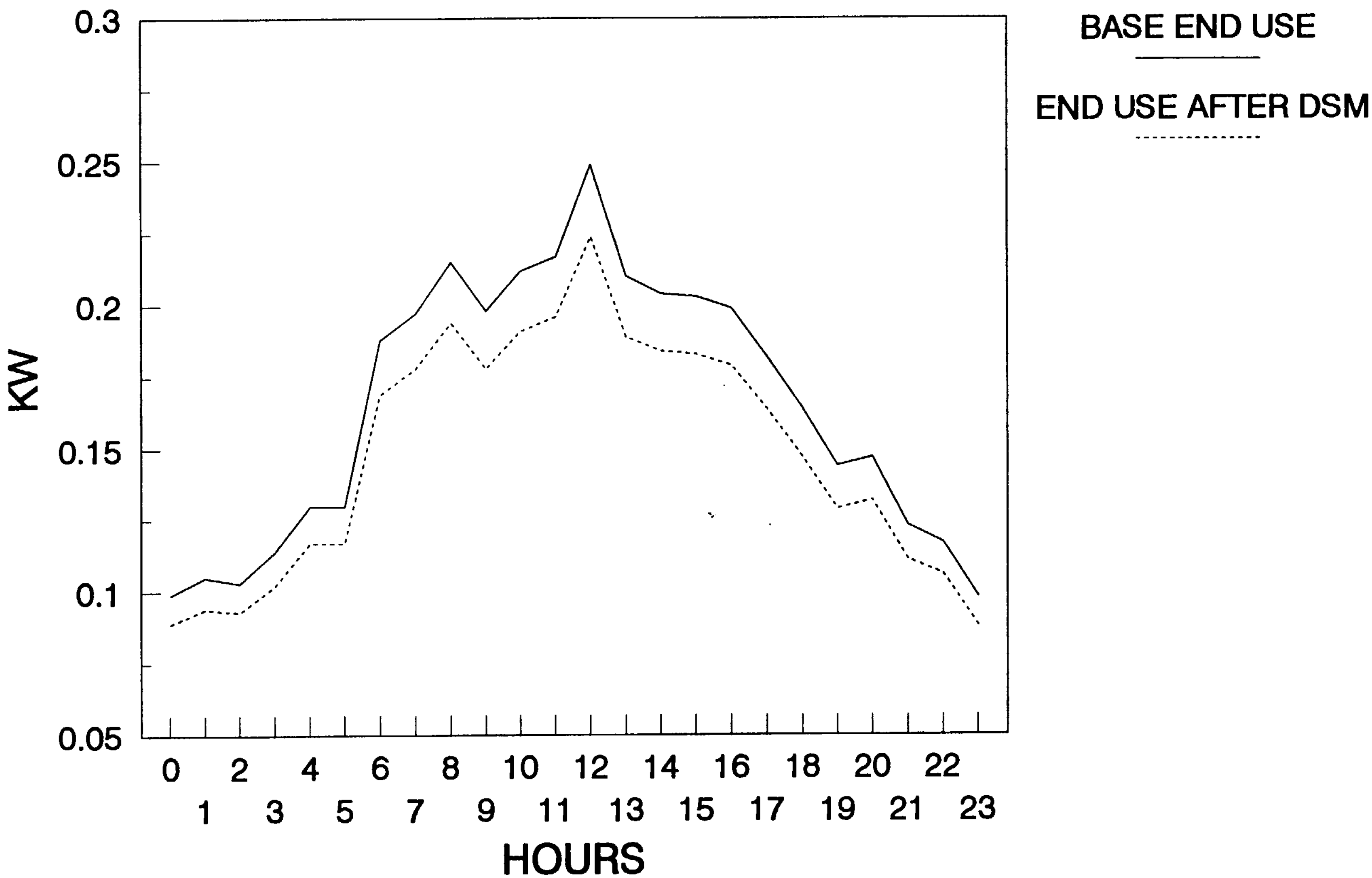

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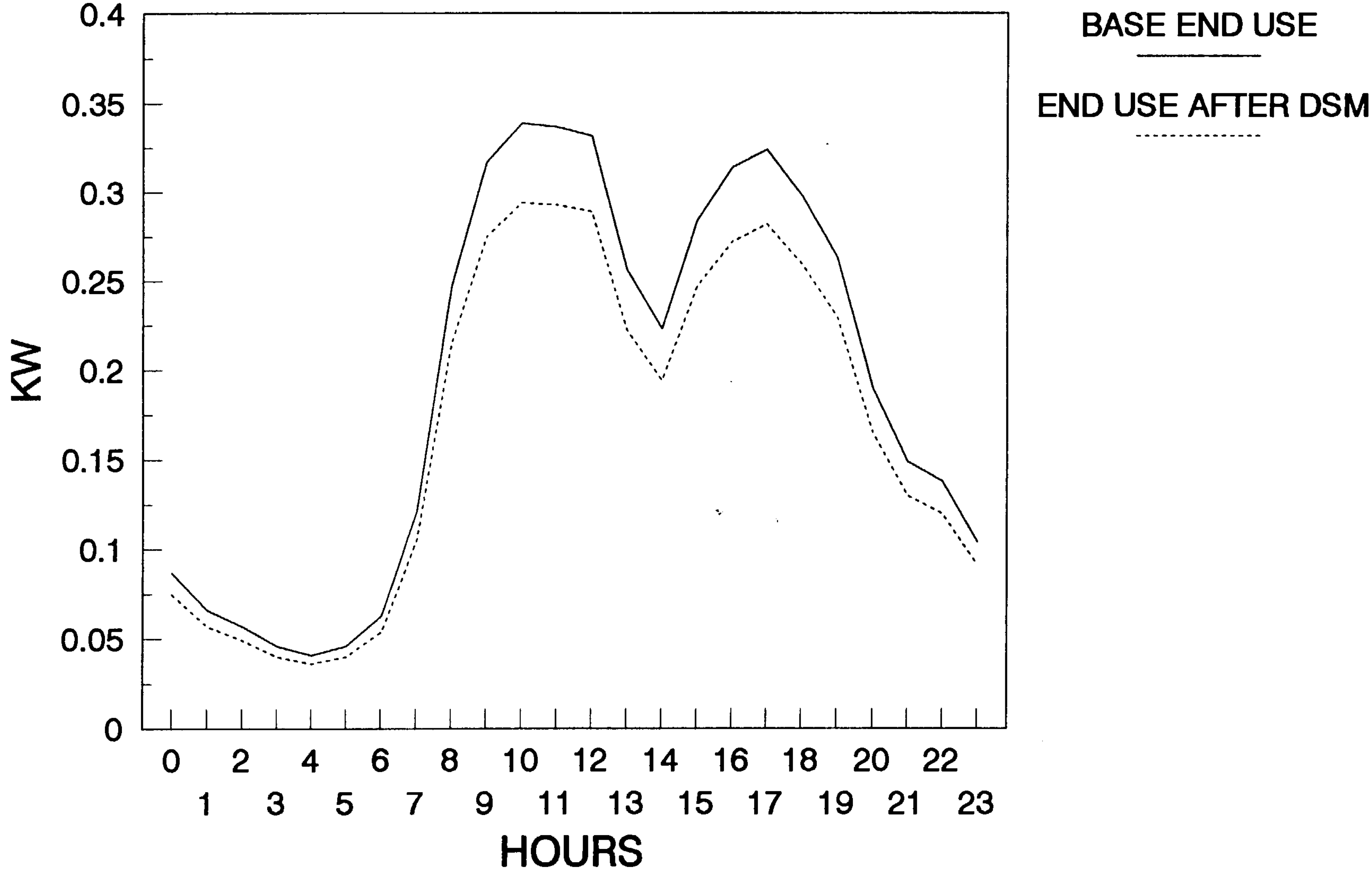
Table 13T

Guatemala Commercial Sector
Other



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APPENDIX E

DEMAND-SIDE MANAGEMENT IMPACT MODEL
Residential Sector

Summary of Energy and Demand Savings by the Year 2010

	Guat. Mkt. Pen.	MWh Usage	% Savings /Inst.	Overall GWh Saved	Overall % Savings	Maximum MW	Peak Coinc. Factor	Peak Coinc. MW	% Savings /Inst.	Peak MW Saved	Peak % Savings
Residential Sector		1,765,000				562	1.00	562			
Refrigeration	55.0%	510,085	29.1%	29.05	1.65	80.4	1.00	80.4	4.5%	3.60	0.64
Lighting	50.0%	360,060	42.6%	45.56	2.58	275.9	1.00	275.9	9.0%	24.82	4.42%
Termoduchas	50.0%	197,327	33.3%	30.18	1.71%	105.0	0.24	24.7	11.8%	2.93	0.52%
Water Heating - WH Tanks	50.0%	48,185	28.9%	1.20	0.07%	25.8	0.24	6.2	2.1%	0.13	0.02%
Cooking	40.0%	259,455	15.0%	7.90	0.45%	88.8	1.00	88.8	2.4%	2.10	0.37%
Total				113.85	6.50%					33.6	6.0%

FINANCIAL ANALYSIS OF MEASURES

RESIDENTIAL SECTOR DSM PROGRAM MEASURES

1	Reference	R-1	R-2*	R-3	R-4**	R-5	R-6	R-7
2	Sector	Residential	Residential	Residential	Residential	Residential	Residential	Residential
3	Subsector	All	All	All	All	All	All	All
4	End Use	Lighting	Lighting	Lighting	Lighting	Cooking	Refrigeration	Refrigeration
5	Measure	Hi Eff Incand (I)	Compact Fluor. (I)	Hi Eff Fluor. (I)	new 40 W fluor electronic ballasts (I)	(I) Eff Stoves (Insulation & Cktop Upgrade)	(I)Refrigerator Insulation & Compr Upgrade)	Seals (1) (F)
6	Application	retrofit	retrofit	retrofit	retrofit	replacement	replacement	retrofit
7	Base Case	incand. 100W	incand. 62W	F40	F40 std ballast	avg 1000 W	70 kWh/mo	70 kWh/mo
8	Demand (Watts)	100	62	40	96	2400	130	130
9	Energy (kWH/year)	109.5	67.89	43.8	105.12	2160	840	840
10	Equip. Cost (US$)	0.5	0.5	1.5	13.35	500	450	0
11	Labor Cost (US$/h)	0	0	0	0	0	0	0
12	Instal. Time (h)	0	0	0	0	0	0	0
13	Total Cost ($)	0.5	0.5	1.5	13.35	500	450	0
	Replacement	Hi eff 90W	CFL 15 W	F40 EE	new ballast	Eff Stove	new refrig.	new seals
14	Demand (Watts)	90	15	34	67	2040	74	123.5
	Energy (kWH/year)	99	16	37	73	1836	479	798
15	Equip. Cost (US$)	1.19	17.4	3.6	44	650	550	10
16	Labor Cost (US$/h)	0	0	0	0	0	0	0
17	Instal. Time (h)	0	0	0	0	0	0	0
18	Total Cost	1.19	14.5	3.6	44	650	550	10
19	Operating time (h/y)	1095	1095	1095	1095	900	6460	6460
	Applicable Tariff(+)							
20	Energy Cost (US$/kWh)	0.060	0.060	0.060	0.060	0.060	0.060	0.060
21	Demand Cost (US$/kW/y)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	% savings	10.0%	76.0%	15.0%	23.4%	15.0%	43.0%	5.0%
23	Energy Savings (kWh/yr)	11	51	7	35	324	361	42
24	Demand Savings (Watts)	10	47	6	32	360	56	7
25	Total Savings (US$/y)	0.65	3.08	0.39	2.08	19.38	21.60	2.51
26	Cost of Measure (US$)	0.69	11.84	2.10	28.24	150	100	10.00
27	Simple Payback (y)	1.1	3.8	5.3	13.6	7.7	4.6	4.0
28	Cost Conserved Energy	$0.078	$0.043	$0.060	$0.109	$0.062	$0.037	$0.066
29	Discount Rate	0.12	0.12	0.12	0.12	0.12	0.12	0.12
30	Capital Recovery Fctr	1.24	0.19	0.19	0.13	0.13	0.13	0.28
31	Life of Meas. in Years	0.9	9.1	9.1	20.0	20.0	20.0	5.0

(I)= Incremental Cost
(F)= Full Cost

* Assumes replacement of 1-50watt & 1-75watt lamp per participant.

** Measures R-1, R-4 and R-12 were not included in further analysis due to their long payback.

*** This measure is used only where the savings can be achieved. Savings can be much greater , based on the conditions of the e

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	RESIDENTIAL PROGRAM MEASURES							
1	Reference	R-8	R-9	R-10	R-11	R-12	R-13	R-14
2	Sector	Residential	Residential	Residential	Residential	Residential	Residential	Residential
3	Subsector	All	All	All	All	All	All	All
4	End Use	Refrigeration	Water heating	Water heating	Water heating	Water heating	Water heating	L.F Shower Head
5	Measure	Behav Mod.	Lower power termoduchas(I)	ins. blanket for tank heaters(F)	Heat Pump for tank heaters(I)	solar heater for tank heaters(I)	hi eff heater for tank heaters(I)	for tank heaters(F)
6	Application	retrofit	replacement	retrofit	replacement	replacement	replacement	retrofit
7	Base Case	70 kWh/mo	3000 W element	2500 W element	2500 W element	2500 W element	2500 W element	2500 W element
8	Demand (Watts)	130	3000	2500	2500	2500	2500	2500
9	Energy (kWH/year)	840	600	1200	1200	1200	1200	1200
10	Equip. Cost (US$)	0	40	255	255	255	255	255
11	Labor Cost (US$/h)	0	0	0	0	0	0	0
12	Instal. Time (h)	0	0	0	0	0	0	0
13	Total Cost ($)	0	40	255	255	255	255	255
	Replacement	Behav Mod.	2000 W element	insulated	HP COP=2.6	Solar Sys.	Eff WH.	L.F Shower Head
14	Demand (Watts)	117	2000	2200	692	200	2000	2000
	Energy (kWH/year)	756	400	1056	332	96	960	960
15	Equip. Cost (US$)	0	50	10	600	1000	355	12
16	Labor Cost (US$/h)	0	0	0	0	0	0	0
17	Instal. Time (h)	0	0	0	0	0	0	0
18	Total Cost	0	50	10	600	1000	355	12
19	Operating time (h/y)	6460	200	480	480	480	480	480
	Applicable Tariff(+)							
20	Energy Cost (US$/kWh)	0.060	0.060	0.060	0.060	0.060	0.060	0.060
21	Demand Cost (US$/kW/y)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	% savings	10.0%	33.3%	12.0%	72.3%	92.0%	20.0%	20.0%
23	Energy Savings (kWh/yr)	84	200	144	868	1104	240	240
24	Demand Savings (Watts)	13	1000	300	1808	2300	500	500
25	Total Savings (US$/y)	5.02	11.96	8.61	51.91	66.03	14.35	14.35
26	Cost of Measure (US$)	0.00	10.00	10.00	345	745	100	12.00
27	Simple Payback (y)	0.0	0.8	1.2	6.6	11.3	7.0	0.8
28	Cost Conserved Energy	$0.000	$0.009	$0.019	$0.058	$0.090	$0.056	$0.014
29	Discount Rate	0.12	0.12	0.12	0.12	0.12	0.12	0.12
30	Capital Recovery Fctr	0.28	0.18	0.28	0.15	0.13	0.13	0.28
31	Life of Meas. in Years	5.0	10.0	5.0	15.0	20.0	20.0	5.0

(I)= Incremental Cost
(F)= Full Cost

(+) Weighted Average Residential Tariff as provided by EEGSA.
Price Quotes are from Guatemala or US prices plus import duty and taxes.
existing seals.

1	Reference	R-15
2	Sector	Residential
3	Subsector	All
4	End Use	Timers
5	Measure	for tank heaters (F)
6	Application	retrofit
7	Base Case	2500 W element
8	Demand (Watts)	2500
9	Energy (kWH/year)	1200
10	Equip. Cost (US$)	255
11	Labor Cost (US$/h)	0
12	Instal. Time (h)	0
13	Total Cost ($)	255
	Replacement	Timers
14	Demand (Watts)	1250
	Energy (kWH/year)	1080
15	Equip. Cost (US$)	35
16	Labor Cost (US$/h)	10
17	Instal. Time (h)	1
18	Total Cost	45
19	Operating time (h/y)	480
	Applicable Tariff(+)	
20	Energy Cost (US$/kWh)	0.060
21	Demand Cost (US$/kW/y)	0.00
22	% savings	10.0%
23	Energy Savings (kWh/yr)	120
24	Demand Savings (Watts)	1250
25	Total Savings (US$/y)	7.18
26	Cost of Measure (US$)	35
27	Simple Payback (y)	4.9
28	Cost Conserved Energy	$0.064
29	Discount Rate	0.12
30	Capital Recovery Fctr	0.22
31	Life of Meas. in Years	7.0
	(I)= Incremental Cost (F)= Full Cost	

TABLE 1

1990 RESIDENTIAL SECTOR ENERGY CONSUMPTION

	EEGSA	INDE	TOTAL
1)1990 Residential	-----	----	-----
Sector Energy Use:	473,567 MWH (1)	126,405 MWH (2)	599,972 MWH
2) % of Total:	78.9%	21.1%	

AUGUST 1991
RESIDENTIAL HOURLY LOAD IN KW

TIME OF DAY	EEGSA SYSTEM RES LOAD (kW)	EEGSA RES LOAD AS % OF DAILY USE*	EEGSA RES LOAD (%) OF PEAK	INDE SYSTEM RES LOAD (kW)	INDE RES LOAD AS % OF DAILY USE*	INDE RES LOAD (%) OF PEAK	SNI RES LOAD (kW)	SNI RES LOAD (%) OF PEAK
----	----	------	-----	----	-----	-----	----	-----
	(Input)			(Output)	(Input)			
0	43,232	2.6%	36.0%	4,453	1.0%	6.5%	47,685	25.8%
1	40,976	2.5%	34.1%	4,453	1.0%	6.5%	45,429	24.6%
2	40,486	2.4%	33.7%	4,453	1.0%	6.5%	44,939	24.3%
3	40,824	2.4%	34.0%	8,906	2.0%	13.1%	49,730	26.9%
4	50,642	3.0%	42.2%	11,132	2.5%	16.3%	61,774	33.5%
5	83,586	5.0%	69.6%	26,717	6.0%	39.2%	110,303	59.7%
6	89,576	5.4%	74.6%	17,811	4.0%	26.1%	107,387	58.2%
7	73,023	4.4%	60.8%	11,132	2.5%	16.3%	84,155	45.6%
8	67,394	4.0%	56.1%	6,679	1.5%	9.8%	74,073	40.1%
9	67,417	4.0%	56.2%	6,679	1.5%	9.8%	74,096	40.1%
10	69,709	4.2%	58.1%	13,359	3.0%	19.6%	83,068	45.0%
11	69,125	4.1%	57.6%	17,811	4.0%	26.1%	86,936	47.1%
12	69,963	4.2%	58.3%	11,132	2.5%	16.3%	81,095	43.9%
13	71,059	4.3%	59.2%	8,906	2.0%	13.1%	79,965	43.3%
14	68,498	4.1%	57.1%	8,906	2.0%	13.1%	77,404	41.9%
15	65,566	3.9%	54.6%	8,906	2.0%	13.1%	74,472	40.3%
16	70,206	4.2%	58.5%	10,687	2.4%	15.7%	80,893	43.8%
17	68,405	4.1%	57.0%	13,359	3.0%	19.6%	81,764	44.3%
18	82,402	4.9%	68.6%	34,732	7.8%	51.0%	117,134	63.4%
19	120,048	7.2%	100.0%	64,566	14.5%	94.8%	184,614	100.0%
20	115,913	6.9%	96.6%	68,129	15.3%	100.0%	184,042	99.7%
21	94,611	5.7%	78.8%	44,528	10.0%	65.4%	139,139	75.4%
22	64,210	3.8%	53.5%	22,264	5.0%	32.7%	86,474	46.8%
23	41,356	2.5%	34.4%	15,585	3.5%	22.9%	56,941	30.8%
	---------	------		--------	------		--------	
Daily kWh:	1,668,227	100.0%	(Input)>	445,285 445,285	100.0%		2,113,512	

Daily Residential Energy Consumption for Typical Day in August 1991:	2,114 MWH
Daily Residential Energy Consumption for Typical Day in August 1991, as a % of 1991 Annual kWh.	0.33%
Annual Residential Energy Consumption for 1990:	599,972 MWH
Annual Residential Energy Consumption for 1991:	635,970 MWH

(Assumes an annual growth rate of 6% in 1991)

(*) = Consumption as % of daily energy consumption.

(**) = INDE consumption was estimated at the same % as EEGSA.

1) Source: Reporte Estadistico de EEGSA 1990, Cuadro No. 1.

2) Source: INDE, Reporte Estadistico 1990.

TABLE 2

TYPICAL DAY

1990 RESIDENTIAL SECTOR ENERGY CONSUMPTION

Residential	EEGSA (MWH)	INDE (MWH)	TOTAL (MWH)	
Annual Usage	473,567	126,405	599,972	(INPUTS)
Daily Usage	1,297	346	1,644	

NOTE: The above variables will change the spreadsheet below.

1990 TYPICAL DAY
RESIDENTIAL HOURLY LOAD IN KW

TIME	EEGSA RES LOAD (kW)	EEGSA RES LOAD AS % OF DAILY USE*	INDE RES LOAD (kW)	INDE RES LOAD AS % OF DAILY USE*	SNI RES LOAD (kW)
0	33,623	2.6%	3,463	1.0%	37,086
1	31,869	2.5%	3,463	1.0%	35,332
2	31,488	2.4%	3,463	1.0%	34,951
3	31,750	2.4%	6,926	2.0%	38,677
4	39,386	3.0%	8,658	2.5%	48,044
5	65,008	5.0%	20,779	6.0%	85,787
6	69,667	5.4%	13,853	4.0%	83,519
7	56,793	4.4%	8,658	2.5%	65,451
8	52,415	4.0%	5,195	1.5%	57,610
9	52,433	4.0%	5,195	1.5%	57,628
10	54,215	4.2%	10,389	3.0%	64,605
11	53,761	4.1%	13,853	4.0%	67,614
12	54,413	4.2%	8,658	2.5%	63,071
13	55,265	4.3%	6,926	2.0%	62,192
14	53,274	4.1%	6,926	2.0%	60,200
15	50,993	3.9%	6,926	2.0%	57,919
16	54,602	4.2%	8,312	2.4%	62,913
17	53,201	4.1%	10,389	3.0%	63,591
18	64,087	4.9%	27,013	7.8%	91,100
19	93,366	7.2%	50,216	14.5%	143,582
20	90,150	6.9%	52,986	15.3%	143,136
21	73,583	5.7%	34,632	10.0%	108,214
22	49,939	3.8%	17,316	5.0%	67,254
23	32,164	2.5%	12,121	3.5%	44,285
Daily kWh:	1,297,444		346,315		1,643,759

Daily Residential Energy Consumption for Typical Day in 1990: .... 1,644 MWH

Daily Residential Energy Consumption for Typical Day in 1990, as a % of 1990 Annual kWh 0.274%

Annual Residential Energy Consumption for 1990 .... 599,972 MWH

(*) = Hourly consumption as % of daily energy consumption.

TABLE 3E

EEGSA RESIDENTIAL SECTOR END-USE BREAKDOWN

		(MWH)	
Total SNI 1990 Residential Consumption:		599,972	MWH
Total 1990 EEGSA Residential Consumption:		473,567	MWH
Total 1990 EEGSA Residential Consumption as % of SNI:		78.93%	
Average Daily 1990 EEGSA Residential Consumption:		1,297	MWH
Number of EEGSA Residential Customers in 1990:	(INPUT)	272,716	Residential Customers (1)

CONSUMPTION BY END-USE	% of Total Sector kWh	Annual Usage (MWh)	Appliance	(INPUTS) Avg. Monthly kWh/end-use	No. of Appli- ances	Estimated Appliance Saturation
Cooking Energy Consumption: (EEGSA)	18.64%	88,256	Stove	180.0	40,859	15.0%
Water Heating Energy Consumption(EEGSA)	12.83%	60,757	Termodu	50.0	101,261	37.1%
(Termoducha + WH Tank) = 16.29%	3.46%	16,379	WH Tank	100.0	13,636	5.0%
Lighting Energy Consumption: (EEGSA)	13.70%	64,871	Lighting	20.0	270,296	99.1%
Refrigeration Energy Consumption(EEGSA):	31.06%	147,091	efrigerator	72.0	170,244	62.4%
Other End-Use Energy Consumption(EEGSA)	20.32%	96,213	Other	29.4	272,626	
	100.00%					

	ELECTRIC COOKING	TERMO-DUCHA	WH TANK	LIGHTING	REFRI-ERATION	OTHER ND-USES
Annual kWh	88,256	60,757	16,379	64,871	147,091	96,213
# Cust w/Appl	40,859	101,261	13,636	270,296	170,244	272,626
# of Days	365	365	365	365	365	365
Avg kWh/Cust/Day	5.92	1.64	3.29	0.66	2.37	0.97

1) Source: Reporte Estadistico de EEGSA 1990, Cuadro No. 1.

TABLE 3E

EEGSA RESIDENTIAL SECTOR - CONTRIBUTION TO HOURLY LOAD BY END-USE

(NOTE: These are the load shape inputs to the MODEL.)

TIME	ELECTRIC COOKING (%)	TERMO-DUCHA (%)	WH TANK (%)	LIGHTING (%)	REFRI-GERATION (%)	OTHER END-USES (%)	CALCULATED EEGSA RES LOAD (kW)	CALCULATED EEGSA HOURLY OINCIDENCE FACTOR (% pk)	D (INPUTS) ACTUAL EEGSA RES LOAD (kW)	ACTUAL EEGSA HOURLY COINCIDENCE FACTOR (% pk)
0	0.40%	1.00%	1.00%	0.50%	3.90%	5.40%	33,920	33.30%	33,623	36.01%
1	0.20%	0.40%	0.40%	0.90%	3.90%	4.80%	31,298	30.72%	31,869	34.13%
2	0.60%	0.70%	0.70%	1.60%	3.90%	4.20%	32,561	31.96%	31,488	33.72%
3	1.20%	3.00%	3.00%	1.60%	3.90%	2.60%	34,655	34.02%	31,750	34.01%
4	1.80%	7.80%	7.80%	2.00%	3.90%	0.50%	41,425	40.66%	39,386	42.18%
5	4.00%	14.00%	14.00%	5.90%	3.95%	0.40%	66,717	65.49%	65,008	69.63%
6	5.00%	15.00%	15.00%	5.60%	4.00%	0.51%	71,206	69.89%	69,667	74.62%
7	4.50%	9.30%	9.30%	5.00%	4.15%	1.00%	58,781	57.70%	56,793	60.83%
8	2.80%	7.00%	7.00%	2.00%	4.20%	3.80%	52,060	51.10%	52,415	56.14%
9	4.90%	5.20%	5.20%	0.50%	4.25%	3.40%	49,815	48.90%	52,433	56.16%
10	6.50%	3.00%	3.00%	0.40%	4.20%	4.00%	50,237	49.31%	54,215	58.07%
11	5.20%	2.20%	2.20%	0.40%	4.25%	6.00%	50,877	49.94%	53,761	57.58%
12	5.10%	1.90%	1.90%	0.50%	4.30%	6.30%	51,171	50.23%	54,413	58.28%
13	4.60%	2.00%	2.00%	0.40%	4.25%	6.20%	49,530	48.62%	55,265	59.19%
14	2.80%	2.75%	2.75%	0.40%	4.28%	6.80%	48,465	47.57%	53,274	57.06%
15	3.40%	2.50%	2.50%	0.70%	4.30%	5.90%	47,629	46.75%	50,993	54.62%
16	4.90%	2.60%	2.60%	1.90%	4.35%	4.00%	48,793	47.89%	54,602	58.48%
17	6.90%	2.80%	2.80%	3.00%	4.40%	2.80%	53,045	52.07%	53,201	56.98%
18	9.00%	3.50%	3.50%	6.00%	4.50%	3.20%	66,392	65.17%	64,087	68.64%
19	9.70%	3.60%	3.60%	20.00%	4.50%	6.50%	101,876	100.00%	93,366	100.00%
20	8.50%	3.50%	3.60%	18.00%	4.35%	5.90%	93,068	91.35%	90,150	96.56%
21	5.00%	3.10%	3.10%	15.00%	4.25%	5.10%	75,871	74.47%	73,583	78.81%
22	2.30%	1.60%	1.60%	6.00%	4.10%	5.00%	49,309	48.40%	49,939	53.49%
23	0.70%	1.50%	1.40%	1.70%	3.95%	5.70%	38,782	38.07%	32,164	34.45%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	1,297,485		1,297,444	

TABLE 3I

INDE RESIDENTIAL SECTOR END-USE BREAKDOWN

	(MWH)		
Total SNI 1990 Residential Consumption:	599,972		
Total 1990 INDE Residential Consumption:	126,405		
Total 1990 INDE Residential Consumption as % of SNI:	21.07%		
Average Daily 1990 INDE Residential Consumption:	346		
Number of INDE Residential Customers in 1990:	254,677	(INPUT)	Residential Customers (2)

CONSUMPTION BY END-USE	(INPUTS) % of Total Sector kWh	Annual Usage (MWh)	Appliance	(INPUTS) Avg. Monthly kWh/end-use	No. of Appli-ances	Estimated Appliance Saturation
Cooking Energy Consumption: (INDE)	0.00%	0	Stove	0.0	0	0.0%
Water Heating Energy Consumption(INDE)	5.00%	6,320	Termodu	50.0	10,534	4.1%
(Termoducha + WH Tank) = 5.00%	0.00%	0	WH Tank	0.0	0	0.0%
Lighting Energy Consumption: (INDE)	55.00%	69,523	Lighting	22.8	254,104	99.8%
Refrigeration Energy Consumption(INDE):	20.00%	25,281	Refrigera	60.0	35,113	13.8%
Other End-Use Energy Consumption(INDE)	20.00%	25,281	Other	16.0	131,672	51.7%

	ELECTRIC COOKING	TERMO-DUCHA	WH TANK	LIGHTING	REFRI-ERATION	OTHER ND-USES
Annual kWh	0	6,320	0	69,523	25,281	25,281
# Cust w/Appl	0	10,534	0	254,104	35,113	131,672
# of Days	365	365	365	365	365	365
Avg kWh/Cust/Day	0.00	1.64	0.00	0.75	1.97	0.53

2) Source: INDE, Reporte Estadistico 1990.

TABLE 3I

INDE RESIDENTIAL SECTOR - CONTRIBUTION TO HOURLY LOAD BY END-USE

(NOTE: These are the load shape inputs to the MODEL.)

TIME	ELECTRIC COOKING (%)	TERMO-DUCHA (%)	WH TANK (%)	LIGHTING (%)	REFRI-GERATION (%)	OTHER END-USES (%)	CALCULATED INDE RES LOAD (kW)	CALCULATED INDE HOURLY OINCIDENCE FACTOR (% pk)	D (INPUTS) ACTUAL INDE RES LOAD (kW)	ACTUAL INDE HOURLY COINCIDENCE FACTOR (% pk)
0	0.00%	0.40%	0.00%	1.00%	3.90%	2.80%	6,615	14.22%	3,463	6.54%
1	0.00%	0.30%	0.00%	1.00%	3.90%	2.00%	6,043	12.99%	3,463	6.54%
2	0.00%	0.70%	0.00%	1.00%	3.90%	1.00%	5,420	11.65%	3,463	6.54%
3	0.00%	3.00%	0.00%	1.80%	3.90%	1.40%	7,619	16.38%	6,926	13.07%
4	0.00%	7.00%	0.00%	2.50%	3.90%	1.40%	9,645	20.73%	8,658	16.34%
5	0.00%	25.00%	0.00%	5.00%	3.95%	2.50%	18,320	39.38%	20,779	39.22%
6	0.00%	10.00%	0.00%	4.00%	4.00%	1.30%	13,021	27.99%	13,853	26.14%
7	0.00%	8.50%	0.00%	2.80%	4.15%	1.20%	10,511	22.59%	8,658	16.34%
8	0.00%	3.00%	0.00%	1.40%	4.20%	1.30%	6,996	15.04%	5,195	9.80%
9	0.00%	1.00%	0.00%	1.10%	4.25%	2.00%	6,597	14.18%	5,195	9.80%
10	0.00%	2.00%	0.00%	1.80%	4.20%	6.00%	10,840	23.30%	10,389	19.61%
11	0.00%	1.90%	0.00%	2.00%	4.25%	7.00%	11,931	25.65%	13,853	26.14%
12	0.00%	1.90%	0.00%	1.00%	4.30%	6.50%	9,714	20.88%	8,658	16.34%
13	0.00%	1.50%	0.00%	0.50%	4.25%	6.00%	8,312	17.87%	6,926	13.07%
14	0.00%	3.00%	0.00%	0.50%	4.28%	8.00%	9,977	21.45%	6,926	13.07%
15	0.00%	3.30%	0.00%	0.70%	4.30%	6.20%	9,177	19.73%	6,926	13.07%
16	0.00%	5.20%	0.00%	1.00%	4.35%	3.00%	7,896	16.97%	8,312	15.69%
17	0.00%	4.50%	0.00%	2.60%	4.40%	2.30%	10,372	22.30%	10,389	19.61%
18	0.00%	6.00%	0.00%	6.50%	4.50%	7.00%	21,385	45.97%	27,013	50.98%
19	0.00%	3.00%	0.00%	19.75%	4.60%	7.50%	46,519	100.00%	50,216	94.77%
20	0.00%	4.00%	0.00%	20.25%	4.35%	5.90%	46,363	99.66%	52,986	100.00%
21	0.00%	2.50%	0.00%	14.00%	4.25%	7.00%	34,891	75.00%	34,632	65.36%
22	0.00%	1.80%	0.00%	6.10%	3.90%	6.50%	19,134	41.13%	17,316	32.68%
23	0.00%	0.50%	0.00%	1.70%	3.80%	4.20%	8,866	19.06%	12,121	22.88%
	0.0%	100.0%	0.0%	100.0%	100%	100.0%	346,163		346,315	

TABLE 3T

SNI RESIDENTIAL SECTOR END-USE MODEL

	(MWH)	
Total SNI 1990 Residential Consumption:	599,972	(Input)
Total 1990 ISNI Residential Consumption:	599,972	(Calculated)
Total 1990 SNI Residential Consumption as % of SNI:	100.00%	
Average Daily 1990 SNI Residential Consumption:	1,644	
Number of SNI Residential Customers in 1990:	527,393	(Input)

CONSUMPTION BY END-USE		(Inputs) % of Total Sector kWh	Annual Usage (MWh)	Appliance	(OUTPUTS) Avg. Monthly kWh/end-use	No. of Appli-ances	Estimated Appliance Saturation
Cooking Energy Consumption: (SNI)		14.71%	88,256	Stove	180.0	40,859	7.7%
Water Heating Energy Consumption(SNI)		11.18%	67,077	Termodu	50.0	111,795	21.2%
(Termoducha + WH Tank) =	13.91%	2.73%	16,379	WH Tank	100.1	13,636	2.6%
Lighting Energy Consumption: (ISNI)		22.40%	134,394	Lighting	21.4	524,399	99.4%
Refrigeration Energy Consumption(SNI):		28.73%	172,372	Refrigera	69.9	205,357	38.9%
Other End-Use Energy Consumption(SNI)		20.25%	121,494	Other	25.0	404,298	76.7%
Total SNI Annual Consumption:			599,972				

	ELECTRIC COOKING	TERMO-DUCHA	WH TANK	LIGHTING	REFRI-ERATION	OTHER ND-USES
Annual MWh	88,256	67,077	16,379	134,394	172,372	121,494
# Cust w/Appl	40,859	111,795	13,636	524,399	205,357	404,298
# of Days	365	365	365	365	365	365
Avg kWh/Cust/Day	5.92	1.64	3.29	0.70	2.30	0.82
Avg kWh/Cust/Yr:	2,160	600	1,201	256	839	301
Coincident KWD/Cust	0.574	0.058	0.118	0.140	0.104	0.056

TABLE 3T

SNI RESIDENTIAL SECTOR - CONTRIBUTION TO HOURLY LOAD BY END-USE

(NOTE: These are the load shape inputs to the MODEL.) — applies to ELECTRIC COOKING, TERMO-DUCHA, WH TANK

TIME	ELECTRIC COOKING (%)	TERMO-DUCHA (%)	WH TANK (%)	LIGHTING (%)	REFRI-GERATION (%)	OTHER END-USES (%)	CALCULATED SNI RES LOAD (kW)	CALCULATED SNI HOURLY OINCIDENCE FACTOR (% pk)	(INPUTS) ACTUAL SNI RES LOAD (kW)	ACTUAL SNI HOURLY COINCIDENCE FACTOR (% pk)
0	0.40%	0.94%	1.00%	0.74%	3.90%	4.55%	39,457	26.51%	37,086	25.83%
1	0.20%	0.39%	0.40%	0.95%	3.90%	3.89%	36,233	24.35%	35,332	24.61%
2	0.60%	0.70%	0.70%	1.31%	3.90%	3.16%	36,801	24.73%	34,951	24.34%
3	1.20%	3.00%	3.00%	1.70%	3.90%	2.21%	41,780	28.07%	38,677	26.94%
4	1.80%	7.72%	7.80%	2.24%	3.90%	0.79%	51,362	34.51%	48,044	33.46%
5	4.00%	15.04%	14.00%	5.46%	3.95%	1.08%	85,967	57.76%	85,787	59.75%
6	5.00%	14.53%	15.00%	4.82%	4.00%	0.77%	84,730	56.93%	83,519	58.17%
7	4.50%	9.22%	9.30%	3.93%	4.15%	1.07%	69,635	46.79%	65,451	45.58%
8	2.80%	6.62%	7.00%	1.71%	4.20%	2.99%	58,150	39.07%	57,610	40.12%
9	4.90%	4.80%	5.20%	0.79%	4.25%	2.94%	55,792	37.49%	57,628	40.14%
10	6.50%	2.91%	3.00%	1.08%	4.20%	4.65%	61,691	41.45%	64,605	45.00%
11	5.20%	2.17%	2.20%	1.18%	4.25%	6.33%	63,006	42.33%	67,614	47.09%
12	5.10%	1.90%	1.90%	0.74%	4.30%	6.37%	60,903	40.92%	63,071	43.93%
13	4.60%	1.95%	2.00%	0.45%	4.25%	6.13%	57,751	38.80%	62,192	43.31%
14	2.80%	2.77%	2.75%	0.45%	4.28%	7.19%	58,900	39.58%	60,200	41.93%
15	3.40%	2.58%	2.50%	0.70%	4.30%	6.00%	56,924	38.25%	57,919	40.34%
16	4.90%	2.84%	2.60%	1.46%	4.35%	3.67%	56,406	37.90%	62,913	43.82%
17	6.90%	2.96%	2.80%	2.81%	4.40%	2.64%	63,270	42.51%	63,591	44.29%
18	9.00%	3.74%	3.50%	6.24%	4.50%	4.44%	89,204	59.94%	91,100	63.45%
19	9.70%	3.54%	3.60%	19.88%	4.52%	6.83%	148,828	100.00%	143,582	100.00%
20	8.50%	3.55%	3.60%	19.09%	4.35%	5.90%	139,159	93.50%	143,136	99.69%
21	5.00%	3.04%	3.10%	14.52%	4.25%	5.72%	111,626	75.00%	108,214	75.37%
22	2.30%	1.62%	1.60%	6.05%	4.07%	5.49%	68,995	46.36%	67,254	46.84%
23	0.70%	1.41%	1.40%	1.70%	3.92%	5.21%	47,043	31.61%	44,285	30.84%
	100.0%	100.0%	99.9%	100.0%	100.0%	100.0%	1,643,615		1,643,759	

TABLE 4E

EEGSA RESIDENTIAL SECTOR HOURLY LOAD SHAPES IN kW								
TIME	ELECTRIC COOKING (kW)	TERMO-DUCHA (kW)	WH TANK (kW)	LIGHTING (kW)	REFRI-ERATION (kW)	OTHER ND-USES (kW)	EEGSA RES LOAD (kW)	EEGSA RES LOAD (% PK)
Formula:	(% of daily consumption at hour Y * daily kWh * # Of appliances)							
0	967	1,665	449	889	15,717	14,234	33,920	33.30%
1	484	666	179	1,600	15,717	12,653	31,298	30.72%
2	1,451	1,165	314	2,844	15,717	11,071	32,561	31.96%
3	2,902	4,994	1,346	2,844	15,717	6,854	34,655	34.02%
4	4,352	12,984	3,500	3,555	15,717	1,318	41,425	40.66%
5	9,672	23,304	6,282	10,486	15,918	1,054	66,717	65.49%
6	12,090	24,968	6,731	9,953	16,120	1,344	71,206	69.89%
7	10,881	15,480	4,173	8,886	16,724	2,636	58,781	57.70%
8	6,770	11,652	3,141	3,555	16,926	10,017	52,060	51.10%
9	11,848	8,656	2,333	889	17,127	8,962	49,815	48.90%
10	15,717	4,994	1,346	711	16,926	10,544	50,237	49.31%
11	12,573	3,662	987	711	17,127	15,816	50,877	49.94%
12	12,332	3,163	853	889	17,329	16,607	51,171	50.23%
13	11,123	3,329	897	711	17,127	16,343	49,530	48.62%
14	6,770	4,578	1,234	711	17,248	17,925	48,465	47.57%
15	8,221	4,161	1,122	1,244	17,329	15,552	47,629	46.75%
16	11,848	4,328	1,167	3,377	17,530	10,544	48,793	47.89%
17	16,684	4,661	1,256	5,332	17,732	7,381	53,045	52.07%
18	21,762	5,826	1,571	10,664	18,135	8,435	66,392	65.17%
19	23,454	5,992	1,615	35,546	18,135	17,134	101,876	100.00%
20	20,553	5,826	1,615	31,991	17,530	15,552	93,068	91.35%
21	12,090	5,160	1,391	26,659	17,127	13,444	75,871	74.47%
22	5,561	2,663	718	10,664	16,523	13,180	49,309	48.40%
23	1,693	2,497	628	3,021	15,918	15,025	38,782	38.07%
	241,797	166,373	44,852	177,729	403,110	263,625	1,297,485	
	18.64%	12.82%	3.46%	13.70%	31.07%	20.32%	100.00%	

TABLE 4I

INDE RESIDENTIAL SECTOR HOURLY LOAD SHAPES IN kW									
TIME	ELECTRIC COOKING (kW)	TERMO-DUCHA (kW)	WH TANK (kW)	LIGHTING (kW)	REFRI-ERATION (kW)	OTHER ND-USES (kW)	INDE RES LOAD (kW)	EEGSA RES LOAD (% PK)
Formula:	(% of daily consumption at hour Y * daily kWh * # 0f appliances)							
0	0	69	0	1,905	2,701	1,939	6,615	14.22%
1	0	52	0	1,905	2,701	1,385	6,043	12.99%
2	0	121	0	1,905	2,701	693	5,420	11.65%
3	0	519	0	3,429	2,701	970	7,619	16.38%
4	0	1,212	0	4,762	2,701	970	9,645	20.73%
5	0	4,329	0	9,524	2,736	1,732	18,320	39.38%
6	0	1,732	0	7,619	2,771	900	13,021	27.99%
7	0	1,472	0	5,333	2,874	831	10,511	22.59%
8	0	519	0	2,667	2,909	900	6,996	15.04%
9	0	173	0	2,095	2,944	1,385	6,597	14.18%
10	0	346	0	3,429	2,909	4,156	10,840	23.30%
11	0	329	0	3,809	2,944	4,848	11,931	25.65%
12	0	329	0	1,905	2,978	4,502	9,714	20.88%
13	0	260	0	952	2,944	4,156	8,312	17.87%
14	0	519	0	952	2,964	5,541	9,977	21.45%
15	0	571	0	1,333	2,978	4,294	9,177	19.73%
16	0	900	0	1,905	3,013	2,078	7,896	16.97%
17	0	779	0	4,952	3,048	1,593	10,372	22.30%
18	0	1,039	0	12,381	3,117	4,848	21,385	45.97%
19	0	519	0	37,618	3,186	5,195	46,519	100.00%
20	0	693	0	38,571	3,013	4,087	46,363	99.66%
21	0	433	0	26,666	2,944	4,848	34,891	75.00%
22	0	312	0	11,619	2,701	4,502	19,134	41.13%
23	0	87	0	3,238	2,632	2,909	8,866	19.06%
	0	17,316	0	190,473	69,111	69,263	346,163	
	0.00%	5.00%	0.00%	55.02%	19.96%	20.01%	100.00%	

TABLE 4T

SNI RESIDENTIAL SECTOR HOURLY LOAD SHAPES IN kW								
TIME	ELECTRIC COOKING (kW)	TERMO-DUCHA (kW)	WH TANK (kW)	LIGHTING (kW)	REFRI-ERATION (kW)	OTHER ND-USES (kW)	SNI RES LOAD (kW)	SNI RES LOAD (% PK)
Formula:	(% of daily consumption at hour Y * daily kWh * # 0f appliances)							
0	967	1,734	449	2,733	18,418	15,156	39,457	26.51%
1	484	718	179	3,492	18,418	12,942	36,233	24.35%
2	1,451	1,286	314	4,821	18,418	10,511	36,801	24.73%
3	2,902	5,513	1,346	6,248	18,418	7,354	41,780	28.07%
4	4,352	14,196	3,500	8,256	18,418	2,640	51,362	34.51%
5	9,672	27,633	6,282	20,118	18,654	3,608	85,967	57.76%
6	12,090	26,700	6,731	17,765	18,890	2,554	84,730	56.93%
7	10,881	16,952	4,173	14,485	19,598	3,545	69,635	46.79%
8	6,770	12,171	3,141	6,294	19,835	9,939	58,150	39.07%
9	11,848	8,829	2,333	2,912	20,071	9,800	55,792	37.49%
10	15,717	5,340	1,346	3,971	19,835	15,483	61,691	41.45%
11	12,573	3,991	987	4,327	20,071	21,056	63,006	42.33%
12	12,332	3,492	853	2,733	20,307	21,187	60,903	40.92%
13	11,123	3,589	897	1,651	20,071	20,421	57,751	38.80%
14	6,770	5,097	1,234	1,651	20,212	23,935	58,900	39.58%
15	8,221	4,733	1,122	2,577	20,307	19,964	56,924	38.25%
16	11,848	5,228	1,167	5,390	20,543	12,230	56,406	37.90%
17	16,684	5,440	1,256	10,332	20,779	8,778	63,270	42.51%
18	21,762	6,865	1,571	22,984	21,251	14,771	89,204	59.94%
19	23,454	6,512	1,615	73,194	21,332	22,720	148,828	100.00%
20	20,553	6,519	1,615	70,291	20,543	19,639	139,159	93.50%
21	12,090	5,593	1,391	53,446	20,071	19,036	111,626	75.00%
22	5,561	2,975	718	22,271	19,201	18,269	68,995	46.36%
23	1,693	2,583	628	6,259	18,533	17,347	47,043	31.61%
	241,796	183,689	44,852	368,202	472,192	332,884	1,643,615	
	14.71%	11.18%	2.73%	22.40%	28.73%	20.25%	100.00%	

TABLE 5E

EEGSA RESIDENTIAL END-USE (%) CONTRIBUTION TO HOURLY DEMAND

TIME	ELECTRIC COOKING (%)	TERMO-DUCHA (%)	WH TANK (%)	LIGHTING (%)	REFRI-ERATION (%)	OTHER ND-USES (%)	EEGSA RES LOAD (kW)	EEGSA % OF DAILY LOAD	EEGSA RES LOAD (kW)	EEGSA RES LOAD (% PK)
0	2.9%	4.9%	1.3%	2.6%	46.3%	42.0%	33,623	2.59%	33,623	36.01%
1	1.5%	2.1%	0.6%	5.1%	50.2%	40.4%	31,869	2.46%	31,869	34.13%
2	4.5%	3.6%	1.0%	8.7%	48.3%	34.0%	31,488	2.43%	31,488	33.72%
3	8.4%	14.4%	3.9%	8.2%	45.4%	19.8%	31,750	2.45%	31,750	34.01%
4	10.5%	31.3%	8.4%	8.6%	37.9%	3.2%	39,386	3.04%	39,386	42.18%
5	14.5%	34.9%	9.4%	15.7%	23.9%	1.6%	65,008	5.01%	65,008	69.63%
6	17.0%	35.1%	9.5%	14.0%	22.6%	1.9%	69,667	5.37%	69,667	74.62%
7	18.5%	26.3%	7.1%	15.1%	28.5%	4.5%	56,793	4.38%	56,793	60.83%
8	13.0%	22.4%	6.0%	6.8%	32.5%	19.2%	52,415	4.04%	52,415	56.14%
9	23.8%	17.4%	4.7%	1.8%	34.4%	18.0%	52,433	4.04%	52,433	56.16%
10	31.3%	9.9%	2.7%	1.4%	33.7%	21.0%	54,215	4.18%	54,215	58.07%
11	24.7%	7.2%	1.9%	1.4%	33.7%	31.1%	53,761	4.14%	53,761	57.58%
12	24.1%	6.2%	1.7%	1.7%	33.9%	32.5%	54,413	4.19%	54,413	58.28%
13	22.5%	6.7%	1.8%	1.4%	34.6%	33.0%	55,265	4.26%	55,265	59.19%
14	14.0%	9.4%	2.5%	1.5%	35.6%	37.0%	53,274	4.11%	53,274	57.06%
15	17.3%	8.7%	2.4%	2.6%	36.4%	32.7%	50,993	3.93%	50,993	54.62%
16	24.3%	8.9%	2.4%	6.9%	35.9%	21.6%	54,602	4.21%	54,602	58.48%
17	31.5%	8.8%	2.4%	10.1%	33.4%	13.9%	53,201	4.10%	53,201	56.98%
18	32.8%	8.8%	2.4%	16.1%	27.3%	12.7%	64,087	4.94%	64,087	68.64%
19	23.0%	5.9%	1.6%	34.9%	17.8%	16.8%	93,366	7.20%	93,366	100.00%
20	22.1%	6.3%	1.7%	34.4%	18.8%	16.7%	90,150	6.95%	90,150	96.56%
21	15.9%	6.8%	1.8%	35.1%	22.6%	17.7%	73,583	5.67%	73,583	78.81%
22	11.3%	5.4%	1.5%	21.6%	33.5%	26.7%	49,939	3.85%	49,939	53.49%
23	4.4%	6.4%	1.6%	7.8%	41.0%	38.7%	32,164	2.48%	32,164	34.45%
							1,297,444			

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TABLE 5I

INDE RESIDENTIAL END-USE (%) CONTRIBUTION TO HOURLY DEMAND										01-Oct-92
TIME	ELECTRIC COOKING (%)	TERMO-DUCHA (%)	WH TANK (%)	LIGHTING (%)	REFRI-ERATION (%)	OTHER ND-USES (%)	INDE RES LOAD (kW)	INDE % OF DAILY LOAD	INDE RES LOAD (kW)	INDE RES LOAD (% PK)
0	0.0%	1.0%	0.0%	28.8%	40.8%	29.3%	3,463	1.00%	3,463	6.54%
1	0.0%	0.9%	0.0%	31.5%	44.7%	22.9%	3,463	1.00%	3,463	6.54%
2	0.0%	2.2%	0.0%	35.1%	49.8%	12.8%	3,463	1.00%	3,463	6.54%
3	0.0%	6.8%	0.0%	45.0%	35.5%	12.7%	6,926	2.00%	6,926	13.07%
4	0.0%	12.6%	0.0%	49.4%	28.0%	10.1%	8,658	2.50%	8,658	16.34%
5	0.0%	23.6%	0.0%	52.0%	14.9%	9.5%	20,779	6.00%	20,779	39.22%
6	0.0%	13.3%	0.0%	58.5%	21.3%	6.9%	13,853	4.00%	13,853	26.14%
7	0.0%	14.0%	0.0%	50.7%	27.3%	7.9%	8,658	2.50%	8,658	16.34%
8	0.0%	7.4%	0.0%	38.1%	41.6%	12.9%	5,195	1.50%	5,195	9.80%
9	0.0%	2.6%	0.0%	31.8%	44.6%	21.0%	5,195	1.50%	5,195	9.80%
10	0.0%	3.2%	0.0%	31.6%	26.8%	38.3%	10,389	3.00%	10,389	19.61%
11	0.0%	2.8%	0.0%	31.9%	24.7%	40.6%	13,853	4.00%	13,853	26.14%
12	0.0%	3.4%	0.0%	19.6%	30.7%	46.3%	8,658	2.50%	8,658	16.34%
13	0.0%	3.1%	0.0%	11.5%	35.4%	50.0%	6,926	2.00%	6,926	13.07%
14	0.0%	5.2%	0.0%	9.5%	29.7%	55.5%	6,926	2.00%	6,926	13.07%
15	0.0%	6.2%	0.0%	14.5%	32.5%	46.8%	6,926	2.00%	6,926	13.07%
16	0.0%	11.4%	0.0%	24.1%	38.2%	26.3%	8,312	2.40%	8,312	15.69%
17	0.0%	7.5%	0.0%	47.7%	29.4%	15.4%	10,389	3.00%	10,389	19.61%
18	0.0%	4.9%	0.0%	57.9%	14.6%	22.7%	27,013	7.80%	27,013	50.98%
19	0.0%	1.1%	0.0%	80.9%	6.8%	11.2%	50,216	14.50%	50,216	94.77%
20	0.0%	1.5%	0.0%	83.2%	6.5%	8.8%	52,986	15.30%	52,986	100.00%
21	0.0%	1.2%	0.0%	76.4%	8.4%	13.9%	34,632	10.00%	34,632	65.36%
22	0.0%	1.6%	0.0%	60.7%	14.1%	23.5%	17,316	5.00%	17,316	32.68%
23	0.0%	1.0%	0.0%	36.5%	29.7%	32.8%	12,121	3.50%	12,121	22.88%
							346,315			

TABLE 5T

SNI RESIDENTIAL END-USE (%) CONTRIBUTION TO HOURLY DEMAND										01-Oct-92
TIME	ELECTRIC COOKING (%)	TERMO-DUCHA (%)	WH TANK (%)	LIGHTING (%)	REFRI-ERATION (%)	OTHER ND-USES (%)	SNI RES LOAD (kW)	SNI % OF DAILY LOAD	SNI RES LOAD (kW)	SNI RES LOAD (% PK)
0	2.5%	4.4%	1.1%	6.9%	46.7%	38.4%	37,086	2.26%	37,086	25.83%
1	1.3%	2.0%	0.5%	9.6%	50.8%	35.7%	35,332	2.15%	35,332	24.61%
2	3.9%	3.5%	0.9%	13.1%	50.0%	28.6%	34,951	2.13%	34,951	24.34%
3	6.9%	13.2%	3.2%	15.0%	44.1%	17.6%	38,677	2.35%	38,677	26.94%
4	8.5%	27.6%	6.8%	16.1%	35.9%	5.1%	48,044	2.92%	48,044	33.46%
5	11.3%	32.1%	7.3%	23.4%	21.7%	4.2%	85,787	5.22%	85,787	59.75%
6	14.3%	31.5%	7.9%	21.0%	22.3%	3.0%	83,519	5.08%	83,519	58.17%
7	15.6%	24.3%	6.0%	20.8%	28.1%	5.1%	65,451	3.98%	65,451	45.58%
8	11.6%	20.9%	5.4%	10.8%	34.1%	17.1%	57,610	3.50%	57,610	40.12%
9	21.2%	15.8%	4.2%	5.2%	36.0%	17.6%	57,628	3.51%	57,628	40.14%
10	25.5%	8.7%	2.2%	6.4%	32.2%	25.1%	64,605	3.93%	64,605	45.00%
11	20.0%	6.3%	1.6%	6.9%	31.9%	33.4%	67,614	4.11%	67,614	47.09%
12	20.2%	5.7%	1.4%	4.5%	33.3%	34.8%	63,071	3.84%	63,071	43.93%
13	19.3%	6.2%	1.6%	2.9%	34.8%	35.4%	62,192	3.78%	62,192	43.31%
14	11.5%	8.7%	2.1%	2.8%	34.3%	40.6%	60,200	3.66%	60,200	41.93%
15	14.4%	8.3%	2.0%	4.5%	35.7%	35.1%	57,919	3.52%	57,919	40.34%
16	21.0%	9.3%	2.1%	9.6%	36.4%	21.7%	62,913	3.83%	62,913	43.82%
17	26.4%	8.6%	2.0%	16.3%	32.8%	13.9%	63,591	3.87%	63,591	44.29%
18	24.4%	7.7%	1.8%	25.8%	23.8%	16.6%	91,100	5.54%	91,100	63.45%
19	15.8%	4.4%	1.1%	49.2%	14.3%	15.3%	143,582	8.73%	143,582	100.00%
20	14.8%	4.7%	1.2%	50.5%	14.8%	14.1%	143,136	8.71%	143,136	99.69%
21	10.8%	5.0%	1.2%	47.9%	18.0%	17.1%	108,214	6.58%	108,214	75.37%
22	8.1%	4.3%	1.0%	32.3%	27.8%	26.5%	67,254	4.09%	67,254	46.84%
23	3.6%	5.5%	1.3%	13.3%	39.4%	36.9%	44,285	2.69%	44,285	30.84%
							1,643,759			

TABLE 6E

EEGSA RESIDENTIAL SECTOR HOURLY DIVERSIFIED DEMAND PER CUSTOMER BY END-USE							
TIME	ELECTRIC COOKING (kW)	TERMO-DUCHA (kW)	WH TANK (kW)	LIGHTING (kW)	REFRI-ERATION (kW)	OTHER ND-USES (kW)	TOTAL DEMAND FOR CUST. W/ALL END-USES (kW)
0	0.02	0.02	0.03	0.00	0.09	0.05	0.22
1	0.01	0.01	0.01	0.01	0.09	0.05	0.18
2	0.04	0.01	0.02	0.01	0.09	0.04	0.21
3	0.07	0.05	0.10	0.01	0.09	0.03	0.35
4	0.11	0.13	0.26	0.01	0.09	0.00	0.60
5	0.24	0.23	0.46	0.04	0.09	0.00	1.06
6	0.30	0.25	0.49	0.04	0.09	0.00	1.17
7	0.27	0.15	0.31	0.03	0.10	0.01	0.87
8	0.17	0.12	0.23	0.01	0.10	0.04	0.66
9	0.29	0.09	0.17	0.00	0.10	0.03	0.68
10	0.38	0.05	0.10	0.00	0.10	0.04	0.67
11	0.31	0.04	0.07	0.00	0.10	0.06	0.58
12	0.30	0.03	0.06	0.00	0.10	0.06	0.56
13	0.27	0.03	0.07	0.00	0.10	0.06	0.53
14	0.17	0.05	0.09	0.00	0.10	0.07	0.47
15	0.20	0.04	0.08	0.00	0.10	0.06	0.49
16	0.29	0.04	0.09	0.01	0.10	0.04	0.57
17	0.41	0.05	0.09	0.02	0.10	0.03	0.70
18	0.53	0.06	0.12	0.04	0.11	0.03	0.88
19	0.57	0.06	0.12	0.13	0.11	0.06	1.05
20	0.50	0.06	0.12	0.12	0.10	0.06	0.96
21	0.30	0.05	0.10	0.10	0.10	0.05	0.70
22	0.14	0.03	0.05	0.04	0.10	0.05	0.40
23	0.04	0.02	0.05	0.01	0.09	0.06	0.27

TABLE 6I

INDE RESIDENTIAL SECTOR HOURLY DIVERSIFIED DEMAND PER CUSTOMER BY END-USE							
TIME	ELECTRIC COOKING (kW)	TERMO-DUCHA (kW)	WH TANK (kW)	LIGHTING (kW)	REFRI-ERATION (kW)	OTHER ND-USES (kW)	TOTAL DEMAND FOR CUST. W/ALL END-USES (kW)
0	0.00	0.01	0.00	0.01	0.08	0.01	0.11
1	0.00	0.00	0.00	0.01	0.08	0.01	0.10
2	0.00	0.01	0.00	0.01	0.08	0.01	0.10
3	0.00	0.05	0.00	0.01	0.08	0.01	0.15
4	0.00	0.12	0.00	0.02	0.08	0.01	0.22
5	0.00	0.41	0.00	0.04	0.08	0.01	0.54
6	0.00	0.16	0.00	0.03	0.08	0.01	0.28
7	0.00	0.14	0.00	0.02	0.08	0.01	0.25
8	0.00	0.05	0.00	0.01	0.08	0.01	0.15
9	0.00	0.02	0.00	0.01	0.08	0.01	0.12
10	0.00	0.03	0.00	0.01	0.08	0.03	0.16
11	0.00	0.03	0.00	0.01	0.08	0.04	0.17
12	0.00	0.03	0.00	0.01	0.08	0.03	0.16
13	0.00	0.02	0.00	0.00	0.08	0.03	0.14
14	0.00	0.05	0.00	0.00	0.08	0.04	0.18
15	0.00	0.05	0.00	0.01	0.08	0.03	0.18
16	0.00	0.09	0.00	0.01	0.09	0.02	0.19
17	0.00	0.07	0.00	0.02	0.09	0.01	0.19
18	0.00	0.10	0.00	0.05	0.09	0.04	0.27
19	0.00	0.05	0.00	0.15	0.09	0.04	0.33
20	0.00	0.07	0.00	0.15	0.09	0.03	0.33
21	0.00	0.04	0.00	0.10	0.08	0.04	0.27
22	0.00	0.03	0.00	0.05	0.08	0.03	0.19
23	0.00	0.01	0.00	0.01	0.07	0.02	0.12

TABLE 6T

SNI RESIDENTIAL SECTOR HOURLY DIVERSIFIED DEMAND PER CUSTOMER BY END-USE							
TIME	ELECTRIC COOKING (kW)	TERMO-DUCHA (kW)	WH TANK (kW)	LIGHTING (kW)	REFRI-ERATION (kW)	OTHER ND-USES (kW)	TOTAL DEMAND FOR CUST. W/ALL END-USES (kW)
0	0.024	0.016	0.033	0.005	0.090	0.037	0.204
1	0.012	0.006	0.013	0.007	0.090	0.032	0.160
2	0.036	0.012	0.023	0.009	0.090	0.026	0.195
3	0.071	0.049	0.099	0.012	0.090	0.018	0.339
4	0.107	0.127	0.257	0.016	0.090	0.007	0.602
5	0.237	0.247	0.461	0.038	0.091	0.009	1.083
6	0.296	0.239	0.494	0.034	0.092	0.006	1.161
7	0.266	0.152	0.306	0.028	0.095	0.009	0.856
8	0.166	0.109	0.230	0.012	0.097	0.025	0.638
9	0.290	0.079	0.171	0.006	0.098	0.024	0.668
10	0.385	0.048	0.099	0.008	0.097	0.038	0.674
11	0.308	0.036	0.072	0.008	0.098	0.052	0.574
12	0.302	0.031	0.063	0.005	0.099	0.052	0.552
13	0.272	0.032	0.066	0.003	0.098	0.051	0.522
14	0.166	0.046	0.090	0.003	0.098	0.059	0.463
15	0.201	0.042	0.082	0.005	0.099	0.049	0.479
16	0.290	0.047	0.086	0.010	0.100	0.030	0.563
17	0.408	0.049	0.092	0.020	0.101	0.022	0.692
18	0.533	0.061	0.115	0.044	0.103	0.037	0.893
19	0.574	0.058	0.118	0.140	0.104	0.056	1.050
20	0.503	0.058	0.118	0.134	0.100	0.049	0.962
21	0.296	0.050	0.102	0.102	0.098	0.047	0.695
22	0.136	0.027	0.053	0.042	0.093	0.045	0.397
23	0.041	0.023	0.046	0.012	0.090	0.043	0.256
	5.918	1.643	3.289	0.702	2.299	0.823	

TABLE 7T(1)

1992 RESIDENTIAL LIGHTING SNI RESIDENTIAL SECTOR HOURLY DSM IMPACT BY END-USE PER AVERAGE PARTICIPANT							
TIME	LIGHTING (kW)	LIGHTING (kW)	LIGHTING (kW)	LIGHTING (kW)	LIGHTING (kW)	LIGHTING (kW)	TOTAL PROGRAM IMPACT W/DSM (kW)
Measure:	CF's*	HE-Incand	HE-Fl.				
Energy Savings:	49.5%	10.0%	15.0%	0.0%	0.0%	0.0%	42.6%
Demand Reductions:	49.5%	10.0%	15.0%	0.0%	0.0%	0.0%	42.6%
Equip. Cost/ Part.	$11.84	$0.69	$2.10	$0.00	$0.00	$0.00	$9.89
Likely Meas Part %	80.0%	0.0%	20.0%	0.0%	0.0%	0.0%	
0	0.003	0.005	0.004	0.005	0.005	0.005	0.003
1	0.003	0.006	0.006	0.007	0.007	0.007	0.004
2	0.005	0.008	0.008	0.009	0.009	0.009	0.005
3	0.006	0.011	0.010	0.012	0.012	0.012	0.007
4	0.008	0.014	0.013	0.016	0.016	0.016	0.009
5	0.019	0.035	0.033	0.038	0.038	0.038	0.022
6	0.017	0.030	0.029	0.034	0.034	0.034	0.019
7	0.014	0.025	0.023	0.028	0.028	0.028	0.016
8	0.006	0.011	0.010	0.012	0.012	0.012	0.007
9	0.003	0.005	0.005	0.006	0.006	0.006	0.003
10	0.004	0.007	0.006	0.008	0.008	0.008	0.004
11	0.004	0.007	0.007	0.008	0.008	0.008	0.005
12	0.003	0.005	0.004	0.005	0.005	0.005	0.003
13	0.002	0.003	0.003	0.003	0.003	0.003	0.002
14	0.002	0.003	0.003	0.003	0.003	0.003	0.002
15	0.002	0.004	0.004	0.005	0.005	0.005	0.003
16	0.005	0.009	0.009	0.010	0.010	0.010	0.006
17	0.010	0.018	0.017	0.020	0.020	0.020	0.011
18	0.022	0.039	0.037	0.044	0.044	0.044	0.025
19	0.070	0.126	0.119	0.140	0.140	0.140	0.080
20	0.068	0.121	0.114	0.134	0.134	0.134	0.077
21	0.051	0.092	0.087	0.102	0.102	0.102	0.059
22	0.021	0.038	0.036	0.042	0.042	0.042	0.024
23	0.006	0.011	0.010	0.012	0.012	0.012	0.007

* Note: The energy and demand savings due to replacement of incandescent with Compact Fluorescent (CF's) are based on the replacement of 1-50w, & 1-75watt incandescent with 15 watt self ballasted CF's.
Average lighting consumption per customer is 256 kWh/year.
Annual savings of 104 kWh/year per participant based on 3 hrs/day usage.

TABLE 7T(2)

1992 RESIDENTIAL ELECTRIC COOKING SNI RESIDENTIAL SECTOR HOURLY DSM IMPACT BY END-USE PER AVERAGE PARTICIPANT							
TIME	ELECTRIC COOKING (kW)	ELECTRIC COOKING (kW)	ELECTRIC COOKING (kW)	ELECTRIC COOKING (kW)	ELECTRIC COOKING (kW)	ELECTRIC COOKING (kW)	TOTAL PROGRAM IMPACT W/DSM (kW)
Technology:	Eff Stoves						
Energy Savings:	15.0%						15.0%
Demand Reductions:	15.0%						15.0%
Equip. Cost/ Part.	$150						$150.00
Likely Meas Part %	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
0	0.020	0.024	0.024	0.024	0.024	0.024	0.020
1	0.010	0.012	0.012	0.012	0.012	0.012	0.010
2	0.030	0.036	0.036	0.036	0.036	0.036	0.030
3	0.060	0.071	0.071	0.071	0.071	0.071	0.060
4	0.091	0.107	0.107	0.107	0.107	0.107	0.091
5	0.201	0.237	0.237	0.237	0.237	0.237	0.201
6	0.252	0.296	0.296	0.296	0.296	0.296	0.252
7	0.226	0.266	0.266	0.266	0.266	0.266	0.226
8	0.141	0.166	0.166	0.166	0.166	0.166	0.141
9	0.246	0.290	0.290	0.290	0.290	0.290	0.246
10	0.327	0.385	0.385	0.385	0.385	0.385	0.327
11	0.262	0.308	0.308	0.308	0.308	0.308	0.262
12	0.257	0.302	0.302	0.302	0.302	0.302	0.257
13	0.231	0.272	0.272	0.272	0.272	0.272	0.231
14	0.141	0.166	0.166	0.166	0.166	0.166	0.141
15	0.171	0.201	0.201	0.201	0.201	0.201	0.171
16	0.246	0.290	0.290	0.290	0.290	0.290	0.246
17	0.347	0.408	0.408	0.408	0.408	0.408	0.347
18	0.453	0.533	0.533	0.533	0.533	0.533	0.453
19	0.488	0.574	0.574	0.574	0.574	0.574	0.488
20	0.428	0.503	0.503	0.503	0.503	0.503	0.428
21	0.252	0.296	0.296	0.296	0.296	0.296	0.252
22	0.116	0.136	0.136	0.136	0.136	0.136	0.116
23	0.035	0.041	0.041	0.041	0.041	0.041	0.035

TABLE 7T(3)

1992 RESIDENTIAL TERMODUCHAS SNI RESIDENTIAL SECTOR HOURLY DSM IMPACT BY END-USE PER AVERAGE PARTICIPANT							
TIME	TERMO-DUCHA (kW)	TERMO-DUCHA (kW)	TERMO-DUCHA (kW)	TERMO-DUCHA (kW)	TERMO-DUCHA (kW)	TERMO-DUCHA (kW)	TOTAL PROGRAM IMPACT W/DSM (kW)
----	--------	--------	--------	--------	--------	--------	--------
Technology:	aller Element						
Energy Savings:	33.3%						33.3%
Demand Reductions:	33.3%						33.3%
Equip. Cost/ Part.	$10						$10.00
Likely Meas Part %	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	
0	0.010	0.016	0.016	0.016	0.016	0.016	0.010
1	0.004	0.006	0.006	0.006	0.006	0.006	0.004
2	0.008	0.012	0.012	0.012	0.012	0.012	0.008
3	0.033	0.049	0.049	0.049	0.049	0.049	0.033
4	0.085	0.127	0.127	0.127	0.127	0.127	0.085
5	0.165	0.247	0.247	0.247	0.247	0.247	0.165
6	0.159	0.239	0.239	0.239	0.239	0.239	0.159
7	0.101	0.152	0.152	0.152	0.152	0.152	0.101
8	0.073	0.109	0.109	0.109	0.109	0.109	0.073
9	0.053	0.079	0.079	0.079	0.079	0.079	0.053
10	0.032	0.048	0.048	0.048	0.048	0.048	0.032
11	0.024	0.036	0.036	0.036	0.036	0.036	0.024
12	0.021	0.031	0.031	0.031	0.031	0.031	0.021
13	0.021	0.032	0.032	0.032	0.032	0.032	0.021
14	0.030	0.046	0.046	0.046	0.046	0.046	0.030
15	0.028	0.042	0.042	0.042	0.042	0.042	0.028
16	0.031	0.047	0.047	0.047	0.047	0.047	0.031
17	0.032	0.049	0.049	0.049	0.049	0.049	0.032
18	0.041	0.061	0.061	0.061	0.061	0.061	0.041
19	0.039	0.058	0.058	0.058	0.058	0.058	0.039
20	0.039	0.058	0.058	0.058	0.058	0.058	0.039
21	0.033	0.050	0.050	0.050	0.050	0.050	0.033
22	0.018	0.027	0.027	0.027	0.027	0.027	0.018
23	0.015	0.023	0.023	0.023	0.023	0.023	0.015

TABLE 7T(4)

1992 RESIDENTIAL WATER HEATER TANKS SNI RESIDENTIAL SECTOR HOURLY DSM IMPACT BY END-USE PER AVERAGE PARTICIPANT							
TIME	WH TANK (kW)	WH TANK (kW)	WH TANK (kW)	WH TANK (kW)	WH TANK (kW)	WH TANK (kW)	TOTAL PROGRAM IMPACT W/DSM (kW)
Technology:	WH Blanket	Eff WH	Ht Pmp	WH Timer	Solar WH	L.F.Shwr.Hd.	
Energy Savings:	12.0%	20.0%	72.3%	10.0%	92.0%	20.0%	28.9%
Demand Reductions:	12.0%	20.0%	72.3%	50.0%	92.0%	20.0%	32.9%
Equip. Cost/ Part.	$10	$100	$345	$35	$745	$12	$93.65
Likely Meas Part %	20.0%	50.0%	5.0%	10.0%	2.0%	50.0%	1.37
0	0.029	0.026	0.009	0.030	0.003	0.026	0.026
1	0.012	0.011	0.004	0.012	0.001	0.011	0.010
2	0.020	0.018	0.006	0.021	0.002	0.018	0.018
3	0.087	0.079	0.027	0.089	0.008	0.079	0.078
4	0.226	0.205	0.071	0.231	0.021	0.205	0.203
5	0.405	0.369	0.128	0.185	0.037	0.369	0.347
6	0.434	0.395	0.137	0.334	0.039	0.395	0.382
7	0.269	0.245	0.085	0.356	0.024	0.245	0.247
8	0.203	0.184	0.064	0.207	0.018	0.184	0.182
9	0.151	0.137	0.047	0.154	0.014	0.137	0.135
10	0.087	0.079	0.027	0.089	0.008	0.079	0.078
11	0.064	0.058	0.020	0.065	0.006	0.058	0.057
12	0.055	0.050	0.017	0.056	0.005	0.050	0.049
13	0.058	0.053	0.018	0.059	0.005	0.053	0.052
14	0.080	0.072	0.025	0.081	0.007	0.072	0.071
15	0.072	0.066	0.023	0.074	0.007	0.066	0.065
16	0.075	0.068	0.024	0.077	0.007	0.068	0.068
17	0.081	0.074	0.026	0.083	0.007	0.074	0.073
18	0.101	0.092	0.032	0.104	0.009	0.092	0.091
19	0.104	0.095	0.033	0.107	0.009	0.095	0.094
20	0.104	0.095	0.033	0.107	0.009	0.095	0.094
21	0.090	0.082	0.028	0.092	0.008	0.082	0.081
22	0.046	0.042	0.015	0.047	0.004	0.042	0.042
23	0.041	0.037	0.013	0.041	0.004	0.037	0.036

TABLE 7T(5)

1992 RESIDENTIAL REFRIGERATORS SNI RESIDENTIAL SECTOR HOURLY DSM IMPACT BY END-USE PER AVERAGE PARTICIPANT							
TIME	REFRI-GERATION (kW)	REFRI-GERATION (kW)	REFRI-ERATION (kW)	REFRI-ERATION (kW)	REFRI-ERATION (kW)	REFRI-ERATION (kW)	TOTAL PROGRAM IMPACT W/DSM (kW)
Technology:	Eff Models	Beh Mod	Seals				
Energy Savings:	43.0%	10.0%	5.0%				29.1%
Demand Reductions:	43.0%	10.0%	5.0%				29.1%
Equip. Cost/ Part.	$100	$0	$10				$61.50
Likely Meas Part %	60.0%	25.0%	15.0%	0.0%	0.0%	0.0%	
0	0.051	0.081	0.085	0.090	0.090	0.090	0.064
1	0.051	0.081	0.085	0.090	0.090	0.090	0.064
2	0.051	0.081	0.085	0.090	0.090	0.090	0.064
3	0.051	0.081	0.085	0.090	0.090	0.090	0.064
4	0.051	0.081	0.085	0.090	0.090	0.090	0.064
5	0.052	0.082	0.086	0.091	0.091	0.091	0.064
6	0.052	0.083	0.087	0.092	0.092	0.092	0.065
7	0.054	0.086	0.091	0.095	0.095	0.095	0.068
8	0.055	0.087	0.092	0.097	0.097	0.097	0.069
9	0.056	0.088	0.093	0.098	0.098	0.098	0.069
10	0.055	0.087	0.092	0.097	0.097	0.097	0.069
11	0.056	0.088	0.093	0.098	0.098	0.098	0.069
12	0.056	0.089	0.094	0.099	0.099	0.099	0.070
13	0.056	0.088	0.093	0.098	0.098	0.098	0.069
14	0.056	0.089	0.094	0.098	0.098	0.098	0.070
15	0.056	0.089	0.094	0.099	0.099	0.099	0.070
16	0.057	0.090	0.095	0.100	0.100	0.100	0.071
17	0.058	0.091	0.096	0.101	0.101	0.101	0.072
18	0.059	0.093	0.098	0.103	0.103	0.103	0.073
19	0.059	0.093	0.099	0.104	0.104	0.104	0.074
20	0.057	0.090	0.095	0.100	0.100	0.100	0.071
21	0.056	0.088	0.093	0.098	0.098	0.098	0.069
22	0.053	0.084	0.089	0.093	0.093	0.093	0.066
23	0.051	0.081	0.086	0.090	0.090	0.090	0.064

TABLE 8T(TOTAL IMPACT)

SNI RESIDENTIAL SECTOR
HOURLY DSM IMPACT BY END-USE

TIME	ELECTRIC COOKING (kW)	TERMO-DUCHA (kW)	WH TANK (kW)	LIGHTING (kW)	REFRI-ERATION (kW)	OTHER ND-USES (kW)	TOTAL DEMAND FOR CUST. W/ALL END-USES (kW)
Technology:							
Energy Savings:	15.0%	33.3%	28.9%	42.6%	29.1%	0.0%	
Demand Reductions:	15.0%	33.3%	32.9%	42.6%	29.1%	0.0%	
0	0.020	0.010	0.026	0.003	0.064	0.037	0.161
1	0.010	0.004	0.010	0.004	0.064	0.032	0.124
2	0.030	0.008	0.018	0.005	0.064	0.026	0.151
3	0.060	0.033	0.078	0.007	0.064	0.018	0.260
4	0.091	0.085	0.203	0.009	0.064	0.007	0.457
5	0.201	0.165	0.347	0.022	0.064	0.009	0.808
6	0.252	0.159	0.382	0.019	0.065	0.006	0.883
7	0.226	0.101	0.247	0.016	0.068	0.009	0.667
8	0.141	0.073	0.182	0.007	0.069	0.025	0.495
9	0.246	0.053	0.135	0.003	0.069	0.024	0.531
10	0.327	0.032	0.078	0.004	0.069	0.038	0.548
11	0.262	0.024	0.057	0.005	0.069	0.052	0.469
12	0.257	0.021	0.049	0.003	0.070	0.052	0.452
13	0.231	0.021	0.052	0.002	0.069	0.051	0.426
14	0.141	0.030	0.071	0.002	0.070	0.059	0.374
15	0.171	0.028	0.065	0.003	0.070	0.049	0.387
16	0.246	0.031	0.068	0.006	0.071	0.030	0.452
17	0.347	0.032	0.073	0.011	0.072	0.022	0.557
18	0.453	0.041	0.091	0.025	0.073	0.037	0.720
19	0.488	0.039	0.094	0.080	0.074	0.056	0.830
20	0.428	0.039	0.094	0.077	0.071	0.049	0.756
21	0.252	0.033	0.081	0.059	0.069	0.047	0.540
22	0.116	0.018	0.042	0.024	0.066	0.045	0.311
23	0.035	0.015	0.036	0.007	0.064	0.043	0.201

Table 7T1P Formulas --------	LIGHTING PROGRAM IMPACT		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	Estimated Energy and Demand Savings for Lighting DSM Measures by Year — Residential Sector															
	0) Annual Cust Escalation Rate:		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:		553,763	581,451	610,523	641,049	673,102	706,757	742,095	779,200	818,160	859,068	902,021	947,122	994,478	1,044,202
	1b) % Cust. w/ End-Use:		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	1c) Total Cust. w/ End-Use:		553,763	581,451	610,523	641,049	673,102	706,757	742,095	779,200	818,160	859,068	902,021	947,122	994,478	1,044,202
	2) End-Use Tech Saturation %:		99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%
(1c)(2)	3) Eligible Target Market		548,225	575,636	604,418	634,639	666,371	699,689	734,674	771,408	809,978	850,477	893,001	937,651	984,533	1,033,760
	4) Interaction Adjustment Factor:		100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(3)(4)	5) MTP Participation:		548,225	575,636	604,418	634,639	666,371	699,689	734,674	771,408	809,978	850,477	893,001	937,651	984,533	1,033,760
	5a) Lighting Program Energy Saving		42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%
(14c)(5a)(4)	6) MTP Energy Reduction(MWH):		59,853	62,846	65,988	69,287	72,752	76,389	80,209	84,219	88,430	92,852	97,494	102,369	107,487	112,862
	6a) Lighting Program Demand Savin		42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%
(5)(6a)(kW@p	7) MTP Demand Reduction(MW):		33	34	36	38	40	42	44	46	48	51	53	56	59	61
	8a) Replacement Factor (%):		-	-	-	10.8%	21.6%	32.4%	43.2%	54.0%	64.8%	75.6%	86.4%	97.2%	97.2%	97.2%
	8b) Economic Attractiveness (%):		62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%
(6)(8a)(8b)	9) Max Econ. Pot.Impact(MWH)		0	0	0	4,639	9,743	15,345	21,483	28,197	35,528	43,521	52,226	61,692	64,776	68,015
(7)(8a)(8b)	10) Max Econ. Pot.Impact(MW)		0.0	0.0	0.0	2.5	5.3	8.4	11.7	15.4	19.3	23.7	28.4	33.6	35.3	37.0
	11) Market Penetration Rate:					0.15%	0.22%	0.34%	0.51%	0.76%	1.13%	1.69%	2.52%	3.73%	5.50%	8.03%
(5)(8a)(8b)(11)	12) Cummulative Participants:					64	201	474	995	1,955	3,685	6,738	12,037	21,079	32,617	50,035
	13) Annual Participants:					64	137	273	521	961	1,729	3,053	5,298	9,042	11,538	17,418
(12)(kWh/Part)	14a) DSM Impact(MWH):					7	22	52	109	213	402	736	1,314	2,301	3,561	5,463
(12)(kW/Part)	14b) DSM Impact(MW):					0.00	0.01	0.03	0.06	0.12	0.22	0.40	0.72	1.25	1.94	2.98
	14c) Base Usage MWH (for Eligible Target Mkt):					162,646	170,778	179,317	188,283	197,697	207,582	217,961	228,859	240,302	252,317	264,933
	14d) Energy Use with MTP Impact (MWH)					93,359	98,027	102,928	108,075	113,478	119,152	125,110	131,365	137,934	144,830	152,072
(14c)-(9)	14e) Energy Use with Economic Potential Impact (MWH)					158,007	161,035	163,972	166,800	169,501	172,055	174,440	176,634	178,611	187,541	196,918
(14c)-(14a)	14f) Energy Usage with DSM Impact (MWH)					162,639	170,756	179,266	188,175	197,484	207,180	217,226	227,545	238,001	248,756	259,471
	15) LRMC Energy/Capacity $	$0.08			ECONOMIC ANALYSIS											
(14a)(15)	16) Annual Energy Cost Savings:					$557	$1,754	$4,142	$8,690	$17,079	$32,184	$58,852	$105,129	$184,106	$284,877	$437,005
	17) NPV Energy Savings (i=12%)	2,434,126														
	18) Equipment Cost/ Participant:	$19.78														
(13)(18)	19) Total Equipment Cost:					$1,261	$2,711	$5,409	$10,303	$19,003	$34,214	$60,408	$104,825	$178,894	$228,261	$344,595
(19)(AO392)	20) Taxes & Import Duties on Equip:	40%				$504	$1,085	$2,164	$4,121	$7,601	$13,686	$24,163	$41,930	$71,558	$91,305	$137,838
(19)-(20)	21) Economic Equipment Cost:					$757	$1,627	$3,246	$6,182	$11,402	$20,529	$36,245	$62,895	$107,337	$136,957	$206,757
	22) Administrative Expenses:	30%				$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
(21)+(22)	23) Annual Program Costs					$20,757	$21,627	$23,246	$26,182	$31,402	$40,529	$56,245	$82,895	$127,337	$156,957	$226,757
	24) NPV Program Costs (i=12%)	1,354,293														
(17)/(24)	25) Benefit Cost Ratio	1.8														
	26) Program Cash Flows					($20,200)	($19,873)	($19,104)	($17,492)	($14,322)	($8,345)	$2,608	$22,234	$56,770	$127,920	$210,249
	27) NPV Program Cash Flows (i=12	1,079,833														
	28) IRR	42.85%														

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Table 7T1P Formulas --------	LIGHTING PROGRAM IMPACT	2005	2006	2007	2008	2009	2010
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	1,096,412	1,151,233	1,208,794	1,269,234	1,332,696	1,399,331
	1b) % Cust. w/ End-Use:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	1c) Total Cust. w/ End-Use:	1,096,412	1,151,233	1,208,794	1,269,234	1,332,696	1,399,331
	2) End-Use Tech Saturation %:	99.0%	99.0%	99.0%	99.0%	99.0%	99.0%
(1c)(2)	3) Eligible Target Market	1,085,448	1,139,720	1,196,706	1,256,542	1,319,369	1,385,337
	4) Interaction Adjustment Factor:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(3)(4)	5) MTP Participation:	1,085,448	1,139,720	1,196,706	1,256,542	1,319,369	1,385,337
	5a) Lighting Program Energy Saving	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%
(14c)(5a)(4)	6) MTP Energy Reduction(MWH):	118,506	124,430	130,651	137,184	144,043	151,245
	6a) Lighting Program Demand Savin	42.6%	42.6%	42.6%	42.6%	42.6%	42.6%
(5)(6a)(kW@p	7) MTP Demand Reduction(MW):	65	68	71	75	78	82
	8a) Replacement Factor (%):	97.2%	97.2%	97.2%	97.2%	97.2%	97.2%
	8b) Economic Attractiveness (%):	62.0%	62.0%	62.0%	62.0%	62.0%	62.0%
(6)(8a)(8b)	9) Max Econ. Pot.Impact(MWH)	71,416	74,986	78,736	82,673	86,806	91,146
(7)(8a)(8b)	10) Max Econ. Pot.Impact(MW)	38.9	40.8	42.9	45.0	47.3	49.6
	11) Market Penetration Rate:	11.59%	16.44%	22.81%	30.73%	39.97%	49.99%
(5)(8a)(8b)(11)	12) Cummulative Participants:	75,817	112,947	164,480	232,669	317,809	417,345
	13) Annual Participants:	25,782	37,130	51,533	68,190	85,139	99,536
(12)(kWh/Part)	14a) DSM Impact(MWH):	8,277	12,331	17,957	25,402	34,697	45,664
(12)(kW/Part)	14b) DSM Impact(MW):	4.51	6.72	9.78	13.83	18.90	24.82
	14c) Base Usage MWH (for Eligible T	278,180	292,089	306,693	322,028	338,130	355,036
	14d) Energy Use with MTP Impact (M	159,675	167,659	176,042	184,844	194,086	203,791
(14c)-(9)	14e) Energy Use with Economic Pote	206,764	217,103	227,958	239,356	251,323	263,890
(14c)-(14a)	14f) Energy Usage with DSM Impact	269,903	279,758	288,736	296,626	303,432	309,472
	15) LRMC Energy/Capacity $						
(14a)(15)	16) Annual Energy Cost Savings:	$662,188	$986,487	$1,436,576	$2,032,150	$2,775,763	$3,645,118
	17) NPV Energy Savings (i=12%)						
	18) Equipment Cost/ Participant:						
(13)(18)	19) Total Equipment Cost:	$510,073	$734,588	$1,019,521	$1,349,065	$1,684,398	$1,969,224
(19)(AO392)	20) Taxes & Import Duties on Equip:	$204,029	$293,835	$407,808	$539,626	$673,759	$787,690
(19)-(20)	21) Economic Equipment Cost:	$306,044	$440,753	$611,713	$809,439	$1,010,639	$1,181,534
	22) Administrative Expenses:	$91,813	$132,226	$183,514	$242,832	$303,192	$354,460
(21)+(22)	23) Annual Program Costs	$397,857	$572,979	$795,226	$1,052,271	$1,313,830	$1,535,995
	24) NPV Program Costs (i=12%)						
(17)/(24)	25) Benefit Cost Ratio						
	26) Program Cash Flows	$264,331	$413,509	$641,350	$979,879	$1,461,932	$2,109,123
	27) NPV Program Cash Flows (i=12						
	28) IRR						

Table 7T2P	ELECTRIC COOKING PROGRAM IMPACT	Estimated Energy and Demand Savings for Electric Cooking DSM Measures by Year													
		Residential Sector													
Formulas		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
--------	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	553,763	581,451	610,523	641,049	673,102	706,757	742,095	779,200	818,160	859,068	902,021	947,122	994,478	1,044,202
	1b) % Cust. w/ End-Use:	7.5%	7.4%	7.2%	7.1%	6.9%	6.8%	6.6%	6.5%	6.4%	6.2%	6.1%	6.0%	5.8%	5.7%
	1c) Total Cust. w/ End-Use:	41,744	42,911	44,110	45,343	46,611	47,913	49,253	50,629	52,044	53,499	54,994	56,531	58,111	59,736
	2) End-Use Tech Saturation %:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(1c)(2)	3) Eligible Target Market	41,744	42,911	44,110	45,343	46,611	47,913	49,253	50,629	52,044	53,499	54,994	56,531	58,111	59,736
	4) Interaction Adjustment Factor:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(3)(4)	5) MTP Participation:	41,744	42,911	44,110	45,343	46,611	47,913	49,253	50,629	52,044	53,499	54,994	56,531	58,111	59,736
	5a) Res Cooking Prog Energy Savin	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
(14c)(5a)(4)	6) MTP Energy Reduction(MWH):	13,525	13,903	14,292	14,691	15,102	15,524	15,958	16,404	16,862	17,334	17,818	18,316	18,828	19,354
	6a) Res Cooking Prog Demand Savi	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
(5)(6a)(kW@pk)	7) MTP Demand Reduction(MW):	3.6	3.7	3.8	3.9	4.0	4.1	4.2	4.4	4.5	4.6	4.7	4.9	5.0	5.1
	8a) Replacement Factor (%):	-	-	-	5.0%	10.1%	15.2%	20.3%	25.4%	30.5%	35.6%	40.7%	45.8%	50.9%	56.0%
	8b) Economic Attractiveness (%):	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(6)(8a)(8b)	9) Max Econ. Pot.Impact(MWH)	0	0	0	735	1,525	2,360	3,239	4,167	5,143	6,171	7,252	8,389	9,583	10,838
(7)(8a)(8b)	10) Max Econ. Pot.Impact(MW)	0.00	0.00	0.00	0.20	0.41	0.63	0.86	1.11	1.37	1.64	1.93	2.23	2.55	2.88
	11) Market Penetration Rate:				1.27%	1.62%	2.07%	2.63%	3.34%	4.23%	5.35%	6.75%	8.47%	10.59%	13.16%
(5)(8a)(8b)(11)	12) Cummulative Participants:				29	76	151	263	429	672	1,020	1,510	2,194	3,133	4,403
	13) Annual Participants:				29	48	74	112	167	243	348	491	684	939	1,270
(12)(kWh/Part)	14a) DSM Impact(MWH):				9	25	49	85	139	218	330	489	711	1,015	1,427
(12)(kW/Part)	14b) DSM Impact(MW):				0.002	0.007	0.013	0.023	0.037	0.058	0.088	0.130	0.189	0.270	0.379
	14c) Base Usage MWH				97,941	100,679	103,493	106,385	109,359	112,415	115,557	118,787	122,107	125,520	129,028
	14d) Energy Use with MTP Impact (MWH)				83,250	85,577	87,969	90,428	92,955	95,553	98,224	100,969	103,791	106,692	109,674
(14c)-(9)	14e) Energy Use with Economic Potential Impact (MWH)				97,207	99,153	101,133	103,146	105,192	107,272	109,387	111,535	113,719	115,937	118,190
(14c)-(14a)	14f) Energy Usage with DSM Impact (MWH)				97,932	100,654	103,444	106,300	109,220	112,198	115,227	118,298	121,396	124,505	127,602
--->	15) LRMC Energy/Capacity $	$0.08			ECONOMIC ANALYSIS										
(14a)(15)	16) Annual Energy Cost Savings:				$748	$1,980	$3,902	$6,814	$11,132	$17,418	$26,427	$39,151	$56,873	$81,207	$114,130
	17) NPV Energy Savings (i=12%)	523,289													
	18) Equipment Cost/ Participant:	$100.00													
(13)(18)	19) Total Equipment Cost:				$2,886	$4,754	$7,413	$11,236	$16,658	$24,253	$34,756	$49,091	$68,371	$93,883	$127,016
(19)(AO449)	20) Taxes & Import Duties on Equip:	20%			$577	$951	$1,483	$2,247	$3,332	$4,851	$6,951	$9,818	$13,674	$18,777	$25,403
(19)-(20)	21) Economic Equipment Cost:				$2,308	$3,803	$5,931	$8,989	$13,326	$19,402	$27,805	$39,272	$54,697	$75,106	$101,613
	22) Administrative Expenses:	20%	2%		$2,665	$2,665	$2,665	$2,665	$2,665	$2,107	$2,107	$2,107	$2,107	$2,107	$2,107
(21)+(22)	23) Annual Program Costs				$4,974	$6,468	$8,596	$11,654	$15,992	$21,509	$29,912	$41,379	$56,803	$77,213	$103,720
	24) NPV Program Costs (i=12%)	443,665													
(17)/(24)	25) Benefit Cost Ratio	1.2													
	26) Program Cash Flows				($4,226)	($4,488)	($4,694)	($4,840)	($4,860)	($4,091)	($3,485)	($2,228)	$69	$3,994	$10,410
	27) NPV Program Cash Flows (i=12	79,624													
	28) IRR	28.22%													

Table 7T2P Formulas	ELECTRIC COOKING PROGRAM IMPACT	2005	2006	2007	2008	2009	2010
--------	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	1,096,412	1,151,233	1,208,794	1,269,234	1,332,696	1,399,331
	1b) % Cust. w/ End-Use:	5.6%	5.5%	5.4%	5.3%	5.1%	5.0%
	1c) Total Cust. w/ End-Use:	61,405	63,121	64,886	66,699	68,563	70,480
	2) End-Use Tech Saturation %:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(1c)(2)	3) Eligible Target Market	61,405	63,121	64,886	66,699	68,563	70,480
	4) Interaction Adjustment Factor:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(3)(4)	5) MTP Participation:	61,405	63,121	64,886	66,699	68,563	70,480
	5a) Res Cooking Prog Energy Savin	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
(14c)(5a)(4)	6) MTP Energy Reduction(MWH):	19,895	20,451	21,023	21,610	22,215	22,835
	6a) Res Cooking Prog Demand Savi	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
(5)(6a)(kW@pk)	7) MTP Demand Reduction(MW):	5.3	5.4	5.6	5.7	5.9	6.1
	8a) Replacement Factor (%):	61.1%	66.2%	71.3%	76.4%	81.5%	86.6%
	8b) Economic Attractiveness (%):	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(6)(8a)(8b)	9) Max Econ. Pot.Impact(MWH)	12,156	13,539	14,989	16,510	18,105	19,775
(7)(8a)(8b)	10) Max Econ. Pot.Impact(MW)	3.23	3.60	3.98	4.39	4.81	5.26
	11) Market Penetration Rate:	16.24%	19.88%	24.10%	28.89%	34.20%	39.94%
(5)(8a)(8b)(11)	12) Cummulative Participants:	6,094	8,308	11,149	14,721	19,111	24,378
	13) Annual Participants:	1,691	2,213	2,841	3,572	4,390	5,267
(12)(kWh/Part)	14a) DSM Impact(MWH):	1,975	2,692	3,612	4,769	6,192	7,898
(12)(kW/Part)	14b) DSM Impact(MW):	0.625	0.715	0.960	1.267	1.645	2.099
	14c) Base Usage MWH	132,635	136,342	140,153	144,070	148,097	152,236
	14d) Energy Use with MTP Impact (M	112,740	115,891	119,130	122,459	125,882	129,401
(14c)-(9)	14e) Energy Use with Economic Pote	120,479	122,803	125,163	127,560	129,992	132,461
(14c)-(14a)	14f) Energy Usage with DSM Impact	130,660	133,650	136,541	139,301	141,905	144,338
---->	15) LRMC Energy/Capacity $						
(14a)(15)	16) Annual Energy Cost Savings:	$157,967	$215,331	$288,973	$381,556	$495,346	$631,871
	17) NPV Energy Savings (i=12%)						
	18) Equipment Cost/ Participant:						
(13)(18)	19) Total Equipment Cost:	$169,126	$221,311	$284,115	$357,190	$439,003	$526,720
(19)(AO449)	20) Taxes & Import Duties on Equip:	$33,825	$44,262	$56,823	$71,438	$87,801	$105,344
(19)-(20)	21) Economic Equipment Cost:	$135,301	$177,049	$227,292	$285,752	$351,202	$421,376
	22) Administrative Expenses:	$2,107	$2,107	$2,107	$2,107	$2,107	$2,107
(21)+(22)	23) Annual Program Costs	$137,408	$179,155	$229,399	$287,859	$353,309	$423,483
	24) NPV Program Costs (i=12%)						
(17)/(24)	25) Benefit Cost Ratio						
	26) Program Cash Flows	$20,559	$36,175	$59,574	$93,697	$142,037	$208,388
	27) NPV Program Cash Flows (i=12						
	28) IRR						

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Table 7T3P		TERMODUCHA	Estimated Energy and Demand Savings for Termoducha DSM Measures by Year													
Formulas		PROGRAM	Residential Sector													
--------		IMPACT	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	0)	Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a)	Customers by year:	553,763	581,451	610,523	641,049	673,102	706,757	742,095	779,200	818,160	859,068	902,021	947,122	994,478	1,044,202
	1b)	% Cust. w/ End-Use:	21.9%	22.6%	23.3%	24.1%	24.9%	25.7%	26.5%	27.3%	28.2%	29.1%	30.1%	31.0%	32.0%	33.1%
	1c)	Total Cust. w/ End-Use:	121,190	131,359	142,382	154,330	167,281	181,318	196,534	213,026	230,902	250,278	271,280	294,044	318,719	345,464
	2)	End-Use Tech Saturation %:	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%
(1c)(2)	3)	Eligible Target Market	72,714	78,816	85,429	92,598	100,369	108,791	117,920	127,815	138,541	150,167	162,768	176,427	191,231	207,279
	4)	Interaction Adjustment Factor:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(3)(4)	5)	MTP Participation:	72,714	78,816	85,429	92,598	100,369	108,791	117,920	127,815	138,541	150,167	162,768	176,427	191,231	207,279
	5a)	Termoducha Prog Energy Savin	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%
(14c)(5a)(4)	6)	MTP Energy Reduction(MWH):	14,528	15,747	17,069	18,501	20,054	21,736	23,560	25,538	27,681	30,003	32,521	35,250	38,208	41,414
	6a)	Termoducha Prog Demand Savi	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%
(5)(6a)(kW@p	7)	MTP Demand Reduction(MW):	1.4	1.5	1.7	1.8	1.9	2.1	2.3	2.5	2.7	2.9	3.2	3.4	3.7	4.0
	8a)	Replacement Factor (%):	-	-	-	5.2%	10.5%	15.8%	21.1%	26.4%	31.7%	37.0%	42.3%	47.6%	52.9%	58.2%
	8b)	Economic Attractiveness (%):	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(6)(8a)(8b)	9)	Max Econ. Pot.Impact(MWH)	0	0	0	962	2,106	3,434	4,971	6,742	8,775	11,101	13,756	16,779	20,212	24,103
(7)(8a)(8b)	10)	Max Econ. Pot.Impact(MW)	0.00	0.00	0.00	0.09	0.20	0.33	0.48	0.65	0.85	1.08	1.34	1.63	1.96	2.34
	11)	Market Penetration Rate:				1.30%	1.70%	2.22%	2.88%	3.75%	4.85%	6.26%	8.05%	10.29%	13.07%	16.46%
(5)(8a)(8b)(11)	12)	Cummulative Participants:				63	179	381	718	1,264	2,131	3,480	5,543	8,644	13,221	19,854
	13)	Annual Participants:				63	116	202	337	546	867	1,349	2,063	3,100	4,578	6,633
(12)(kWh/Part)	14a)	DSM Impact(MWH):				13	36	76	143	253	426	695	1,108	1,727	2,642	3,967
(12)(kW/Part)	14b)	DSM Impact(MW):				0.00	0.00	0.01	0.01	0.02	0.04	0.07	0.11	0.17	0.26	0.39
	14c)	Base Usage MWH				55,559	60,221	65,275	70,752	76,689	83,125	90,100	97,661	105,856	114,739	124,367
	14d)	Energy Use with MTP Impact (MWH)				37,058	40,167	43,538	47,192	51,152	55,444	60,097	65,140	70,606	76,531	82,953
(14c)-(9)	14e)	Energy Use with Economic Potential Impact (MWH)				54,597	58,115	61,840	65,781	69,947	74,350	78,999	83,904	89,077	94,527	100,264
(14c)-(14a)	14f)	Energy Usage with DSM Impact (MWH)				55,546	60,185	65,198	70,609	76,437	82,699	89,405	96,553	104,129	112,097	120,400
	15)	LRMC Energy/Capacity $	$0.08				ECONOMIC ANALYSIS									
	16)	Annual Energy Cost Savings:				$1,003	$2,864	$6,089	$11,471	$20,203	$34,060	$55,627	$88,602	$138,159	$211,328	$317,352
(14a)(15)	17)	NPV Energy Savings (i=12%)	1,676,640													
	18)	Equipment Cost/ Participant:	$10.00													
	19)	Total Equipment Cost:				$627	$1,165	$2,018	$3,367	$5,463	$8,669	$13,493	$20,630	$31,004	$45,776	$66,332
(13)(18)	20)	Taxes & Import Duties on Equip:	20%			$125	$233	$404	$673	$1,093	$1,734	$2,699	$4,126	$6,201	$9,155	$13,266
(19)(AO507)	21)	Economic Equipment Cost:				$502	$932	$1,614	$2,693	$4,371	$6,935	$10,794	$16,504	$24,803	$36,621	$53,065
(19)-(20)	22)	Administrative Expenses:	10%			$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000	$10,000
	23)	Annual Program Costs				$10,502	$10,932	$11,614	$12,693	$14,371	$16,935	$20,794	$26,504	$34,803	$46,621	$63,065
(21)+(22)	24)	NPV Program Costs (i=12%)	325,056													
	25)	Benefit Cost Ratio	5.2													
(17)/(24)	26)	Program Cash Flows				($9,499)	($8,068)	($5,525)	($1,223)	$5,833	$17,125	$34,833	$62,098	$103,356	$164,707	$254,287
	27)	NPV Program Cash Flows (i=12	1,351,584													
	28)	IRR	66.28%													

Table 7T3P Formulas	TERMODUCHA PROGRAM IMPACT	2005	2006	2007	2008	2009	2010
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	1,096,412	1,151,233	1,208,794	1,269,234	1,332,696	1,399,331
	1b) % Cust. w/ End-Use:	34.2%	35.3%	36.4%	37.6%	38.8%	40.0%
	1c) Total Cust. w/ End-Use:	374,454	405,876	439,936	476,853	516,868	560,241
	2) End-Use Tech Saturation %:	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%
(1c)(2)	3) Eligible Target Market	224,672	243,526	263,961	286,112	310,121	336,144
	4) Interaction Adjustment Factor:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(3)(4)	5) MTP Participation:	224,672	243,526	263,961	286,112	310,121	336,144
	5a) Termoducha Prog Energy Savin	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%
(14c)(5a)(4)	6) MTP Energy Reduction(MWH):	44,890	48,656	52,739	57,165	61,962	67,162
	6a) Termoducha Prog Demand Savi	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%
(5)(6a)(kW@p	7) MTP Demand Reduction(MW):	4.4	4.7	5.1	5.5	6.0	6.5
	8a) Replacement Factor (%):	63.5%	68.8%	74.1%	79.4%	84.7%	90.0%
	8b) Economic Attractiveness (%):	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(6)(8a)(8b)	9) Max Econ. Pot.Impact(MWH)	28,505	33,476	39,080	45,389	52,482	60,446
(7)(8a)(8b)	10) Max Econ. Pot.Impact(MW)	2.77	3.25	3.79	4.41	5.10	5.87
	11) Market Penetration Rate:	20.52%	25.28%	30.71%	36.74%	43.22%	49.93%
(5)(8a)(8b)(11)	12) Cummulative Participants:	29,272	42,349	60,071	83,466	113,517	151,059
	13) Annual Participants:	9,418	13,077	17,721	23,396	30,051	37,541
(12)(kWh/Part)	14a) DSM Impact(MWH):	5,849	8,461	12,002	16,677	22,681	30,182
(12)(kW/Part)	14b) DSM Impact(MW):	0.57	0.82	1.17	1.62	2.20	2.93
	14c) Base Usage MWH	134,803	146,116	158,377	171,667	186,072	201,687
	14d) Energy Use with MTP Impact (M	89,914	97,459	105,637	114,502	124,110	134,525
(14c)-(9)	14e) Energy Use with Economic Pote	106,299	112,640	119,297	126,278	133,591	141,241
(14c)-(14a)	14f) Energy Usage with DSM Impact	128,955	137,654	146,375	154,990	163,392	171,505
	15) LRMC Energy/Capacity $						
(14a)(15)	16) Annual Energy Cost Savings:	$467,889	$676,912	$960,171	$1,334,125	$1,814,463	$2,414,524
	17) NPV Energy Savings (i=12%)						
	18) Equipment Cost/ Participant:						
(13)(18)	19) Total Equipment Cost:	$94,179	$130,770	$177,214	$233,956	$300,512	$375,413
(19)(AO507)	20) Taxes & Import Duties on Equip:	$18,836	$26,154	$35,443	$46,791	$60,102	$75,083
(19)-(20)	21) Economic Equipment Cost:	$75,344	$104,616	$141,771	$187,164	$240,409	$300,331
	22) Administrative Expenses:	$10,000	$10,000	$10,000	$18,716	$24,041	$30,033
(21)+(22)	23) Annual Program Costs	$85,344	$114,616	$151,771	$205,881	$264,450	$330,364
	24) NPV Program Costs (i=12%)						
(17)/(24)	25) Benefit Cost Ratio						
	26) Program Cash Flows	$382,545	$562,296	$808,400	$1,128,245	$1,560,013	$2,084,160
	27) NPV Program Cash Flows (i=12						
	28) IRR						

Table 7T4P

Estimated Energy and Demand Savings for Water Heater Tank DSM Measures by Year

Residential Sector

Formulas	TANK WATER HEATER PROGRAM IMPACT		1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	0) Annual Cust Escalation Rate:		0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:		553,763	581,451	610,523	641,049	673,102	706,757	742,095	779,200	818,160	859,068	902,021	947,122	994,478	1,044,202
	1b) % Cust. w/ End-Use:		2.5%	2.5%	2.4%	2.3%	2.3%	2.2%	2.2%	2.1%	2.1%	2.0%	1.9%	1.9%	1.8%	1.8%
	1c) Total Cust. w/ End-Use:		14,023	14,342	14,667	15,000	15,341	15,689	16,045	16,409	16,782	17,163	17,552	17,951	18,358	18,775
	2) End-Use Tech Saturation %:		80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
(1c)(2)	3) Eligible Target Market		11,219	11,473	11,734	12,000	12,273	12,551	12,836	13,128	13,426	13,730	14,042	14,361	14,687	15,020
	4) Interaction Adjustment Factor:		90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
(3)(4)	5) MTP Participation:		10,097	10,326	10,561	10,800	11,045	11,296	11,553	11,815	12,083	12,357	12,638	12,925	13,218	13,518
	5a) Water Htr Prog Energy Savings		28.9%	28.9%	28.9%	28.9%	28.9%	28.9%	28.9%	28.9%	28.9%	28.9%	28.9%	28.9%	28.9%	28.9%
(14c)(5a)(4)	6) MTP Energy Reduction(MWH):		3,500	3,579	3,660	3,743	3,828	3,915	4,004	4,095	4,188	4,283	4,380	4,480	4,581	4,685
	6a) Water Htr Prog Demand Savings		32.9%	32.9%	32.9%	32.9%	32.9%	32.9%	32.9%	32.9%	32.9%	32.9%	32.9%	32.9%	32.9%	32.9%
(5)(6a)(kW@p	7) MTP Demand Reduction(MW):		0.39	0.40	0.41	0.42	0.43	0.44	0.45	0.46	0.47	0.48	0.49	0.50	0.51	0.53
	8a) Replacement Factor (%):		-	-	-	5.0%	10.1%	15.2%	20.3%	25.4%	30.5%	35.6%	40.7%	45.8%	50.9%	56.0%
	8b) Economic Attractiveness (%):		50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
(6)(8a)(8b)	9) Max Econ. Pot.Impact(MWH)		0	0	0	94	193	298	406	520	639	762	891	1,026	1,166	1,312
(7)(8a)(8b)	10) Max Econ. Pot.Impact(MW)		0.00	0.00	0.00	0.01	0.02	0.03	0.05	0.06	0.07	0.09	0.10	0.12	0.13	0.15
	11) Market Penetration Rate:					5.84%	6.87%	8.06%	9.44%	11.03%	12.85%	14.92%	17.25%	19.87%	22.77%	25.96%
(5)(8a)(8b)(11)	12) Cummulative Participants:					16	38	69	111	166	237	328	444	588	766	982
	13) Annual Participants:					16	23	31	42	55	71	91	116	144	178	217
(12)(kWh/Part)	14a) DSM Impact(MWH):					5	13	24	38	57	82	114	154	204	265	341
(12)(kW/Part)	14b) DSM Impact(MW):					0.001	0.001	0.003	0.004	0.006	0.009	0.013	0.017	0.023	0.030	0.038
	14c) Base Usage MWH					14,415	14,742	15,076	15,419	15,769	16,127	16,493	16,867	17,250	17,641	18,042
	14d) Energy Use with MTP Impact (MWH)					10,671	10,913	11,161	11,414	11,674	11,939	12,210	12,487	12,770	13,060	13,357
(14c)-(9)	14e) Energy Use with Economic Potential Impact (MWH)					14,321	14,548	14,779	15,012	15,249	15,488	15,730	15,976	16,224	16,475	16,730
(14c)-(14a)	4f) Energy Usage with DSM Impact (MWH)					14,409	14,728	15,052	15,380	15,711	16,044	16,379	16,713	17,046	17,376	17,701
	15) LRMC Energy/Capacity $	$0.08														
	ECONOMIC ANALYSIS															
(14a)(15)	16) Annual Energy Cost Savings:					$437	$1,062	$1,919	$3,070	$4,590	$6,565	$9,098	$12,302	$16,304	$21,237	$27,241
	17) NPV Energy Savings (i=12%)	107,586														
	18) Equipment Cost/ Participant:	$93.65														
(13)(18)	19) Total Equipment Cost:					$1,477	$2,111	$2,894	$3,888	$5,132	$6,673	$8,554	$10,822	$13,514	$16,662	$20,278
(19)(AO565)	20) Taxes & Import Duties on Equip:	20%				$295	$422	$579	$778	$1,026	$1,335	$1,711	$2,164	$2,703	$3,332	$4,056
(19)-(20)	21) Economic Equipment Cost:					$1,181	$1,689	$2,315	$3,110	$4,106	$5,338	$6,843	$8,657	$10,811	$13,329	$16,223
	22) Administrative Expenses:	5%				$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$1,000	$541	$666	$811
(21)+(22)	23) Annual Program Costs					$2,181	$2,689	$3,315	$4,110	$5,106	$6,338	$7,843	$9,657	$11,352	$13,996	$17,034
	24) NPV Program Costs (i=12%)	70,888														
(17)/(24)	25) Benefit Cost Ratio	1.5														
	26) Program Cash Flows					($1,744)	($1,627)	($1,396)	($1,040)	($516)	$227	$1,255	$2,645	$4,952	$7,241	$10,207
	27) NPV Program Cash Flows (i=12	36,699														
	28) IRR	36.74%														

Table 7T4P

Formulas	TANK WATER HEATER PROGRAM IMPACT	2005	2006	2007	2008	2009	2010
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	1,096,412	1,151,233	1,208,794	1,269,234	1,332,696	1,399,331
	1b) % Cust. w/ End-Use:	1.8%	1.7%	1.7%	1.6%	1.6%	1.5%
	1c) Total Cust. w/ End-Use:	19,201	19,637	20,083	20,539	21,005	21,482
	2) End-Use Tech Saturation %:	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
(1c)(2)	3) Eligible Target Market	15,361	15,710	16,066	16,431	16,804	17,186
	4) Interaction Adjustment Factor:	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
(3)(4)	5) MTP Participation:	13,825	14,139	14,460	14,788	15,124	15,467
	5a) Water Htr Prog Energy Savings	28.9%	28.9%	28.9%	28.9%	28.9%	28.9%
(14c)(5a)(4)	6) MTP Energy Reduction(MWH):	4,792	4,901	5,012	5,126	5,242	5,361
	6a) Water Htr Prog Demand Savings	32.9%	32.9%	32.9%	32.9%	32.9%	32.9%
(5)(6a)(kW@p	7) MTP Demand Reduction(MW):	0.54	0.55	0.56	0.58	0.59	0.60
	8a) Replacement Factor (%):	61.1%	66.2%	71.3%	76.4%	81.5%	86.6%
	8b) Economic Attractiveness (%):	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
(6)(8a)(8b)	9) Max Econ. Pot.Impact(MWH)	1,464	1,622	1,787	1,958	2,136	2,321
(7)(8a)(8b)	10) Max Econ. Pot.Impact(MW)	0.16	0.18	0.20	0.22	0.24	0.26
	11) Market Penetration Rate:	29.42%	33.14%	37.08%	41.21%	45.46%	49.77%
(5)(8a)(8b)(11)	12) Cummulative Participants:	1,243	1,551	1,912	2,328	2,801	3,333
	13) Annual Participants:	260	308	361	416	474	532
(12)(kWh/Part)	14a) DSM Impact(MWH):	431	538	663	807	971	1,155
(12)(kW/Part)	14b) DSM Impact(MW):	0.048	0.060	0.074	0.091	0.109	0.130
	14c) Base Usage MWH	18,451	18,870	19,299	19,737	20,185	20,643
	14d) Energy Use with MTP Impact (M	13,660	13,970	14,287	14,611	14,943	15,282
(14c)-(9)	14e) Energy Use with Economic Pote	16,988	17,248	17,512	17,779	18,049	18,322
(14c)-(14a)	4f) Energy Usage with DSM Impact	18,021	18,333	18,636	18,930	19,214	19,488
	15) LRMC Energy/Capacity $						
(14a)(15)	16) Annual Energy Cost Savings:	$34,454	$43,004	$53,004	$64,543	$77,677	$92,429
	17) NPV Energy Savings (i=12%)						
	18) Equipment Cost/ Participant:						
(13)(18)	19) Total Equipment Cost:	$24,360	$28,878	$33,775	$38,971	$44,361	$49,824
(19)(AO565)	20) Taxes & Import Duties on Equip:	$4,872	$5,776	$6,755	$7,794	$8,872	$9,965
(19)-(20)	21) Economic Equipment Cost:	$19,488	$23,102	$27,020	$31,177	$35,488	$39,859
	22) Administrative Expenses:	$974	$1,155	$1,351	$1,559	$1,774	$1,993
(21)+(22)	23) Annual Program Costs	$20,463	$24,257	$28,371	$32,736	$37,263	$41,852
	24) NPV Program Costs (i=12%)						
(17)/(24)	25) Benefit Cost Ratio						
	26) Program Cash Flows	$13,991	$18,746	$24,633	$31,807	$40,414	$50,577
	27) NPV Program Cash Flows (i=12						
	28) IRR						

Table 7T5P

Formulas

DOMESTIC REFRIGERATORS PROGRAM IMPACT

Estimated Energy and Demand Savings for Refrigerator DSM Measures by Year

Residential Sector

Formulas	DOMESTIC REFRIGERATORS PROGRAM IMPACT	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	553,763	581,451	610,523	641,049	673,102	706,757	742,095	779,200	818,160	859,068	902,021	947,122	994,478	1,044,202
	1b) % Cust. w/ End-Use:	39.8%	40.6%	41.5%	42.4%	43.4%	44.3%	45.3%	46.3%	47.3%	48.3%	49.4%	50.4%	51.6%	52.7%
	1c) Total Cust. w/ End-Use:	220,131	236,200	253,441	271,941	291,791	313,091	335,945	360,467	386,779	415,012	445,306	477,811	512,689	550,113
	2) End-Use Tech Saturation %:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(1c)(2)	3) Eligible Target Market	220,131	236,200	253,441	271,941	291,791	313,091	335,945	360,467	386,779	415,012	445,306	477,811	512,689	550,113
	4) Interaction Adjustment Factor:	71.0%	71.0%	71.0%	71.0%	71.0%	71.0%	71.0%	71.0%	71.0%	71.0%	71.0%	71.0%	71.0%	71.0%
(3)(4)	5) MTP Participation:	156,293	167,702	179,943	193,078	207,172	222,294	238,521	255,932	274,613	294,659	316,167	339,246	364,009	390,580
	5a) Refrig Prog Energy Savings	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%
(14c)(5a)(4)	6) MTP Energy Reduction(MWH):	38,110	40,892	43,877	47,080	50,517	54,204	58,161	62,406	66,962	71,849	77,094	82,722	88,760	95,239
	6a) Refrig Prog Demand Savings	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%
(5)(6a)(kW@p	7) MTP Demand Reduction(MW):	4.716	5.061	5.430	5.826	6.252	6.708	7.198	7.723	8.287	8.892	9.541	10.237	10.985	11.786
	8a) Replacement Factor (%):	-	-	-	5.5%	11.0%	16.5%	22.0%	27.5%	33.0%	38.5%	44.0%	49.5%	55.0%	60.5%
	8b) Economic Attractiveness (%):	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%
(6)(8a)(8b)	9) Max Econ. Pot.Impact(MWH)	26,677	28,625	30,714	32,956	35,362	37,943	40,713	43,684	46,873	50,295	53,966	57,905	62,132	66,667
(7)(8a)(8b)	10) Max Econ. Pot.Impact(MW)	3.301	3.542	3.801	4.079	4.376	4.696	5.038	5.406	5.801	6.224	6.679	7.166	7.689	8.250
	11) Market Penetration Rate:				3.67%	4.52%	5.56%	6.80%	8.31%	10.11%	12.25%	14.77%	17.71%	21.08%	24.91%
(5)(8a)(8b)(11)	12) Cummulative Participants:				273	448	977	1,521	2,572	3,842	5,888	8,498	12,318	17,228	23,968
	13) Annual Participants:				273	175	529	544	1,051	1,270	2,046	2,611	3,819	4,910	6,739
(12)(kWh/Part)	14a) DSM Impact(MWH):				67	109	238	371	627	937	1,436	2,072	3,004	4,201	5,844
(12)(kW/Part)	14b) DSM Impact(MW):				0.008	0.014	0.029	0.046	0.078	0.116	0.178	0.256	0.372	0.520	0.723
	14c) Base Usage MWH				228,261	212,733	228,261	244,923	262,802	281,985	302,568	324,654	348,352	373,780	401,064
(14c)-(9)	14d) Energy Use with MTP Impact (M				181,181	168,856	181,181	194,407	208,597	223,824	240,162	257,693	276,503	296,686	318,343
	14e) Energy Use with Economic Pote				195,305	182,019	195,305	209,562	224,859	241,272	258,884	277,781	298,058	319,814	343,159
(14c)-(14a)	14f) Energy Usage with DSM Impact				228,195	212,624	228,023	244,553	262,174	281,048	301,133	322,582	345,349	369,579	395,220
	15) LRMC Energy/Capacity $	$0.08		ECONOMIC ANALYSIS											
(14a)(15)	16) Annual Energy Cost Savings:				$5,327	$8,741	$19,065	$29,668	$50,166	$74,938	$114,851	$165,775	$240,282	$336,072	$467,539
	17) NPV Energy Savings (i=12%)	2,050,666													
	18) Equipment Cost/ Participant:	$61.50													
(13)(18)	19) Total Equipment Cost:				$16,796	$10,761	$32,550	$33,426	$64,625	$78,097	$125,835	$160,549	$234,896	$301,996	$414,476
(19)(AO623)	20) Taxes & Import Duties on Equip:	20%			$3,359	$2,152	$6,510	$6,685	$12,925	$15,619	$25,167	$32,110	$46,979	$60,399	$82,895
(19)-(20)	21) Economic Equipment Cost:				$13,437	$8,609	$26,040	$26,741	$51,700	$62,478	$100,668	$128,439	$187,916	$241,597	$331,581
	22) Administrative Expenses:	10%			$20,000	$861	$2,604	$2,674	$5,170	$6,248	$10,067	$12,844	$18,792	$24,160	$33,158
(21)+(22)	23) Annual Program Costs				$33,437	$9,470	$28,644	$29,415	$56,870	$68,725	$110,734	$141,283	$206,708	$265,756	$364,739
	24) NPV Program Costs (i=12%)	1,464,719													
(17)/(24)	25) Benefit Cost Ratio	1.4													
	26) Program Cash Flows				($28,109)	($729)	($9,579)	$253	($6,704)	$6,212	$4,117	$24,493	$33,574	$70,316	$102,800
	27) NPV Program Cash Flows (i=12	585,947													
	28) IRR	41.85%													

Table 7T5P Formulas --------	DOMESTIC REFRIGERATORS PROGRAM IMPACT	2005	2006	2007	2008	2009	2010
	0) Annual Cust Escalation Rate:	0.05	0.05	0.05	0.05	0.05	0.05
	1a) Customers by year:	1,096,412	1,151,233	1,208,794	1,269,234	1,332,696	1,399,331
	1b) % Cust. w/ End-Use:	53.8%	55.0%	56.2%	57.5%	58.7%	60.0%
	1c) Total Cust. w/ End-Use:	590,268	633,355	679,587	729,193	782,421	839,533
	2) End-Use Tech Saturation %:	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
(1c)(2)	3) Eligible Target Market	590,268	633,355	679,587	729,193	782,421	839,533
	4) Interaction Adjustment Factor:	71.0%	71.0%	71.0%	71.0%	71.0%	71.0%
(3)(4)	5) MTP Participation:	419,090	449,682	482,507	517,727	555,519	596,069
	5a) Refrig Prog Energy Savings	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%
(14c)(5a)(4)	6) MTP Energy Reduction(MWH):	102,191	109,650	117,654	126,242	135,457	145,345
	6a) Refrig Prog Demand Savings	29.1%	29.1%	29.1%	29.1%	29.1%	29.1%
(5)(6a)(kW@p	7) MTP Demand Reduction(MW):	12.647	13.570	14.560	15.623	16.764	17.987
	8a) Replacement Factor (%):	66.0%	71.5%	77.0%	82.5%	88.0%	93.5%
	8b) Economic Attractiveness (%):	70.0%	70.0%	70.0%	70.0%	70.0%	70.0%
(6)(8a)(8b)	9) Max Econ. Pot.Impact(MWH)	71,534	76,755	82,358	88,370	94,820	101,742
(7)(8a)(8b)	10) Max Econ. Pot.Impact(MW)	8.853	9.499	10.192	10.936	11.735	12.591
	11) Market Penetration Rate:	29.16%	33.82%	38.82%	44.06%	49.44%	54.83%
(5)(8a)(8b)(11)	12) Cummulative Participants:	32,501	43,627	57,336	74,411	94,783	119,142
	13) Annual Participants:	8,533	11,126	13,709	17,075	20,373	24,359
(12)(kWh/Part)	14a) DSM Impact(MWH):	7,925	10,638	13,981	18,144	23,112	29,052
(12)(kW/Part)	14b) DSM Impact(MW):	0.981	1.317	1.730	2.245	2.860	3.595
	14c) Base Usage MWH	430,340	461,753	495,458	531,624	570,430	612,069
	14d) Energy Use with MTP Impact (M	341,580	366,514	393,268	421,974	452,776	485,827
(14c)-(9)	14e) Energy Use with Economic Pote	368,208	395,086	423,925	454,869	488,072	523,699
(14c)-(14a)	14f) Energy Usage with DSM Impact	422,415	451,115	481,478	513,480	547,318	583,017
	15) LRMC Energy/Capacity $						
(14a)(15)	16) Annual Energy Cost Savings:	$634,003	$851,033	$1,118,458	$1,451,539	$1,848,955	$2,324,130
	17) NPV Energy Savings (i=12%)						
	18) Equipment Cost/ Participant:						
(13)(18)	19) Total Equipment Cost:	$524,807	$684,228	$843,109	$1,050,102	$1,252,929	$1,498,080
(19)(AO623)	20) Taxes & Import Duties on Equip:	$104,961	$136,845	$168,622	$210,020	$250,586	$299,616
(19)-(20)	21) Economic Equipment Cost:	$419,846	$547,382	$674,487	$840,081	$1,002,343	$1,198,464
	22) Administrative Expenses:	$41,985	$54,738	$67,449	$84,008	$100,234	$119,846
(21)+(22)	23) Annual Program Costs	$461,830	$602,121	$741,936	$924,090	$1,102,577	$1,318,310
	24) NPV Program Costs (i=12%)						
(17)/(24)	25) Benefit Cost Ratio						
	26) Program Cash Flows	$172,172	$248,912	$376,522	$527,450	$746,378	$1,005,820
	27) NPV Program Cash Flows (i=12						
	28) IRR						

DESCRIPTION	Estimated Energy Savings for DSM Technologies in MWh per Year												
	Residential Sector												
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
LIGHTING PROGRAM	7.0	21.9	51.8	108.6	213.5	402.3	735.7	1,314.1	2,301.3	3,561.0	5,462.6	8,277.3	12,331.1
COOKING	9.3	24.8	48.8	85.2	139.1	217.7	330.3	489.4	710.9	1,015.1	1,426.6	1,974.6	2,691.6
TERMODUCHAS	12.5	35.8	76.1	143.4	252.5	425.8	695.3	1,107.5	1,727.0	2,641.6	3,966.9	5,848.6	8,461.4
WATER HEATER TANKS	5.5	13.3	24.0	38.4	57.4	82.1	113.7	153.8	203.8	265.5	340.5	430.7	537.5
DOMESTIC REFRIGERATORS	66.6	109.3	238.3	370.8	627.1	936.7	1,435.6	2,072.2	3,003.5	4,200.9	5,844.2	7,925.0	10,637.9
1) TOTAL ENERGY SAVINGS (GWH)	0.10	0.21	0.44	0.75	1.29	2.06	3.31	5.14	7.95	11.68	17.04	24.46	34.66
2) TOTAL ANNUAL ENERGY CONSUMPTION (GWH)	3,213	3,377	3,542	3,706	3,870	4,035	4,199	4,363	4,528	4,692	4,856	5,021	5,185
3) PERCENT RESIDENTIAL ENERGY CONSUMPTION OF TOTAL (%)	30.2%	30.2%	30.2%	30.2%	30.2%	30.2%	30.2%	30.2%	30.2%	30.2%	30.2%	30.2%	30.2%
4) TOTAL ANNUAL RESIDENTIAL ENERGY CONSUMPTION (GWH)	970	1,020	1,070	1,119	1,169	1,218	1,268	1,318	1,367	1,417	1,467	1,516	1,566
5) PERCENT ENERGY SAVINGS	0.01%	0.02%	0.04%	0.07%	0.11%	0.17%	0.3%	0.4%	0.6%	0.8%	1.2%	1.6%	2.2%
File: RESMODEL.WK1 Range Name: SUMM-KWH													

DESCRIPTION	Estimated Coincident Diversified Demand for DSM Technologies in MW by Year												
	Residential Sector												
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
LIGHTING PROGRAM	0.004	0.012	0.03	0.06	0.12	0.22	0.40	0.72	1.25	1.94	2.98	4.51	6.72
COOKING	0.002	0.007	0.01	0.02	0.04	0.06	0.09	0.13	0.19	0.27	0.38	0.52	0.72
TERMODUCHAS	0.001	0.003	0.01	0.01	0.02	0.04	0.07	0.11	0.17	0.26	0.39	0.57	0.82
WATER HEATER TANKS	0.001	0.001	0.00	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.04	0.05	0.06
DOMESTIC REFRIGERATORS	0.008	0.014	0.03	0.05	0.08	0.12	0.18	0.26	0.37	0.52	0.72	0.98	1.32
1) TOTAL DEMAND SAVINGS (GW)	0.016	0.037	0.08	0.15	0.26	0.44	0.75	1.23	2.00	3.02	4.50	6.63	9.63
2) ANNUAL MAXIMUM SYSTEM DEMAND(GW)	643	676	709	742	775	808	841	874	907	940	973	1,005	1,038
3) PERCENT RESIDENTIAL DEMAND CONTRIBUTION TO PEAK (%)	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%	48.0%
4) RESIDENTIAL SECTOR DEMAND CONTRIBUTION TO PEAK (GW)	309	325	340	356	372	388	404	419	435	451	467	483	498
5) PERCENT DEMAND REDUCTION (%)	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.2%	0.3%	0.5%	0.7%	1.0%	1.4%	1.9%
File: RESMODEL.WK1 Range Name: SUMM-GW													

DESCRIPTION	2007	2008	2009	2010	Percent of Total Savings
LIGHTING PROGRAM	17,957.2	25,401.9	34,697.0	45,564.0	40.0%
COOKING	3,612.2	4,769.5	6,191.8	7,898.4	6.9%
TERMODUCHAS	12,002.1	16,676.6	22,680.8	30,181.5	26.5%
WATER HEATER TANKS	662.6	806.8	971.0	1,155.4	1.0%
DOMESTIC REFRIGERATORS	13,980.7	18,144.2	23,111.9	29,051.6	25.5%
1) TOTAL ENERGY SAVINGS (GWH)	48.21	65.80	87.65	113.85	100.0%
2) TOTAL ANNUAL ENERGY CONSUMPTION (GWH)	5,350	5,514	5,678	5,843	
3) PERCENT RESIDENTIAL ENERGY CONSUMPTION OF TOTAL (%)	30.2%	30.2%	30.2%	30.2%	
4) TOTAL ANNUAL RESIDENTIAL ENERGY CONSUMPTION (GWH)	1,616	1,665	1,715	1,765	
5) PERCENT ENERGY SAVINGS	3.0%	4.0%	5.1%	6.5%	
File: RESMODEL.WK1 Range Name: SUMM-K					

DESCRIPTION	2007	2008	2009	2010
LIGHTING PROGRAM	9.78	13.83	18.90	24.82
COOKING	0.96	1.27	1.65	2.10
TERMODUCHAS	1.17	1.62	2.20	2.93
WATER HEATER TANKS	0.07	0.09	0.11	0.13
DOMESTIC REFRIGERATORS	1.73	2.25	2.86	3.60
1) TOTAL DEMAND SAVINGS (GW)	13.71	19.06	25.71	33.57
2) ANNUAL MAXIMUM SYSTEM DEMAND(GW)	1,071	1,104	1,137	1,170
3) PERCENT RESIDENTIAL DEMAND CONTRIBUTION TO PEAK (%)	48.0%	48.0%	48.0%	48.0%
4) RESIDENTIAL SECTOR DEMAND CONTRIBUTION TO PEAK (GW)	514	530	546	562
5) PERCENT DEMAND REDUCTION (%)	2.7%	3.6%	4.7%	6.0%
File: RESMODEL.WK1 Range Name: SUMM-G				

Table 9T

Guatemala Residential Lighting
Comparison of DSM Impact on Load Shape

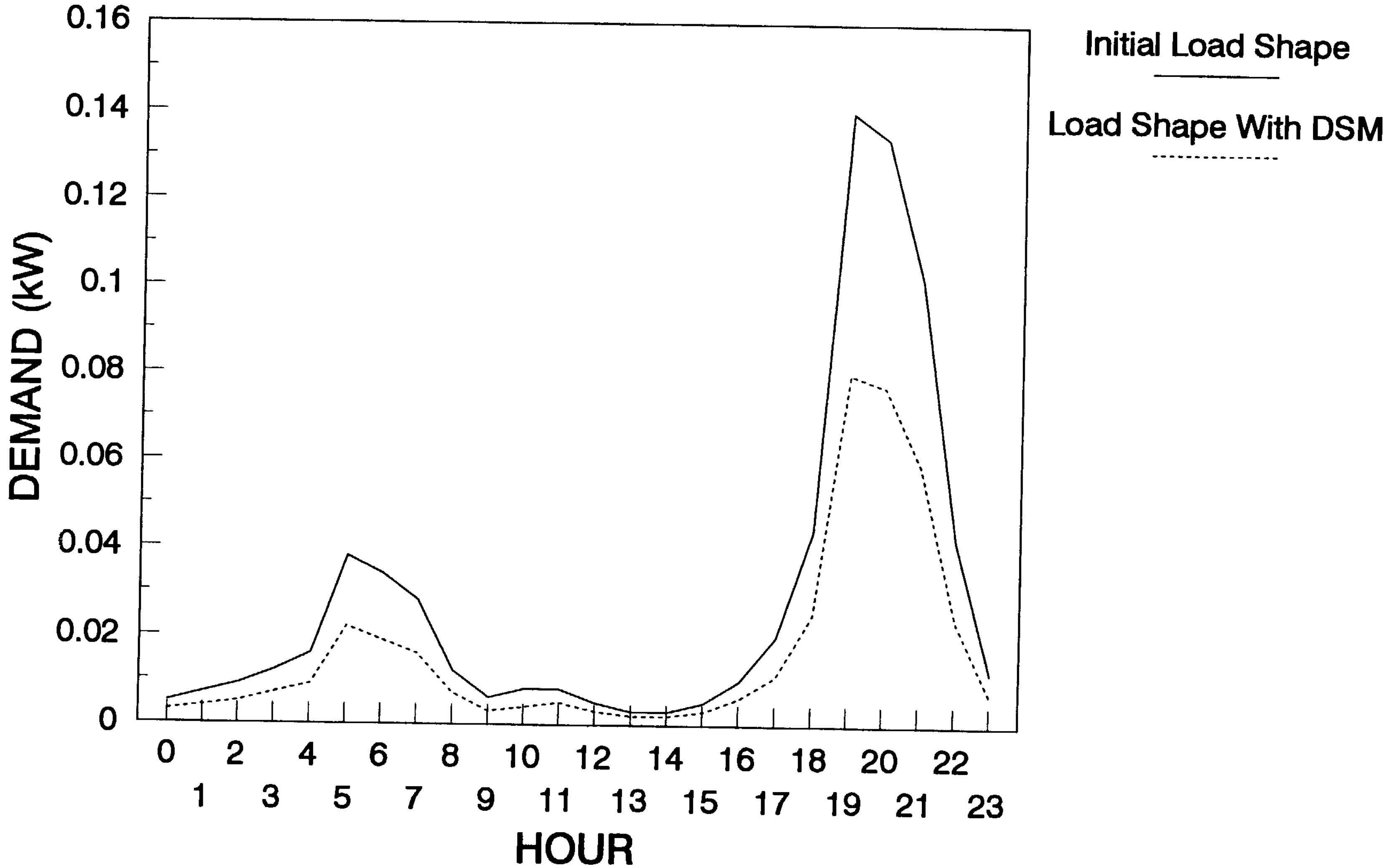

Table 10T
Guatemala Residential Cooking
Comparison of DSM Impact on Load Shape

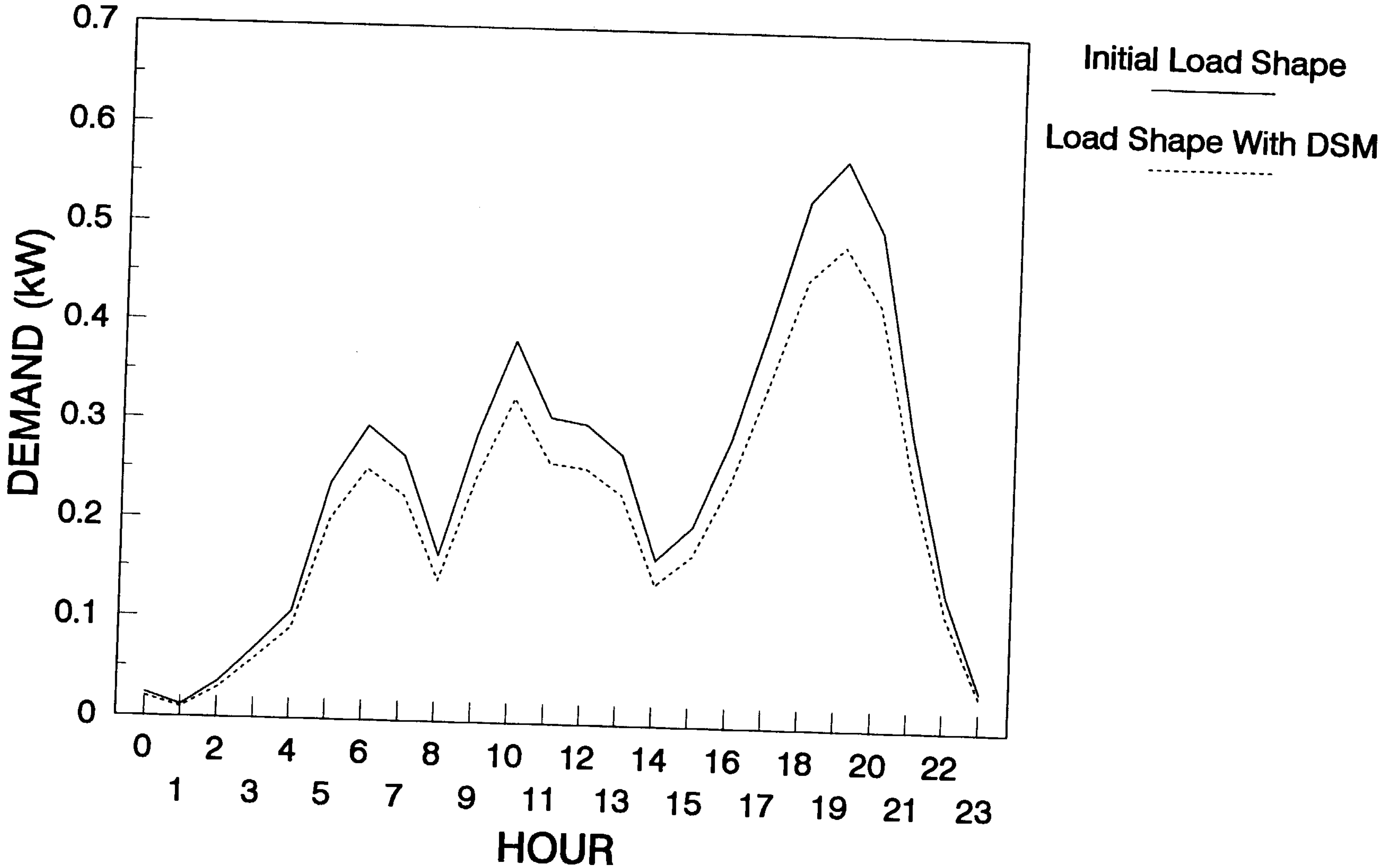

Table 11T

Guatemala Residential Termo Duchas
Comparison of DSM Impact on Load Shape

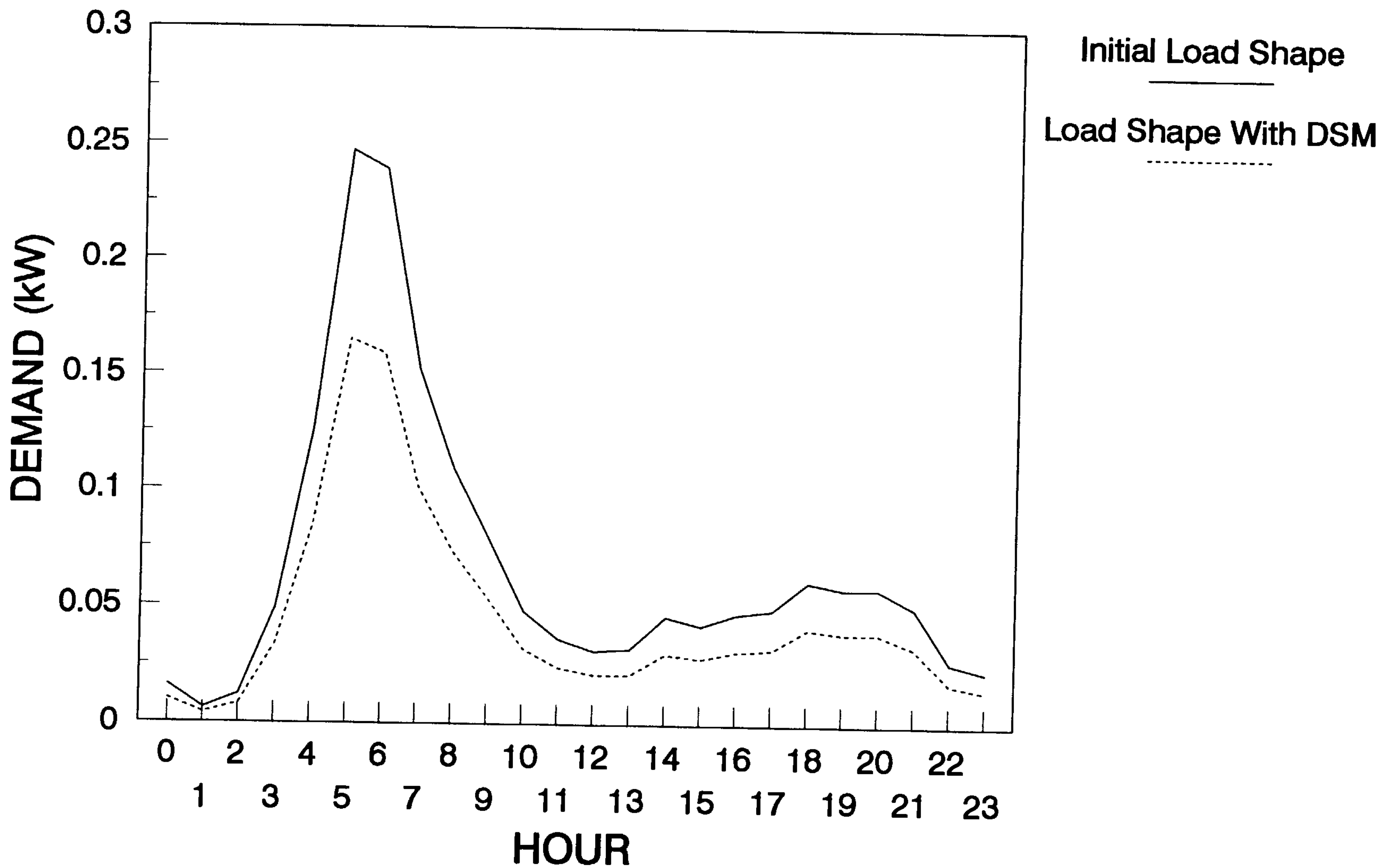

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Table 12T

Guatemala Residential Tank Water Heater
Comparison of DSM Impact on Load Shape

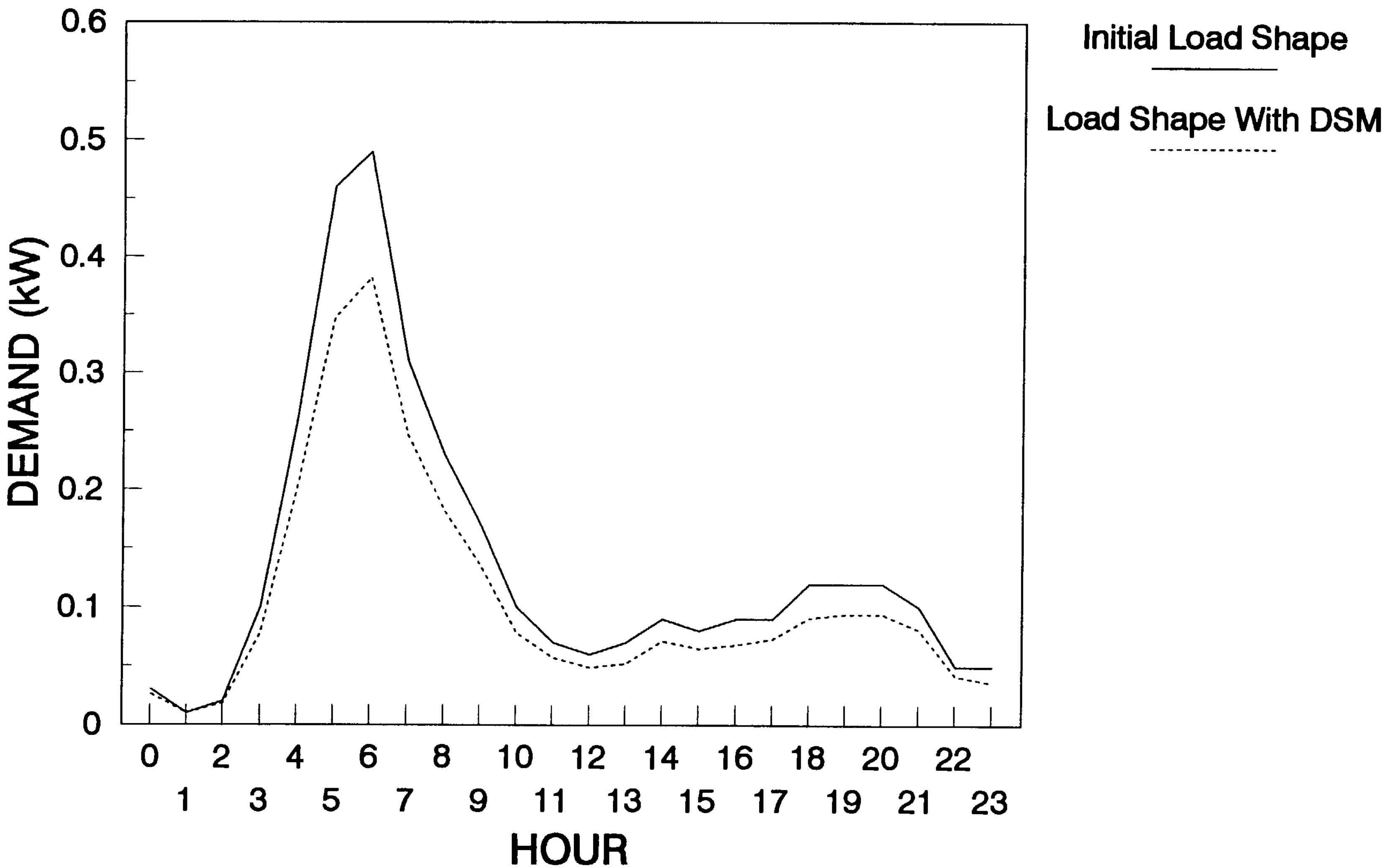
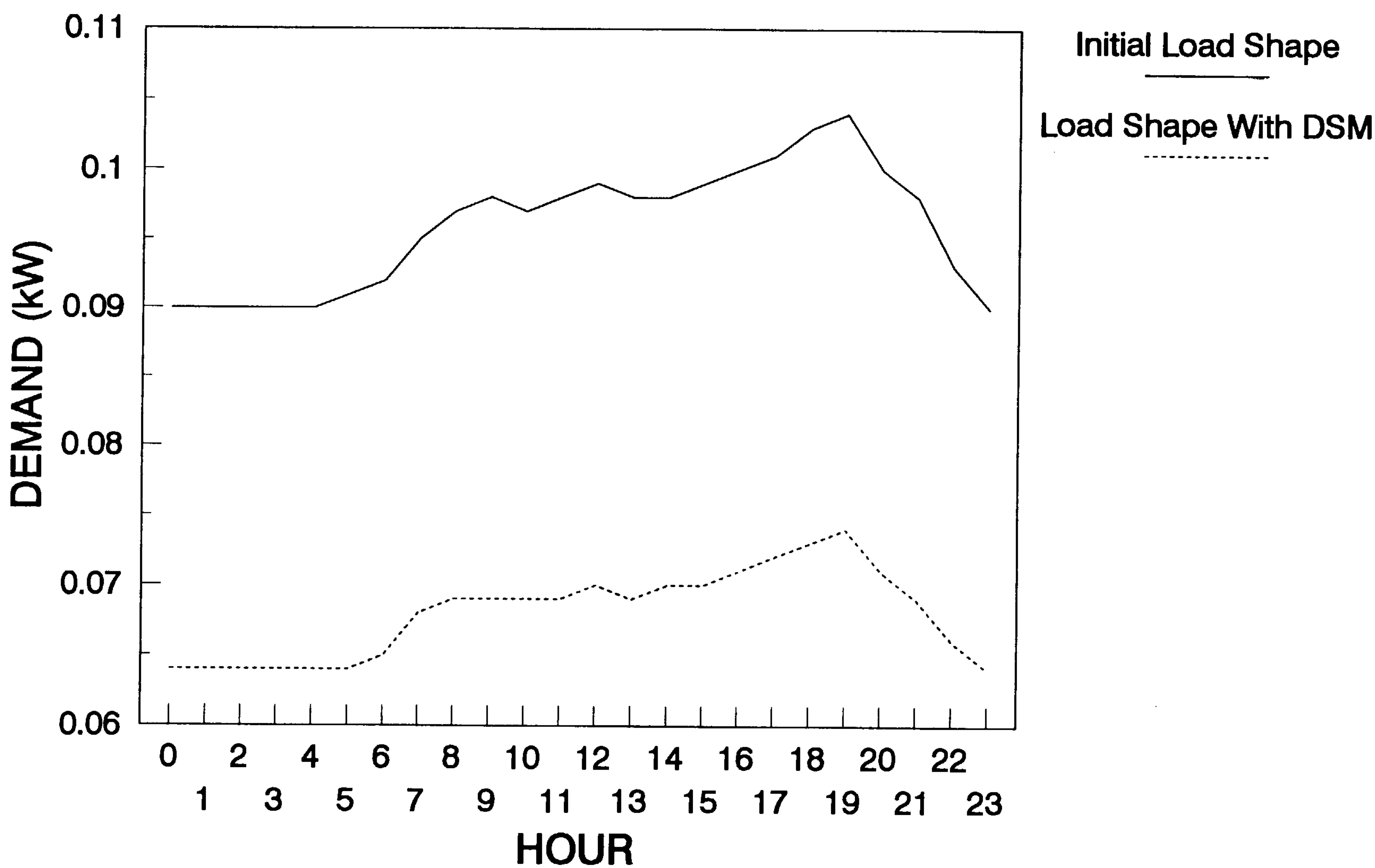


Table 13T

Guatemala Residential Refrigeration
Comparison of DSM Impact on Load Shape



APPENDIX F

SUPPLY CURVE CALCULATION FOR IMPLEMENTATION OF INTERRUPTIBLE RATES FOR INDUSTRIAL CUSTOMERS' PROGRAM

SUPPLY CURVE CALCULATION FOR IMPLEMENTATION OF
INTERRUPTIBLE RATES FOR INDUSTRIAL CUSTOMERSPROGRAM

SSUMPTIONS /1:

ROGRAM	1
OST OF EQUIPTMENT	$850 PER CUSTOMER
NSTALLATION COSTS	$50 PER CUSTOMER
&M COSTS	$25 PER CUSTOMER
ALARIES	$30,000 PER YEAR
ROMOTION COSTS	$10,000 PER YEAR
NCENTIVES	$0.00 PER KW
ONSERVED DEMAND	69.70 KW PER CUSTOMER
IXED COSTS BEGIN	1994
EAL DISCOUNT RATE	12%
AX RATE	0%

ALCULATIONS:

EAR	# OF NEW CUST.	CUM CUST	ANNUAL MW	CUM. MW	EQUIPT. COSTS	INSTALL COSTS	SALARIES	PROMO. COSTS	O&M	INCENT.	TOTAL ANNUAL IMPLEMENT. COSTS	ANNUAL INCREM. COSTS
991	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
992	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
993	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
994	0	0	0.0	0.0	$0	$0	$30,000	$10,000	$0	$0	$40,000	$40,000
995	5	5	0.3	0.3	$4,250	$250	$30,000	$10,000	$125	$0	$44,625	$44,625
996	8	13	0.6	0.9	$6,800	$400	$30,000	$10,000	$325	$0	$47,525	$47,525
997	10	23	0.7	1.6	$8,500	$500	$30,000	$10,000	$575	$0	$49,575	$49,575
998	13	36	0.9	2.5	$11,050	$650	$30,000	$10,000	$900	$0	$52,600	$52,600
999	15	51	1.0	3.6	$12,750	$750	$30,000	$10,000	$1,275	$0	$54,775	$54,775
000	20	71	1.4	4.9	$17,000	$1,000	$30,000	$10,000	$1,775	$0	$59,775	$59,775
001	20	91	1.4	6.3	$17,000	$1,000	$30,000	$10,000	$2,275	$0	$60,275	$60,275
002	20	111	1.4	7.7	$17,000	$1,000	$30,000	$10,000	$2,775	$0	$60,775	$60,775
003	20	131	1.4	9.1	$17,000	$1,000	$30,000	$10,000	$3,275	$0	$61,275	$61,275
004	20	151	1.4	10.5	$17,000	$1,000	$30,000	$10,000	$3,775	$0	$61,775	$61,775
005	25	176	1.7	12.3	$21,250	$1,250	$30,000	$10,000	$4,400	$0	$66,900	$66,900
006	25	201	1.7	14.0	$21,250	$1,250	$30,000	$10,000	$5,025	$0	$67,525	$67,525
007	25	226	1.7	15.8	$21,250	$1,250	$30,000	$10,000	$5,650	$0	$68,150	$68,150
008	25	251	1.7	17.5	$21,250	$1,250	$30,000	$10,000	$6,275	$0	$68,775	$68,775
009	25	276	1.7	19.2	$21,250	$1,250	$30,000	$10,000	$6,900	$0	$69,400	$69,400
010	25	301	1.7	21.0	$21,250	$1,250	$30,000	$10,000	$7,525	$0	$70,025	$70,025
NPV				42.2							$299,333	

ESULTS:

OST OF CONSERVED DEMAND = ANNUALIZED IMPLEMENTATION COSTS / ANNUALIZED CONSERVED KW DEMAND

OST OF CONSERVED DEMAND = (PV IMPLEMENTATION COSTS) x (CAPITAL RECOVERY FACTOR) / (PV CONSERVED KWD) x (CAPITAL RECOVERY FACTOR)

OST OF CONSERVED DEMAND = ($299333) x (0.1468) / (42218 KW) x (0.1468)

OST OF CONSERVED DEMAND = $7.09 PER KW PER YEAR

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Q

SUPPLY CURVE CALCULATION FOR IMPLEMENTATION OF
TOU RATES FOR INDUSTRIAL CUSTOMERS

ASSUMPTIONS /1:

PROGRAM 2

COST OF EQUIPTMENT $350 PER CUSTOMER

APPENDIX G

Q

SUPPLY CURVE CALCULATION FOR IMPLEMENTATION OF
TOU RATES FOR INDUSTRIAL CUSTOMERS

INSTALLATION COSTS $50 PER CUSTOMER

O&M COSTS $15 PER CUSTOMER

SALARIES $30,000 PER YEAR

PROMOTION COSTS $10,000 PER YEAR

INCENTIVES $0.00 PER KW

CONSERVED DEMAND 25.00 KW PER CUSTOMER

FIXED COSTS BEGIN 1995

REAL DISCOUNT RATE 12%

TAX RATE 0%

CALCULATIONS:

YEAR	# OF NEW CUST.	CUM CUST	ANNUAL MW	CUM. MW	EQUIPT. COSTS	INSTALL COSTS	SALARIES	PROMO. COSTS	O&M	INCENT.	TOTAL ANNUAL IMPLEMENT. COSTS	ANNUAL INCREM. COSTS
1991	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1992	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1993	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1994	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1995	0	0	0.0	0.0	$0	$0	$30,000	$10,000	$0	$0	$0	$0
1996	0	0	0.0	0.0	$0	$0	$30,000	$10,000	$0	$0	$40,000	$40,000
1997	10	10	0.3	0.3	$3,500	$500	$30,000	$10,000	$150	$0	$40,000	$40,000
1998	15	25	0.4	0.6	$5,250	$750	$30,000	$10,000	$375	$0	$44,150	$44,150
1999	20	45	0.5	1.1	$7,000	$1,000	$30,000	$10,000	$675	$0	$46,375	$46,375
2000	25	70	0.6	1.8	$8,750	$1,250	$30,000	$10,000	$1,050	$0	$48,675	$48,675
2001	30	100	0.8	2.5	$10,500	$1,500	$30,000	$10,000	$1,500	$0	$51,050	$51,050
2002	35	135	0.9	3.4	$12,250	$1,750	$30,000	$10,000	$2,025	$0	$53,500	$53,500
2003	40	175	1.0	4.4	$14,000	$2,000	$30,000	$10,000	$2,625	$0	$56,025	$56,025
2004	40	215	1.0	5.4	$14,000	$2,000	$30,000	$10,000	$3,225	$0	$58,625	$58,625
2005	40	255	1.0	6.4	$14,000	$2,000	$30,000	$10,000	$3,825	$0	$59,225	$59,225
2006	40	295	1.0	7.4	$14,000	$2,000	$30,000	$10,000	$4,425	$0	$59,825	$59,825
2007	35	330	0.9	8.3	$12,250	$1,750	$30,000	$10,000	$4,950	$0	$60,425	$60,425
2008	35	365	0.9	9.1	$12,250	$1,750	$30,000	$10,000	$5,475	$0	$58,950	$58,950
2009	30	395	0.8	9.9	$10,500	$1,500	$30,000	$10,000	$5,925	$0	$59,475	$59,475
2010	30	425	0.8	10.6	$10,500	$1,500	$30,000	$10,000	$6,375	$0	$57,925	$57,925
											$58,375	$58,375
NPV				18.9							$240,575	

RESULTS:

COST OF CONSERVED DEMAND = ANNUALIZED IMPLEMENTATION COSTS / ANNUALIZED CONSERVED KW DEMAND

COST OF CONSERVED DEMAND = (PV IMPLEMENTATION COSTS) x (CAPITAL RECOVERY FACTOR) / (PV CONSERVED KWD) x (CAPITAL RECOVERY FACTOR)

COST OF CONSERVED DEMAND = ($240575) x (0.1468) / (18923 KW) x (0.1468)

COST OF CONSERVED DEMAND = $12.71 PER KW PER YEAR

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SUPPLY CURVE CALCULATION FOR IMPLEMENTATION OF
TOU RATES FOR COMMERCIAL CUSTOMERS

ASSUMPTIONS /1:

PROGRAM 3

COST OF EQUIPTMENT $250 PER CUSTOMER

INSTALLATION COSTS $35 PER CUSTOMER

O&M COSTS $10 PER CUSTOMER

SALARIES $25,000 PER YEAR

PROMOTION COSTS $10,000 PER YEAR

INCENTIVES $0.00 PER KW

CONSERVED DEMAND 0.45 KW PER CUSTOMER

FIXED COSTS BEGIN 1995

REAL DISCOUNT RATE 12%

TAX RATE 0%

CALCULATIONS:

YEAR	# OF NEW CUST.	CUM CUST	ANNUAL MW	CUM. MW	EQUIPT. COSTS	INSTALL COSTS	SALARIES	PROMO. COSTS	O&M	INCENT.	TOTAL ANNUAL IMPLEMENT. COSTS	ANNUAL INCREM. COSTS
1991	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1992	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1993	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1994	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1995	400	400	0.2	0.2	$100,000	$14,000	$25,000	$10,000	$4,000	$0	$153,000	$153,000
1996	400	800	0.2	0.4	$100,000	$14,000	$25,000	$10,000	$8,000	$0	$157,000	$157,000
1997	300	1100	0.1	0.5	$75,000	$10,500	$25,000	$10,000	$11,000	$0	$131,500	$131,500
1998	300	1400	0.1	0.6	$75,000	$10,500	$25,000	$10,000	$14,000	$0	$134,500	$134,500
1999	600	2000	0.3	0.9	$150,000	$21,000	$25,000	$10,000	$20,000	$0	$226,000	$226,000
2000	600	2600	0.3	1.2	$150,000	$21,000	$25,000	$10,000	$26,000	$0	$232,000	$232,000
2001	600	3200	0.3	1.4	$150,000	$21,000	$25,000	$10,000	$32,000	$0	$238,000	$238,000
2002	600	3800	0.3	1.7	$150,000	$21,000	$25,000	$10,000	$38,000	$0	$244,000	$244,000
2003	900	4700	0.4	2.1	$225,000	$31,500	$25,000	$10,000	$47,000	$0	$338,500	$338,500
2004	900	5600	0.4	2.5	$225,000	$31,500	$25,000	$10,000	$56,000	$0	$347,500	$347,500
2005	900	6500	0.4	2.9	$225,000	$31,500	$25,000	$10,000	$65,000	$0	$356,500	$356,500
2006	900	7400	0.4	3.3	$225,000	$31,500	$25,000	$10,000	$74,000	$0	$365,500	$365,500
2007	1200	8600	0.5	3.9	$300,000	$42,000	$25,000	$10,000	$86,000	$0	$463,000	$463,000
2008	1200	9800	0.5	4.4	$300,000	$42,000	$25,000	$10,000	$98,000	$0	$475,000	$475,000
2009	1200	11000	0.5	5.0	$300,000	$42,000	$25,000	$10,000	$110,000	$0	$487,000	$487,000
2010	1200	12200	0.5	5.5	$300,000	$42,000	$25,000	$10,000	$122,000	$0	$499,000	$499,000
NPV				10.5							$1,149,777	

RESULTS:

COST OF CONSERVED DEMAND = ANNUALIZED IMPLEMENTATION COSTS / ANNUALIZED CONSERVED KW DEMAND

COST OF CONSERVED DEMAND = (PV IMPLEMENTATION COSTS) x (CAPITAL RECOVERY FACTOR) / (PV CONSERVED KWD) x (CAPITAL RECOVERY FACTOR)

COST OF CONSERVED DEMAND = ($1149777) x (0.1468) / (10505 KW) x (0.1468)

COST OF CONSERVED DEMAND = $109.45 PER KW PER YEAR

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SUPPLY CURVE CALCULATION FOR IMPLEMENTATION OF
A RESIDENTIAL LOAD CONTROL FOR ELECTRIC WATER HEATER TANKS

ASSUMPTIONS /1:

PROGRAM	4	
COST OF EQUIPTMENT	$50	PER CUSTOMER
INSTALLATION COSTS	$20	PER CUSTOMER
O&M COSTS	$1	PER CUSTOMER
SALARIES	$10,000	PER YEAR
PROMOTION COSTS	$10,000	PER YEAR
INCENTIVES	$0.00	PER KW
CONSERVED DEMAND	0.12	KW PER CUSTOMER
FIXED COSTS BEGIN	1998	
REAL DISCOUNT RATE	12%	
TAX RATE	0%	

CALCULATIONS:

YEAR	# OF NEW CUST.	CUM CUST	ANNUAL MW	CUM. MW	EQUIPT. COSTS	INSTALL COSTS	SALARIES	PROMO. COSTS	O&M	INCENT.	TOTAL ANNUAL IMPLEMENT. COSTS	ANNUAL INCREM. COSTS
1991	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1992	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1993	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1994	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1995	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1996	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1997	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1998	0	0	0.0	0.0	$0	$0	$10,000	$10,000	$0	$0	$20,000	$20,000
1999	250	250	0.0	0.0	$12,500	$5,000	$10,000	$10,000	$250	$0	$37,750	$37,750
2000	500	750	0.1	0.1	$25,000	$10,000	$10,000	$10,000	$750	$0	$55,750	$55,750
2001	750	1500	0.1	0.2	$37,500	$15,000	$10,000	$10,000	$1,500	$0	$74,000	$74,000
2002	1000	2500	0.1	0.3	$50,000	$20,000	$10,000	$10,000	$2,500	$0	$92,500	$92,500
2003	1500	4000	0.2	0.5	$75,000	$30,000	$10,000	$10,000	$4,000	$0	$129,000	$129,000
2004	2000	6000	0.2	0.7	$100,000	$40,000	$10,000	$10,000	$6,000	$0	$166,000	$166,000
2005	2000	8000	0.2	1.0	$100,000	$40,000	$10,000	$10,000	$8,000	$0	$168,000	$168,000
2006	2000	10000	0.2	1.2	$100,000	$40,000	$10,000	$10,000	$10,000	$0	$170,000	$170,000
2007	2000	12000	0.2	1.4	$100,000	$40,000	$10,000	$10,000	$12,000	$0	$172,000	$172,000
2008	2000	14000	0.2	1.7	$100,000	$40,000	$10,000	$10,000	$14,000	$0	$174,000	$174,000
2009	2000	16000	0.2	1.9	$100,000	$40,000	$10,000	$10,000	$16,000	$0	$176,000	$176,000
2010	2500	18500	0.3	2.2	$125,000	$50,000	$10,000	$10,000	$18,500	$0	$213,500	$213,500
NPV				2.6							$307,690	

RESULTS:

COST OF CONSERVED DEMAND = ANNUALIZED IMPLEMENTATION COSTS / ANNUALIZED CONSERVED KW DEMAND

COST OF CONSERVED DEMAND = (PV IMPLEMENTATION COSTS) x (CAPITAL RECOVERY FACTOR) / (PV CONSERVED KWD) x (CAPITAL RECOVERY FACTOR)

COST OF CONSERVED DEMAND = ($307690) x (0.1468) / (2641 KW) x (0.1468)

COST OF CONSERVED DEMAND = $116.51 PER KW PER YEAR

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SUPPLY CURVE CALCULATION FOR IMPLEMENTATION OF
TOU RATES FOR RESIDENTIAL CUSTOMERS

SSUMPTIONS /1:

ROGRAM	5	
OST OF EQUIPTMENT	$120	PER CUSTOMER
NSTALLATION COSTS	$20	PER CUSTOMER
&M COSTS	$1	PER CUSTOMER
ALARIES	$10,000	PER YEAR
ROMOTION COSTS	$10,000	PER YEAR
NCENTIVES	$0.00	PER KW
ONSERVED DEMAND	0.21	KW PER CUSTOMER
IXED COSTS BEGIN	1998	
EAL DISCOUNT RATE	12%	
AX RATE	0%	

ALCULATIONS:

EAR	# OF NEW CUST.	CUM CUST	ANNUAL MW	CUM. MW	EQUIPT. COSTS	INSTALL COSTS	SALARIES	PROMO. COSTS	O&M	INCENT.	TOTAL ANNUAL IMPLEMENT. COSTS	ANNUAL INCREM. COSTS
1991	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1992	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1993	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1994	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1995	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1996	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1997	0	0	0.0	0.0	$0	$0	$0	$0	$0	$0	$0	$0
1998	0	0	0.0	0.0	$0	$0	$10,000	$10,000	$0	$0	$20,000	$20,000
1999	100	100	0.0	0.0	$12,000	$2,000	$10,000	$10,000	$100	$0	$34,100	$34,100
2000	200	300	0.0	0.1	$24,000	$4,000	$10,000	$10,000	$300	$0	$48,300	$48,300
2001	300	600	0.1	0.1	$36,000	$6,000	$10,000	$10,000	$600	$0	$62,600	$62,600
2002	500	1100	0.1	0.2	$60,000	$10,000	$10,000	$10,000	$1,100	$0	$91,100	$91,100
2003	1000	2100	0.2	0.4	$120,000	$20,000	$10,000	$10,000	$2,100	$0	$162,100	$162,100
2004	1000	3100	0.2	0.7	$120,000	$20,000	$10,000	$10,000	$3,100	$0	$163,100	$163,100
2005	1000	4100	0.2	0.9	$120,000	$20,000	$10,000	$10,000	$4,100	$0	$164,100	$164,100
2006	2000	6100	0.4	1.3	$240,000	$40,000	$10,000	$10,000	$6,100	$0	$306,100	$306,100
2007	2000	8100	0.4	1.7	$240,000	$40,000	$10,000	$10,000	$8,100	$0	$308,100	$308,100
2008	2000	10100	0.4	2.1	$240,000	$40,000	$10,000	$10,000	$10,100	$0	$310,100	$310,100
2009	2000	12100	0.4	2.5	$240,000	$40,000	$10,000	$10,000	$12,100	$0	$312,100	$312,100
2010	2000	14100	0.4	3.0	$240,000	$40,000	$10,000	$10,000	$14,100	$0	$314,100	$314,100
NPV				2.9							$391,076	

RESULTS:

COST OF CONSERVED DEMAND = ANNUALIZED IMPLEMENTATION COSTS / ANNUALIZED CONSERVED KW DEMAND

COST OF CONSERVED DEMAND = (PV IMPLEMENTATION COSTS) x (CAPITAL RECOVERY FACTOR) / (PV CONSERVED KWD) x (CAPITAL RECOVERY FACTOR)

COST OF CONSERVED DEMAND = ($391076) x (0.1468) / (2910 KW) x (0.1468)

COST OF CONSERVED DEMAND = $134.38 PER KW PER YEAR

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