FINAL REPORT

Republic of the Philippines
Department of Energy

Demand-Side Management Action Plan for the Philippines
(DSM/IRP Pre-Assessment)

31 July 1994

Prepared by:

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A number of Hagler Bailly staff contributed to this project and report. Alain Streicher and John Armstrong provided overall direction. Michael Ellis was the resident advisor for the technical assistance task under which this work was done. David Wolcott managed the project, was responsible for the institutional development work, and co-authored the report. Michael Crosetti was responsible for the DSM program design work and co-authored the report. Ali Balali provided research assistance and co-authored the report. Stanley Bowden and Ashley Brown conducted the power sector restructuring and privatization study and contributed to the institutional development work. Wynne Cougill, Jane Enright, Alicia Dees, Jessica Bardell, and Rosario Citan provided editorial, graphics, word processing, and production assistance.

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ACRONYMS

ADB	Asian Development Bank
ASD	adjustable-speed drive
ASEAN	Association of Southeast Asian Nations
ASTAE	Alternative Energy Unit/Asia Technical Department, World Bank
BOT	build-own-transfer
CC	combined cycle
CFL	compact fluorescent lamp
DENR	Department of Environment and Natural Resources
DLC	direct load control
DOE	Department of Energy
DSM	demand-side management
EPRI	Electric Power Research Institute
ERB	Energy Regulatory Board
ESAP	Energy Sector Action Plan
ESCO	energy service company
ESMAP	Energy Sector Management Assistance Program
GDP	gross domestic product
GEF	the Global Environment Facility of the World Bank
GT	gas turbine
HID	high-intensity discharge
HVAC	heating, ventilation and air conditioning
I&C	interruptible and curtailable
IRP	integrated resource planning
IRR	internal rate of return
LRMC	long-run marginal cost
MDB	multilateral development bank
NAPOCOR	National Power Corporation
NCR	National Capital Region
NEDA	National Economic Development Authority
PDP	Power Development Program
PEPOA	Philippines Electric Plant Owners Association
T&D	transmission and distribution
TOU	time-of-use
USAID	U.S. Agency for International Development
VAC	ventilation and air conditioning
VAV	variable air volume

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EXECUTIVE SUMMARY

This report presents the results of work sponsored by the Office of Energy, Environment, and Technology and the Philippines Mission of the United States Agency for International Development (USAID). Through a bilateral program, USAID has been providing technical assistance through its Energy Efficiency Project to support the implementation of the Energy Sector Action Plan of the Philippine Department of Energy (DOE). One of the project's tasks was a "DSM/IRP Pre-Assessment" designed to evaluate the current environment in the Philippine energy sector and to make recommendations for DOE to pursue in promoting demand-side management and integrated resource planning. This *Demand-Side Management Action Plan for the Philippines* presents the result of work performed under that task.

Demand-side management (DSM) is the planning, implementation, and evaluation of utility activities designed to encourage customers to modify the timing and level of their electricity consumption. DSM is typically achieved through ***energy efficiency***, which is the reduction of kilowatt hours (kWh) of energy consumption, or ***load management***, which is the reduction of kilowatts (kW) of power demanded or the displacement of demand to off-peak times. DSM programs offer a broad range of measures to encourage customers to voluntarily modify their consumption without compromising service quality or customer satisfaction. The key to the success of DSM measures is that they can often be implemented for less than what it would cost the utility to build another power plant or generate more electricity.

Integrated resource planning (IRP) is a comprehensive process through which utilities identify and acquire the most cost-effective electric resources necessary to meet their customers' incremental requirements for energy and power. In North America, IRP has become a regulatory reform initiative that provides significant changes to the way that utilities traditionally have conducted business. IRP also provides a strategic context in which to understand the importance and role of demand-side management.

Chapter 1 describes the objective of this *Demand-Side Management Action Plan*, which is to review the current situation in the Philippine energy sector and make recommendations for DOE to consider in coordinating the development of DSM and IRP in the country. This report is intended to present a possible course of action, and associated costs and benefits, in sufficient detail to provide a basis for follow-on funding from donor institutions and Philippine government and utility organizations. While an important first step is taken with this *DSM Action Plan*, the reader is cautioned that this report does not present detailed DSM program designs suitable for utility filing before a regulator or application to a financial institution. Detailed analyses of the concepts presented here would be required for that subsequent step of DSM implementation in the Philippines.

There were two important inputs into the development of this *DSM Action Plan*. The first was the "Roundtable Discussion Forum on DSM/IRP Action Plan Options in the Philippines," which was held on April 13, 1994. This all-day event brought together a number of high-level representatives of all relevant Philippine government and utility organizations, and donor organizations to discuss how DSM can be most effectively implemented in the Philippines. The second input was an August 1994 companion report completed by RCG/Hagler Bailly, *Restructuring and Privatization of the Electricity Industry in the Philippines*. Prepared for DOE and USAID, it presents a recommended approach to power sector restructuring and the privatization of the National Power Corporation (NAPOCOR), and has important implications for the development and implementation of DSM in the Philippines.

Chapter 2 presents an overview of DSM topics. The motivation for government involvement and utility participation in DSM programs is reviewed. Cost-effective demand-side management can create multiple benefits for all segments of Philippine society. Properly conceived and implemented, DSM programs can provide financial benefits to power sector organizations, economic benefits to utility customers, and environmental benefits to society.

Implementing DSM requires developing an institutional framework that establishes a clear policy mandate, provides appropriate incentives for the utilities, and fosters a utility planning and resource acquisition process conducive to the consideration of DSM. These institutional requirements and incentives are reviewed, including IRP planning and modeling as the basis for developing a power sector plan, all-source competitive bidding involving the use of energy service companies to implement DSM, regulatory incentives for DSM, and the need for public participation through a collaborative process. Finally, a framework for DSM program design and implementation is presented. It includes selecting appropriate DSM objectives, conducting market research and assessments of DSM potential, designing and conducting pilot programs, and evaluating pilots to implement full-scale DSM programs.

Chapter 3 defines load shape objectives for the Philippines and characterizes the composition of electricity demand by sector and end-use. Just as supply-side options are developed in response to specific system needs (e.g., baseload or peak load growth), demand-side resources must be similarly defined in terms of how they meet system requirements.

The Philippine power system is characterized by roughly 6,800 MW of installed generation capacity, of which half is oil-fired, a third is hydroelectric, and the remainder is geothermal and coal-fired. The transmission system is composed of three different island grids on Luzon, Mindanao, and in the Visayas region (actually composed of four separate grids). Power is distributed through 16 private, investor-owned distribution companies, 120 small public electric cooperatives, and 11 municipal utilities. Energy consumption is currently over 27,000 GWh per year. By far, the largest load center is on Luzon (including Metro Manila), comprising about 75% of the entire country's consumption. Total load is currently about 5,000 MW; it has been increasing at 6 to 7% annually over recent years and is projected to increase at 10 to 11% annually through 2000.

Since 1991, the Philippines has suffered serious power shortages, with rolling blackouts (called "brownouts" in the Philippines) on the Luzon grid lasting three to eight hours a day. This situation, in which NAPOCOR experienced capacity shortfalls of 400 to 500 MW, continued throughout the summer of 1993. The Philippine economy has suffered from the impacts of these electricity shortages. While NAPOCOR has not brought a new power plant into operation for the last six years, it is planning an aggressive capacity expansion plan to meet its needs. 6,000 MW of additional capacity are planned through 2000, including significant new transmission facilities to provide interties between all the island grids. The magnitude of necessary investments, $10 billion, will strain the government's ability to mobilize resources as well as utility customers' ability to pay for electricity.

With such high levels of load growth and ambitious generation expansion plans, both peak clipping and strategic conservation are appropriate load shape objectives for DSM in the Philippines. The formulation of these load shape objectives is an important step to guide the subsequent development of potential DSM programs to meet those objectives. Chapter 4 defines the following potential DSM programs that could be implemented in the Philippines to achieve these load shape objectives:

Industrial Sector Programs. The industrial sector is the largest single electricity-consuming sector in the Philippines, accounting for approximately 44% of total consumption and 36% of the system peak demand. Based on experience in other countries, it is estimated that 74% of industrial consumption is attributable to motors, 20% to process and other loads, and 6% to lighting. As in many countries, the industrial sector in the Philippines offers some of the largest and most immediate DSM benefits.

Time-of-Use Tariffs. Currently NAPOCOR and the distribution companies offer their large industrial consumers two-part tariffs which charge for energy and contracted demand. However, more sophisticated tariff measures are available to encourage load shifting. Time-of-use (TOU) tariffs provide incentives for consumers to shift demand from on-peak to off-peak periods by offering the consumer lower electricity prices during the off-peak periods. Although residential demand may in fact contribute more to the national peak, the industrial sector would probably be the most responsive to changes in a tariff structure designed to encourage load shifting and reflect the economic value of power. Experience in other countries suggests that the introduction of well-designed TOU tariffs alone may be insufficient to induce significant load shape modification. Many consumers initially need help in understanding the impact of tariff revisions on their bills, and in developing and implementing appropriate responses. Thus, TOU programs, particularly those with innovative components such as real-time or peak-activated pricing, require marketing and technical assistance to customers as well as financial incentives for technology (e.g., controls) that enable them to respond to the tariffs.

Interruptible and Curtailable (I&C) Tariffs. I&C tariffs allow the utility to interrupt or reduce service to those consumers in order to reduce demand during critical periods.

Consumers subscribing to the tariff benefit from reduced rates. Load interruption is generally facilitated by a phone call from the dispatch center to the participating customer; compliance is verified after the fact by reviewing TOU meter readings. I&C programs in other countries have typically required consumers to offer a minimum interruptible load of 500 kW or more to be eligible. The recent power supply deficit in the Philippines caused many industrial consumers to purchase stand-by generating units. Distribution companies would interrupt service without notice, but the interruptions were often so regular that no notice was necessary. I&C programs differ from this situation in several important ways. The implementation of an I&C tariff program transforms service interruptions from an emergency measure with high economic costs to a power sector resource that minimizes economic costs. I&C programs provide organized procedures for load shedding that can help maintain good customer relations. Moreover, by providing customers with advance notice (from as little as a few minutes to as much as a day depending on program options), the impact of service interruptions on customer operations can be minimized for those customers with stand-by generation, and the overall economic cost of interruption is minimized.

Efficient Motor and Drive Programs. Industrial motors account for 32% of all electricity consumption in the Philippines, and 26% of system peak demand (this is the largest single share of peak demand among all end-uses). Motor efficiency and adjustable-speed drive (ASD) programs may therefore represent an important demand-side resource, in terms of both peak reduction and overall energy conservation. Motor efficiency programs entail the replacement or retrofit of standard motors with more efficient motors. ASD programs target motors with varying loads and improve the match between motor power consumption and motor work load by controlling the frequency and/or voltage of the motor's power supply. Given the further industrial growth expected in the Philippines, new purchases rather than retrofits or replacements will provide the predominant opportunity for the use of improved motors and drives.

Commercial Sector Programs. The commercial sector accounts for approximately 24% of electricity sales and 24% of system peak demand in the Philippines. It is estimated that 60% of commercial load is attributable to ventilation and air conditioning (VAC), 15% to lighting, and 25% to other loads.

VAC Efficiency Programs. As in the other ASEAN countries, economic development in the Philippines has been accompanied by changes in the commercial building stock. Large air conditioned office buildings and shopping complexes are replacing traditional, less energy-intensive low-rise buildings and small markets. Air conditioning has emerged as the largest single commercial end-use by far in this sector, and represents an estimated 12% of system peak demand. Work carried out under the ASEAN-USAID Buildings Energy Conservation Project indicated a number of measures that are promising for reducing air conditioning loads. These measures could be delivered using rebates, training, audits, and information dissemination. Trade allies, such as air conditioning equipment vendors and architects, could receive training and rebates for promoting high-efficiency and properly sized VAC equipment.

Lighting Efficiency Programs. Savings of up to 75% are possible for individual lighting installations, and high potential participation rates make commercial lighting programs attractive. The following measures are commonly used in commercial lighting programs: replacing incandescent bulbs with compact fluorescent lamps, replacing standard fluorescent tube lamps with energy-saving fluorescent tube lamps, replacing standard fluorescent ballasts with high-efficiency magnetic or electronic ballasts, installing optical reflectors and removing lamps that are no longer required, and installing occupancy sensors, timers, and daylighting controls.

Residential Sector Programs. The residential sector accounts for 30% of total electricity consumption and 37% of system peak demand. Lighting accounts for 28% of total residential sales, refrigeration 27%, ironing 12%, and other miscellaneous end-uses the remaining third.

Refrigerator Efficiency Programs. Residential refrigerators account for 8% of total electricity consumption and 7.5% of peak system demand. Refrigerator efficiency improvements therefore offer both energy and capacity saving benefits. The program would entail three components to encourage the use of the more-efficient domestic refrigerators: testing and labelling of all refrigerators to be sold, rebates to trade allies (e.g., appliance retailers) to help encourage the sale of these improved models, and incentives to manufacturers and assemblers in the Philippines to incorporate more-efficient designs in their production.

Lighting Efficiency Programs. Residential lighting accounts for 8% of total energy consumption and 17% of system peak demand in the Philippines. Because of the disproportionate contribution of residential lighting to peak system demand, lighting efficiency measures can yield substantial peak clipping benefits. Incandescent lighting accounts for approximately 53% of residential lighting demand and presents the most promising opportunity for residential lighting efficiency improvements. In particular, the use of compact fluorescent lamps (CFLs) in place of standard incandescent bulbs can save up to 75% of the energy that would have otherwise been consumed by those bulbs. This program could rely on three delivery mechanisms: the direct installation of CFLs to replace incandescent bulbs in households, rebates for the purchase of CFLs, and information-only programs that explain the benefits of CFL use to consumers.

In terms of meeting the load shape objectives, the tariff programs result in peak clipping, the motor/drive and commercial programs result in strategic conservation, and the residential programs provide both benefits. Each of these potential programs is described in the report in terms of its design, its energy and capacity savings, and the budget necessary to implement the program.

Chapter 5 develops the foundation for implementing DSM in the Philippines, which is proposed through a comprehensive, three-phase, nine-year program. The first phase of the program, institutional development and program design, entails the creation of an appropriate institutional framework for DSM implementation, the collection of necessary data, and the design of specific DSM pilot programs.

The current institutional setting is reviewed, including the authorities and activities of DOE, the Energy Regulatory Board, NAPOCOR, and the distribution companies. Then, developments that have been proposed in the Philippines that could have a material influence on the roles and responsibilities of the power sector entities are discussed. These include a bill originally introduced before the 1993 Congress and reintroduced in 1994 "To Institutionalize Energy Conservation and Enhance Efficient Use of Energy," a Department Order that DOE has drafted on "Instituting Integrated Resource Planning Including Demand-Side Management By Electric Utilities," and the efforts to restructure the power sector and to privatize NAPOCOR. The following institutional development initiatives are proposed in light of the institutional setting and developments:

Establish a Policy Framework. A clear statement of government policy is required to establish the legitimacy of DSM in power sector planning and resource acquisition activities. Such a policy statement is necessary to marshall the enthusiastic participation of relevant government agencies and to remove disincentives that utilities currently face when considering DSM implementation. A consensus was reached at the DSM/IRP Roundtable that DOE currently has the authority under the DOE Act to promulgate DSM policy. A clear opinion was expressed that the development of the Department Order on DSM by DOE represents the best near-term solution for establishing the necessary policy framework.

Initiate a Collaborative Process. The concept of a collaborative process was introduced by the World Bank/ASTAE in its Regulatory and Utility DSM Workshops and Open Forums. A collaborative process allows all relevant and interested parties to participate in an informal deliberation on DSM program design and implementation issues. Participants at the DSM/IRP Roundtable acknowledged that a collaborative process could possibly provide a constructive means to engage different views and to mitigate possible opposition to the presentation of DSM program proposals in regulatory proceedings. Such concern for the influence of intervenors in DSM proceedings before Energy Regulatory Board could be warranted given the strong political opposition to energy rate increases by consumer groups in the Philippines.

Introduce Integrated Resource Planning to the Distribution Companies. The recommended privatization scenario would transfer most responsibilities for utility planning to the distribution companies. This transition would be fairly rapid, as the distribution companies would become directly responsible for the "obligation to connect and serve" in Phase One of the restructuring process. And yet, the distribution utilities have had little need in the past to conduct load forecasts (except MERALCO) and develop their own resource plans; this activity was always carried out by NAPOCOR. Therefore, an important task would be to provide the distribution companies with the training, models and organizational development support necessary to create their own IRP capabilities.

Implement All-Source Competitive Bidding at the Distribution Companies. IRP entails not only integrated resource planning but also integrated resource acquisition. The process of all-source competitive bidding allows supply-side and DSM resources to compete not only in computer models, but more importantly, in the marketplace. The restructuring and privatization plan anticipates the introduction of all-source competitive bidding processes at the distribution companies as a means to acquire electric resources. The key attribute of this approach is that a market-based mechanism provides for the acquisition of electric resources to meet the distribution companies' requirements on an IRP basis.

Broker Energy Service Company Business Opportunities. A potentially serious limitation may be Philippine businesses' lack of experience in providing the equipment and services called for under DSM programs. While there are a number of engineering and mechanical contractors and vendors of energy-efficient equipment in the Philippines, they may not be prepared to do business with utilities and their customers to implement DSM programs. Energy service companies (ESCOs) are a well-established industry for implementing utility DSM programs in North America, but are virtually non-existent in the Philippines. A critical program design component of the *DSM Action Plan* provides for the implementation of DSM programs by private sector contractors such as ESCOs. Therefore, a significant institutional development task would be for DOE to identify local businesses that could provide DSM technologies and services and establish a database of such firms. The database would also include international ESCOs that are active or have expressed an interest in doing business in the Asia Pacific region. DOE could then provide ESCO training and business development activities that will support the linking of the Philippine firms through joint ventures with international ESCOs, which can be sources of equipment, capital and know-how.

Reform NAPOCOR's Tariffs. The level and configuration of NAPOCOR's tariffs have important implications for determining the extent to which DSM is considered a cost-effective electric resource in the Philippines. For example, an accurate estimation of NAPOCOR'S avoided costs, based on long-run marginal cost (LRMC) principles, is essential to determine the economically efficient mix of resources needed in the future, including DSM. To the extent that subsidies continue to exist in rates or cross-subsidization exists between rate classes, economically efficient resource decisions and investment allocations will be compromised. Important changes are anticipated in ratemaking in the Philippines with the introduction of the proposed approach to restructuring the power sector and privatizing NAPOCOR. Tariffs throughout the entire sector will evolve to become more market-based, and should naturally move to LRMC levels as a consequence of investment and operating cost recovery requirements for the least-cost resources selected through competitive processes.

DSM program design tasks are also proposed in Phase I such as conducting DSM market research to identify DSM capabilities in the Philippines and to gather end-use load research and other customer data. Other program design tasks include assessing DSM potential at the distribution companies and performing preliminary DSM pilot project designs. The total

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budget for Phase 1 activities is estimated at $2.0 million; these activities are expected to be carried out over a two-year period.

Phase II entails the implementation of the pilot programs described above, which will provide the actual field experience necessary to determine the future role of DSM in the Philippines and to develop the capability of the utilities to design, implement, and evaluate DSM programs. Experience with pilot-scale programs will also remove the uncertainty surrounding key program parameters (e.g., participation rates) and thereby reduce the risks associated with full-scale implementation. The principal components of this phase include detailed program design, development of tracking systems, program marketing and delivery of DSM measures, and program evaluation. At the end of conducting the pilot programs, Philippine authorities would know whether DSM should be implemented on a large scale, and if so, how it should be done. The total budget for Phase II activities is estimated at $10.7 million; these activities are expected to be carried out over a three-year period, with two years overlapping with Phases II and III.

Phase III entails full-scale implementation of the eight DSM programs proposed in Chapter 4. This phase will be carried out over a six-year period, which would end, for the purposes of analysis, in 2003. While the economic cost for these programs would be $189 million, it is proposed that the budget for the utilities would be $84 million, with the remainder to be paid by program participants. The savings estimated for these programs by the end of 2003 amount to 391 MW (4.6% of peak demand) and 983 GWh per year (1.6% of total consumption). These programs are economically justified, yielding a real economic internal rate of return of 75% and a net present value of $129 million. Exhibit ES-1 presents an overall timeline and budget for all three phases and Exhibit ES-2 summarizes the energy and peak demand savings, budget costs (the amounts that the sponsoring agency would spend for the program), and economic costs of each DSM program.

Because these programs represent the first round of full-scale DSM activities in the Philippines, savings can be expected to increase rapidly in subsequent programs that will benefit from the experience of these early programs. Moreover, early DSM programs that are characterized by high customer satisfaction will accelerate participation as the vast majority of consumers who are initially reluctant to participate become more comfortable with these programs, and utilities come to see DSM as a form of customer service. Peak demand savings of between 5 to 10% would certainly be possible by 2010.

Exhibit ES-1
Timetable for DSM Activities

Activity	Budget	1995	1996	1997	1998	1999	2000	2001	2002	2003
Phase I: Inst. Development & Program Design	$2 million	■	■							
Phase II: Pilot Programs	$10.7 million	■	■	■	■					
Phase III: Full-Scale Implementation	$84.1 million				■	■	■	■	■	■

Exhibit ES-2
Summary of Program Costs and Impacts

Program	Energy Savings, GWh	Peak Demand Savings, MW	Budget Cost	Economic Cost
Industrial TOU Tariffs	81.8	74.5	$5.5 million	$14.5 million
Industrial I&C Tariffs	218.1	198.6	$1.9 million	$5.1 million
Industrial Motors & Drives	52.5	6.0	$2.1 million	$4.5 million
Commercial VAC	42.9	5.1	$5.2 million	$10.2 million
Commercial Lighting	33.6	6.2	$4.5 million	$13.2 million
Residential Refrigerators	357.1	46.6	$57.5 million	$114.5 million
Residential Lighting	196.8	54.0	$7.4 million	$27.2 million
TOTAL	982.7	391.0	$84.1 million	$189.2 million

Note: Annual energy and peak demand savings are reported for 2003 (the last year of the program), and are measured at the point of consumption.

CHAPTER 1
INTRODUCTION

This report presents the results of work sponsored by the Office of Energy, Environment, and Technology and the Philippines Mission of the United States Agency for International Development (USAID). Through a bilateral program, USAID has been providing technical assistance through its Energy Efficiency Project (EEP) to support the implementation of the Energy Sector Action Plan (ESAP) of the Philippine Department of Energy (DOE). One of the project's tasks was a "DSM/IRP Pre-Assessment" designed to evaluate the current environment in the Philippine energy sector and to make recommendations for DOE to pursue in promoting demand-side management (DSM) and integrated resource planning (IRP). This *Demand-Side Management Action Plan for the Philippines* presents the result of work performed under that task.

1.1 DEMAND-SIDE MANAGEMENT ACTION PLAN OBJECTIVES

Demand-side management is the planning, implementation, and evaluation of utility activities designed to encourage customers to modify their electricity consumption patterns, with respect to both the timing and level of electricity demand. DSM is typically achieved through ***energy efficiency***, which is the reduction of kilowatt hours (kWh) of energy consumption, or ***load management***, which is the reduction of kilowatts (kW) of power demanded or the displacement of demand to off-peak times.

DSM programs offer a broad range of measures to encourage customers to voluntarily modify their consumption without compromising service quality or customer satisfaction. Tariffs can be designed to stimulate a shift in consumption to off-peak periods. End-use energy efficiency can reduce both energy and peak power demand. Direct load control can likewise limit peak power demand. The key to the success of DSM measures is that they can often be implemented for less than what it would cost the utility to add another unit of capacity or provide another unit of energy.

DSM has become a topic of great interest among multilateral and bilateral financial and donor organizations interested in assisting developing countries to improve the efficiency and reduce the environmental impacts of their power systems. For example, the World Bank is starting to appraise DSM investments in its power sector loans. The Asian Development Bank recently announced a requirement in its power sector loans that recipient utilities establish a DSM unit within their organizations. USAID is promoting DSM in developing countries worldwide as a means to improve the efficiency of power system operations.

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The situation in the Philippines power sector appears to be ripe for the introduction of DSM concepts. Electricity demand is growing at a relatively high rate, while at the same time the country has recently experienced a severe shortage of electric generation capacity. The Philippines is also facing a limited ability to finance additional power sector investments, given the competing capital requirements in its society for other economic development and infrastructure projects. Growing out of this situation is a strong call from the government for the restructuring of the power sector and the privatization of the National Power Corporation (NAPOCOR).

Given the multilateral and bilateral interest and the situation in the Philippines, perhaps it should be no surprise that a large number of DSM activities have been proposed or are underway involving all relevant Philippine government and utility organizations such as DOE, NAPOCOR, the Energy Regulatory Board (ERB), and the electric distribution companies. This large number of programs has posed a challenge for optimal coordination by participating Philippine organizations as well as the donors.

The objective of this *Demand-Side Management Action Plan* is to review the current situation in the Philippine energy sector and to make recommendations for DOE to consider in coordinating the development of DSM in the country. This report is intended to present a possible course of action, and associated costs and benefits, in sufficient detail to provide a basis for follow-on funding from donor institutions and Philippine government and utility organizations. While an important first step is taken with this *DSM Action Plan*, the reader is cautioned that this report does not present detailed DSM program designs suitable for utility filing before a regulator or application to a financial institution. Detailed analyses of the concepts presented here would be required for that subsequent step of DSM implementation in the Philippines.

There were two important inputs into the development of this Action Plan. The first was the "Roundtable Discussion Forum on DSM Action Plan Options in the Philippines," which was held on April 13, 1994. This all-day event brought together a number of high-level representatives of all relevant Philippine government and utility organizations, and donor organizations to discuss how DSM can be most effectively implemented in the Philippines. The result of the meeting was a general understanding regarding how all organizations could best coordinate their activities to implement DSM in the Philippines. The proceedings of the Roundtable are presented as Annex D of this report and its findings are reflected throughout this report. The following are the conclusions and general recommendations reached at the Roundtable:

- Much DSM training has been conducted in the Philippines. However, what is needed now is more operational and less theoretical training.

- Political will is needed to develop the policy instruments for DOE and ERB.

- It is time to get a pilot program underway. What is needed is empirical evidence from the field.
- The World Bank should have a larger role. So far, its contributions to DSM efforts have mostly been training activities. DSM should be considered in a power sector loan.
- The time has come for pledging commitments to DSM, not only from lenders but also from participating Philippine organizations.
- It is time to implement DSM, focusing on solutions and not on barriers.
- The cooperation of donors is needed to gain a common focus on DSM and IRP.

The second important input to this study was a companion report recently completed by RCG/Hagler Bailly under the same USAID-sponsored technical assistance project through which this *DSM Action Plan* was developed. The report, *Restructuring and Privatization of the Electricity Industry in the Philippines* (August 1994), was prepared for DOE and USAID to present a recommended approach to power sector restructuring and the privatization of NAPOCOR. This approach has significant implications for the development and implementation of DSM in the Philippines. Thus, its conclusions are also reflected throughout this report.

1.2 POWER SECTOR OVERVIEW

The Philippine power system is characterized by roughly 6,800 MW of installed generation capacity, of which half is oil-fired, a third is hydroelectric, and the remainder is geothermal and coal-fired. The transmission system is composed of three different island grids on Luzon, Mindanao, and in the Visayas region (actually composed of four separate grids). Power is distributed through 16 private, investor-owned distribution companies, 120 small public electric cooperatives, and 11 municipal utilities. Energy consumption is currently over 27,000 GWh per year. By far, the largest load center is on Luzon (including Metro Manila), comprising about 75% of the entire country's consumption. Total load is currently about 5,000 MW and has been increasing at 6 to 7% annually over recent years and is projected to increase at 10 to 11% annually through 2000.

Since 1991, the Philippines has suffered serious power shortages, with rolling blackouts (called "brownouts" in the Philippines) on the Luzon grid lasting three to eight hours a day. This situation, in which NAPOCOR experienced capacity shortfalls of 400 to 500 MW, continued throughout the summer of 1993. The Philippine economy has suffered from the impacts of these electricity shortages.

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While NAPOCOR has not brought a new power plant into operation for the last six years, it is planning an aggressive capacity expansion plan to meet its needs. 6,000 MW of additional capacity are planned through 2000, including significant new transmission facilities to provide interties between all the island grids. The expansion plan counts on the construction of significant independent power facilities that are being expedited through a "fast track" licensing process. The magnitude of necessary investments, $10 billion, will strain the government's ability to mobilize resources as well as utility customers' ability to pay for electricity.

In this environment, it is clear that a comprehensive power system planning process is necessary that considers all cost-effective electric resources, including DSM. Details on the operation of the power system and NAPOCOR's Power Development Plan are presented in Section 3.1 and a discussion of each of the participants in power system planning and operations is presented in Section 5.1.1.

1.3 ENERGY EFFICIENCY AND DSM ACTIVITIES TO DATE

A number of different energy efficiency programs have been carried out in the Philippines over the last ten years, some of which are relevant to DSM. Many of these programs have been implemented by DOE and its predecessor agency, the Office of Energy Affairs. For example, the following DOE programs are illustrative of these activities:

- engineers conducted energy audits for industrial and commercial firms
- training programs were offered for energy managers employed by large commercial firms
- an appliance testing and labeling program has developed a standard for window-type air conditioning units and is now developing one for refrigerators and freezers
- the Fuel and Appliance Testing Laboratory (FATL) was established, one of the only two in Asia
- a building efficiency standard was adopted by the Department of Public Works and made part of the building code
- assistance was provided to private companies to invest in energy-efficient technologies through USAID's Technology Transfer for Energy Management (TTEM) project. Appropriations for this program are 60 million pesos, to be used over the next three years

While some of these programs address electricity efficiency issues (e.g., the appliance labeling program), none of them explicitly focuses on DSM as a utility resource. Thus, the recent interest in DSM is notable, as represented by the large number of programs that have been proposed or are underway. Exhibit 1-1 provides details on nine different programs that have been identified, sponsored by the following multilateral and bilateral donors:

The U.S. Agency for International Development

- The Energy Efficiency Program sponsored the project resulting in this *DSM Action Plan*.
- The Energy Training Program conducted a workshop in February 1994 and plans another one in October 1994.
- A $4.5 million technical assistance program has been proposed with Global Environmental Facility (GEF) money.

The World Bank

- The Power Systems Planning Training Program produced a workshop on DSM in December 1993.
- ASTAE produced a regulatory DSM training workshop in October 1993 and a utility DSM training workshop in June 1994.
- The CFL Lighting Efficiency and Market Research Study is testing specific energy-efficient lighting technologies and conducting market research on customer reactions.

The Asian Development Bank

- The Long-Term Power Systems Planning Study is providing technical assistance to DOE and NAPOCOR to start to develop an integrated resource planning capability.
- A DSM soft loan program of an undetermined amount has been proposed.

The Australian International Development Assistance Bureau

- An Energy-Efficiency Pre-Feasibility Study was conducted to examine establishing a technology training center in the Philippines focused on DSM.

Exhibit 1-1
Summary of Demand-Side Management Programs in the Philippines

USAID Technical Assistance to the Philippine DOE	**ADB Power Systems Planning Technical Assistance**
Title: DSM/IRP Pre-Assessment **Description**: 1. Evaluate institutional issues: - Legislation/laws/policies - Regulatory mechanisms - Privatization activities - Role of GOP agencies - Power system planning 2. Identify other DSM/IRP programs and establish linkages and coordination activities. 3. Evaluate rate structure. 4. Assess capabilities and needs for the Philippines to adopt DSM/IRP measures and programs. 5. Evaluate other ASEAN DSM/IRP programs for application in the Philippines. 6. Develop an Action Plan for the GOP to utilize in implementing DSM/IRP activities in the power sector. **Provider:** USAID/Philippines/R&D **Implementor:** RCG/Hagler Bailly **Schedule:** January 1994-July 1994 **Philippine Counterpart:** DOE **Effort/Budget:** 70 Person-Days, $70,000 **Notes**: Follow-up technical assistance program can expand DSM/IRP technical assistance.	**Title:** Long-Term Power Systems Planning Study **Description:** 1. Review DSM-related activities: - Identify barriers - Develop practical DSM program - Estimate costs/benefits - Detail financial/institutional arrangement - Detail required policies/procedures - Recommend legislative reform - Assess impact of DSM on load forecasting 2. Review the current load forecast and recommend appropriate methodologies to refine load forecasting, including database and software. 3. Resource assessment and fuel surveys: - Survey fuels currently used - Develop diversification plan 4. Review economics of BOT/BOO projects. 5. Power system plan: - Develop an IRP-based least-cost power generation and transmission plan for 1998-2005. - Review generation technologies. - Identify/recommend alternatives. **Provider**: ADB **Implementor**: Synergic Resources Corporation, IIEC, EGAT staff, Fichtner, Beijing Economic Research Institute **Schedule**: April 1994 - October 1994 **Philippine Counterparts:** DOE, NAPOCOR **Effort/Budget**: 20 Person-Months, $600,000

Exhibit 1-1 (continued)
Summary of Demand-Side Management Programs in the Philippines

ADB DSM Loan	World Bank Power Systems Training for DOE
Title: DSM Loan Program **Description:** - Negotiable amount for DSM equipment and commodities. **Provider:** ADB **Implementor:** To be determined **Schedule:** 1995+ **Philippine Counterparts:** DOE, NAPOCOR **Effort/Budget:** To be determined **Notes:** 1. ADB has set aside loan funds for commodities at 6.75%	**Title:** Training in Power System Planning **Description:** 1. Training in the following areas: - Load forecasting - Generation planning - DSM/IRP - Transmission and distribution 2. Training is conducted in one-week modules. **Provider:** World Bank Energy Sector Loan **Implementor:** RCG/Hagler Bailly **Schedule:** June 1993 - July 1994 **Philippine Counterparts:** DOE, NAPOCOR **Effort/Budget:** 16 Person-Weeks, $275,000 **Notes:** Substantially Complete

Exhibit 1-1 (continued)
Summary of Demand-Side Management Programs in the Philippines

TDA Industrial DSM Study	World Bank DSM Training
Title: Feasibility Study of Industrial DSM Potential in the Philippines **Description:** 1. Develop a database of the largest non-residential customers throughout the small distribution companies. 2. Conduct DSM feasibility studies for 24 customers drawn from representative subgroups of the database. 3. Extrapolate studies to the entire database. 4. Evaluate a program implementation mechanism involving PEPOA members and a U.S. utility partner. 5. Evaluate alternative financing vehicles. 6. Develop a detailed implementation plan, including training and U.S. study tours. **Provider:** U.S. Trade & Development Agency **Implementor:** To be determined **Schedule:** 1994+ **Philippine Counterpart:** PEPOA, CEPALCO **Effort/Budget:** 2,430 Person-hours, $295,000 Notes: 1. Special focus on creating business opportunities for U.S. vendors of DSM. 2. Results will be used to obtain bilateral and multilateral financing of DSM improvements in the Philippines industrial sector. 3. Proposals from short-listed firms due September 1994.	**Title:** Regulatory and Utility DSM Workshops **Description:** 1. Initial Workshop - A one-week workshop was held in October 1993 that was oriented around a general introductory session on DSM and regulatory issues. The workshop was conducted for ERB, but had wide attendance from other energy sector entities (about 50 participants) at a special Open Forum at the conclusion of the workshop. 2. A second workshop was conducted in June 1994 and covered the following: - Examined the DSM framework from the utility perspective. - Continued work on the DSM Collaborative Action Plan begun under the first workshop. - Program and regulatory issues. - Conducted a second Open Forum on DSM. **Provider:** WB/ASTAE **Implementor:** Barakat & Chamberlin, RCG/Hagler Bailly, WB/ASTAE Staff **Schedule:** October 1993 - June 1994 **Philippine Counterparts:** ERB (October 1993 Workshop) DOE/MERALCO/NAPOCOR/NEA/PEPOA (June 1994 Workshop) **Effort/Budget:** Two 1-week training courses Notes: 1. Workshops complete. 2. In-country training only.

Exhibit 1-1 (continued)
Summary of Demand-Side Management Programs in the Philippines

USAID ETP DSM/IRP Training	WB Lighting Efficiency Study
Title: DSM/IRP Training Program **Description**: Training curriculum covers the following topics: 1. Introduction to DSM/IRP 2. DSM Resource Assessment 3. DSM Program Planning 4. Program Implementation 5. Program Monitoring 6. Integration 7. U.S. Study Tour 8. Follow-up Training **Provider**: USAID/Energy Training Program **Implementor:** IIE **Schedule:** February 1994 - October 1994 **Philippine Counterpart**: None specific **Notes**: 1. One week in-country training conducted in February 1994. 2. Two six-week U.S. study tours (one for DSM and one for IRP) scheduled for October 1994.	**Title:** CFL Lighting Efficiency Study and Market Research **Description:** 1. Survey CFL users in MERALCO service territory. 2. CFL performance testing (also other fluorescents and electronic ballasts). 3. Rank products. 4. Recommend strategy to promote products within a DSM framework. **Provider**: WB/ASTAE **Implementor**: ARO, Inc. **Schedule**: October 1993 - February 1995 **Philippine Counterparts**: DOE/FATL, MERALCO **Notes**: 1. Provides for participation of a lighting efficiency expert at FATL. 2. Market research being performed by ARO, Inc., a Philippine market research company.

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Exhibit 1-1 (continued)
Summary of Demand-Side Management Programs in the Philippines

Australia Energy Efficiency
Project Pre-Feasibility

Title: Pre-Feasibility Study

Description:

1. Two-week mission to the Philippines to focus on opportunities for DSM and energy efficiency.

2. Conclusions and recommendations:

   - Lack of up-to-date information and training on energy conservation has been a key constraint in the Philippines.
   - Development of Energy Technology Transfer and Training Center(s) is recommended.
   - Initial building to be in Manila, built as a demonstration of an energy-efficient designed building.
   - Other regional centers will be set up.

3. Functions of the Center:

   - Demonstrate technologies
   - Information dissemination
   - Training
   - Energy efficiency data base
   - Case studies
   - Technical support to industry
   - Loan equipment

4. Funding:
   - $4 to $6 million
   - AIDAB funded

Provider: AIDAB
Implementor: Energetics, Integrated Energy Management Center
Schedule: November 1993 - December 1994
Philippine Counterparts: None specific
Effort/Budget: 6 person-weeks
Notes:

1. Definitional mission complete.

2. Study defined the establishment of energy technology transfer and training centers in the Philippines.

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The U.S. Trade and Development Agency

- An assessment of DSM potential in the industrial sector will be conducted with the CEPALCO distribution company hosting the project.

1.4 ORGANIZATION OF THE ACTION PLAN

This section describes the information presented in this *DSM Action Plan for the Philippines*:

Chapter 2 presents an overview of DSM topics. The motivation for government involvement and utility participation in DSM programs is reviewed. The key load shape objectives that a utility may seek to accomplish with DSM are presented. Institutional requirements and incentives are reviewed such as integrated resource planning and acquisition, all-source competitive bidding, the role of energy service companies, and the need for public participation through a collaborative process. Finally, a framework for DSM program design and implementation is presented.

Chapter 3 develops DSM load shape objectives for the Philippines that frame the recommended DSM programs. These are determined through an analysis of the composition of electricity demand. Data supporting the derivation of sectoral and end-use load shapes are presented in Annex A.

Chapter 4 defines the following candidate DSM programs that were determined to be appropriate for the Philippines:

- Industrial Sector
  - Time-of-Use Tariffs
  - Interruptible and Curtailable Tariffs
  - Motor Efficiency Programs
  - Adjustable Speed Drive (ASD) Programs
- Commercial Sector
  - Ventilation and Air Conditioning (VAC) Efficiency Programs
  - Lighting Efficiency Programs
- Residential Sector
  - Refrigerator Efficiency Programs
  - Lighting Efficiency Programs.

Data that support the DSM program design and impact assumptions are presented in Annex B. Case studies of similar programs in the United States as well as other DSM programs in the Asia Pacific region are presented in Annex C.

Chapter 5 presents the foundation for DSM implementation in the Philippines, which is proposed to be carried out in a three-phase process. Phase I entails institutional development and program design activities. First, the current institutional setting in the Philippines is reviewed. Then a series of institutional development activities are proposed such as establishing a policy framework, initiating a collaborative process, introducing integrated resource planning to the distribution companies, developing all-source bidding mechanisms, brokering energy service company business opportunities, and reforming NAPOCOR's tariffs. Finally, program design activities are proposed such as conducting DSM market research, assessing DSM potential at the distribution companies, and designing DSM pilot programs.

Phase II of Chapter 5 presents the activities, timetable, and budget for the implementation of DSM pilot programs in the Philippines. Phase III presents the activities, timetable, and budget for the implementation of full-scale DSM programs.

CHAPTER 2
OVERVIEW OF DEMAND-SIDE MANAGEMENT

Demand-side management (DSM) is the planning, implementation, and evaluation of utility activities designed to encourage customers to modify the timing and level of their electricity consumption. DSM is typically achieved through ***energy efficiency***, which is the reduction of kilowatt hours (kWh) of energy consumption, or ***load management***, which is the reduction of kilowatts (kW) of power demanded or the displacement of demand to off-peak times.

DSM programs offer a broad range of measures to encourage customers to voluntarily modify their consumption without compromising service quality or customer satisfaction. Tariffs can be designed to stimulate a shift in consumption to off-peak periods. End-use energy efficiency can reduce both energy and peak power demand. Direct load control can likewise limit peak power demand. The key to the success of DSM measures is that they can often be implemented for less than what it would cost the utility to build another unit of capacity or generate another unit of energy.

Government leaders increasingly recognize that demand-side resources should be developed when they are shown to be less costly from society's point of view than building another power plant or generating more electricity. For instance, if a utility manages to reduce electricity demand, it can postpone the construction of expensive new power plants or increase reliability. Additionally, reducing total generation can avoid the need to install costly environmental controls. In such a process, DSM yields economic as well as environmental benefits for the nation, the utility, and customers.

Capturing these benefits, however, requires utilities to view their roles differently. Whereas utilities that rely solely on conventional supply-side resources such as power plants often view themselves as commodity producers, utilities that tap the potential of DSM perceive themselves as service providers, i.e., they are in the business of meeting customer needs rather than simply producing kilowatt hours. Such an attitude is gaining importance in an increasingly competitive world.

2.1 THE MOTIVATION FOR DSM

Cost-effective demand-side management can create multiple benefits for all segments of Philippine society. Properly conceived and implemented, DSM programs can provide financial benefits to power sector organizations, economic benefits to utility customers, and environmental benefits to society at large. How these factors can motivate the development of DSM programs is briefly discussed below.

It may seem irrational for a utility to try to sell less of its product. This perception reflects the limitations of traditional power sector regulation rather than the value of DSM. Power sector regulations in many countries have not provided utilities with incentives to consider both supply-side and demand-side resources when developing a least-cost resource mix. In fact, load-reducing DSM may be an important strategy for providing electric services at least-cost, because it is often cheaper to save energy than to produce it. In instances in which regulations encourage market choices and socially optimal investments to coincide, utilities have come to understand that the electric resources that exist on the customer's side of the meter may be more cost-effective in meeting electric power needs than building expensive new power plants. Thus was borne the recognition that a "negawatt" of electricity saved through DSM is as good as a megawatt of generation capacity.

This concept is particularly relevant for the Philippines, which is experiencing a relatively high rate of growth in electricity demand and a severe capacity shortage, while also facing a limited ability to finance additional power sector investments. The increase in energy demand results from such factors as increasing economic activity and population growth, which are imposing competing capital requirements on Philippine society for other economic development and infrastructure activities such as highway, water, and sewer projects. Increasing demand also requires increasing fuel imports in the Philippines, which exacerbates a balance-of-trade problem.

A major issue is that electricity prices in the Philippines have historically been subsidized to encourage energy consumption, stimulate economic activity, and improve household welfare. The result is that average tariffs are below the long-run marginal costs of production. The growing gap between debt burden and revenues has resulted in a financial predicament for the utility sector. This situation has obliged the government and utilities to seek alternatives to the strategy of ever-increasing capacity and subsidized pricing. By reducing capacity and generation requirements, DSM can help Philippine utilities to reduce their financing requirements. While DSM addresses only one dimension of the utilities' financial predicament, it remains a key element of any program to help utilities achieve financial viability.

DSM also provides direct economic benefits to utility customers. By increasing the efficiency with which they consume energy, customers can exercise some control over their utility bills. Paying less to the utility frees up scarce capital resources that can be used for other purposes, such as a homeowner saving for a child's college education or an industrial manager making an investment to increase productivity. In either case, DSM can give utility customers the means to thrive in the local economy and compete in the global economy.

Finally, DSM addresses environmental concerns as well. DSM strategies such as improved end-use efficiency can reduce pollution emissions and other undesirable by-products of electricity generation. Reduced ash and sulfur dioxide emissions are examples of local environmental benefits of energy efficiency, while lower carbon dioxide emissions are desirable in terms of mitigating potential global climate change. The scope for DSM to improve environmental quality is large because it is estimated that about half of all global greenhouse gas emissions (on a CO_2 equivalent basis) originate from energy consumption, much of it in the power sector. These environmental benefits have made DSM attractive, not only to governments throughout the world, but to also bilateral and multilateral funding agencies.

2.2 KEY DSM OBJECTIVES

As discussed above, government, utilities, utility customers, and society at large can define a number of different goals to be accomplished through DSM programs. Government might desire an improved balance of trade, the utilities seek a better financial bottom line, customers want control over their bills, and society would appreciate less environmental pollution. However, from an operational point of view, the objectives of DSM are best described in terms of load shape objectives. How can the utility use DSM to achieve a more desirable load shape?

Exhibit 2-1 presents the six different ways that DSM programs can influence customer demand and meet the utility's load shape objectives. Some of these methods entail a reduction in peak demand or total consumption, while others seek an increase in demand or consumption. The desired effects depend on the utility in question; clearly, not all of these objectives are relevant to the Philippines.

The primary objective is to manipulate the timing or level of customer demand so as to achieve the financial, economic, and environmental benefits of the utility's least-cost plan. In the Philippines where the demand for electricity is growing, peak clipping or strategic conservation may be more helpful to defer costly new capacity additions, improve customer service, reduce environmental impacts, and maximize national economic benefits. Section 3.1 of this report presents an analysis of the specific load shape objectives appropriate for the Philippines.

2.3 INSTITUTIONAL REQUIREMENTS AND INCENTIVES

A number of DSM activities have been proposed in the Philippines and quite a few training workshops have been offered over the last year, as noted in Chapter 1. Nonetheless, actual utility DSM programs have yet to be initiated. Taking this step requires the development of an appropriate institutional framework that establishes a clear policy mandate, provides appropriate regulatory incentives for the utilities, and fosters a utility planning and resource acquisition process conducive to the consideration of DSM. Section 5.1.1 reviews the current

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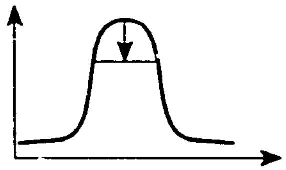
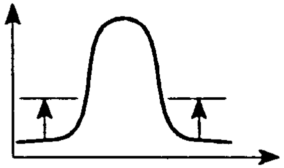
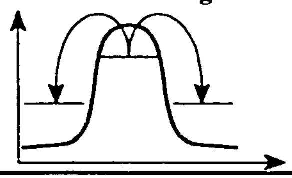
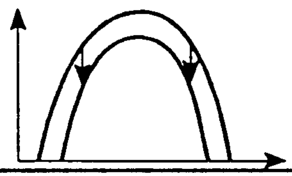
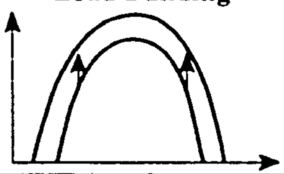
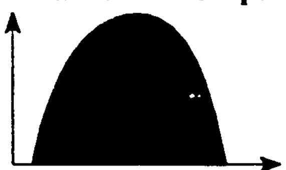
Exhibit 2-1
Demand-Side Management Load Shape Objectives

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.
Valley Filling 	**Valley filling** entails building of 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.

institutional setting in the Philippines and Section 5.1.2 recommends some institutional development activities that would create an appropriate framework. The next section presents some general information on the basic concepts that underpin those recommendations.

2.3.1 Integrated Resource Planning

Integrated resource planning (IRP) is a comprehensive process through which utilities identify and acquire the most cost-effective electric resources necessary to meet their customers' incremental requirements for energy and power. In North America, IRP has become a regulatory reform initiative that provides significant changes to the way that utilities traditionally have conducted business. IRP also provides a strategic context in which to understand the importance and role of demand-side management.

IRP is often called "least-cost" planning, which refers to the acquisition of electric resources by utilities with the lowest possible cost to themselves, their customers, and society at large. "Electric resources" are available throughout the entire power system, from the point of generation to the point of consumption. They include the traditional supply-side measures that provide megawatts from the construction of new generators, repowering and rehabilitating existing generation facilities, and purchasing power from wholesale markets or independent power producers. Electric resources also include measures that provide "negawatts" from efficiency improvements in generators (better heat rates), the transmission and distribution system (fewer line losses), and at the end-use (demand-side management).

In determining which are the most cost-effective resources to a utility, it is important to calculate costs and benefits properly. Utilities have traditionally calculated costs and benefits strictly from their own perspective. Thus, the benefits of a DSM program (utility avoided operating and capital costs) would have to exceed the costs of the program (administrative costs, financial incentives, and lost revenues from reduced consumption) for the program to be cost-effective. From this utility perspective, the most cost-effective DSM is that achieved by load management, preferably the shifting of load from peak to off-peak times.

An important innovation of IRP is the inclusion of the costs and benefits to the utility's customers. Thus, customer bill savings from DSM add a large benefit that makes a number of energy efficiency measures cost-effective. Adding the customer's perspective to the cost/benefit analysis is increasingly important in economies like the Philippines, which must be competitive in world markets.

Another innovation of IRP is the inclusion of benefits to society from the acquisition of electric resources that are environmentally benign, such as DSM and most renewable resources. The reduced social costs from reliance on technologies that do not create pollution from the combustion of fossil fuels are increasingly important in a country like the Philippines, which suffers environmental damages from uncontrolled power generation

The electric resources that are systematically identified and acquired in the Philippines should be the lowest-cost options from the perspectives of the utility, its customers, and all society. This approach will yield the most economically-efficient outcome and will ensure the sustainable development of the Philippine power system to meet current needs as well as those of future generations.

While IRP implies a "planning" activity, it is only one component of the entire process through which utilities systematically identify and acquire least-cost resources. The following components of IRP are addressed below: 1) the power sector plan, 2) computer modeling to perform the quantitative analyses that support the plan, 3) resource acquisition activities that implement the plan, 4) the role of energy service companies, and 5) a system of incentives to motivate utilities to act in accordance with the plan. These and related components of IRP are discussed below.

2.3.2 Developing the Power Sector Plan

The basis for IRP is a plan that provides extensive analyses and recommendations for a course of action. In North America, laws and regulations on IRP vary widely, but nearly all of them specify the requirement to produce and regularly update a plan that is based on the following tasks:

1. Identifying the objectives of the plan (e.g., reliable service, minimal environmental effects, low cost of environmental controls, meeting peak demand in a cost-effective manner, and minimal bills for electricity customers).

2. Developing one or more load forecasts for different scenarios.

3. Determining the levels of capacity expected for each year of the plan.

4. Identifying needed resources (e.g., fuels, generating capacity, transmission and distribution capacity, a manageable load shape, demand reductions) needed to bridge the gap between expected loads and capacities.

5. Evaluating all of the electric resources in a consistent fashion and selecting the most promising resources for fashioning an effective, flexible, and responsive plan; and integrating methods of supplying power with methods for controlling and moderating demand.

6. Constructing scenarios that project the selected mixes of resources against possible economic, environmental, and social circumstances.

7. Evaluating the economic and technical characteristics of each mix of resources and analyzing the uncertainties associated with the various scenarios.

8. Screening the alternatives to eliminate those that are not suitable and rank-ordering alternative courses of action.

9. Testing each alternative for cost-effectiveness from a variety of perspectives (the utilities, ratepayers of different classes, and society at large).

10. Reevaluating the alternatives considering economic, environmental, and societal factors, and selecting a plan for implementation that most nearly satisfies all the objectives of the plan.

11. Developing and implementing a plan of action.

12. Monitoring and evaluating the operation of the utilities under the plan and revising the plan if necessary.

2.3.3 IRP Modeling

Utility planning is an intensely quantitative process that requires modern computer technologies to establish databases, analyze options, and present results in meaningful ways to decision makers. Most utilities have used large mainframe supply-side expansion models for this purpose for years. IRP models are relatively new on the scene and represent an important evolution in utility planning. The most important feature of IRP models is their ability to inherently evaluate specific supply-side and DSM resource options in a common analytical framework. Because these models are relatively new, they also provide state-of-the-art features, such as running on high-powered personal computers and work stations, providing "user-friendly" operational formats, and presenting high-quality graphical outputs.

From a functional perspective, IRP models provide utility planners with the capability to literally integrate the results of a number of different models into one systematic analytical framework. For example, IRP models take as inputs the results of load forecast analyses, long-run marginal cost tariff studies, supply-side expansion plans, transmission and distribution plans, assessments of DSM potential, and production costing models. Most IRP models will accept the results of any number of other models as inputs. IRP models then produce an optimal mix of available utility assets to determine the type and timing of supply-side and DSM resources that best meet the demand forecast requirements over various time periods.

Two different analytical methods have evolved to conduct the resource selection process. The first method uses optimization models that incorporate dynamic programming techniques to evaluate all combinations of supply-side and DSM options. From this evaluation, an optimal plan is selected based on an objective function of minimizing revenue requirements or total resource costs (a good example is the Electric Power Research Institute's IRP Workstation, formerly called EGEAS). The second method simulates a utility's chronological performance over long planning horizons and selects the most cost-effective options by ranking all alternatives available each year based on any combination of user-specified objective functions, e.g., minimizing total resource costs and rates (a good example is EPRI's IRP-Manager, derived from LMSTM). Both kinds of IRP models facilitate the analysis of risk due to uncertainty in key assumptions through sensitivity and decision analysis techniques. They also allow financial analyses to calculate the impact of resource strategies on the utility's capital requirements, income statement, balance sheet, and source and use of funds. Additionally, these models enable consideration of the impacts that different resource strategies will have on the utility's revenue requirements and its customers' electricity tariffs.

Some utilities have gone half-way toward IRP modeling by conducting separate supply-side and DSM analyses using different models for each task. These models can be linked for purposes of data-sharing and conducting iterative analyses. The results of this approach can take two forms. 1) the subtraction of a cost-effective block of DSM resources from the load forecast with supply-side resources then applied to the remaining load, and 2) the determination of separate blocks of cost-effective supply-side and DSM resources that meet the load forecast. While these results can provide a rough estimate of the relationship between cost-effective supply-side and DSM resources, they do not provide the necessary detail required of an IRP analysis.

This is because neither supply-side nor DSM resources are monolithic; they cannot be compared as blocks of potential resources, but must be disaggregated into their constituent parts. Just like a gas-fired combined cycle generator cannot be lumped together with a coal plant in a supply-side analysis, an industrial efficient-motor program cannot be lumped together with a residential refrigerator efficiency program in a DSM analysis. The same concept applies to IRP: specific supply-side and DSM resources must be compared discretely, one against the other. Thus, IRP models do not operate in the same way as linked supply-side and DSM models because IRP models produce a rank-ordered resource mix that lists a combination of specific supply-side and DSM resources. This approach is essential for producing a meaningful investment plan and also for evaluating supply-side and DSM project proposals received in response to all-source competitive bidding programs (see below).

2.3.4 Integrated Resource Acquisition

In order for IRP to function properly in the Philippines, it is essential that utilities be given the authority to implement the plan, i.e., they should have the responsibility for acquiring both supply-side and demand-side resources according to the plan. "Acquiring" means arranging, directly or indirectly, for resources to be made available to the Philippines electric system. A method for acquiring electric resources on an IRP basis has been developed in North America and is referred to as all-source competitive bidding. A specific approach to implementing all-source bidding in the Philippines is described in Section 5.1.2. A general description of this method of integrated resource acquisition follows.

Competitive bidding is a process that utilities can undertake to acquire electric resources through the marketplace. In a competitive bid, utilities solicit proposals for electric resources in an auction. The auction can take place periodically (for example, once a year) or whenever the utility believes that resources are required, as the result of a comparison of load forecasts with supply plans. In the auction, proposals are typically solicited that must include the following characteristics:

- the amount of electric resources bid (MW and/or MWh)
- the bid price (in currency units per MW and/or MWh)
- a deadline or schedule to deliver the electric resources
- security for the delivery of the resources.

The utility then evaluates the proposals and ranks the bids based on a number of pre-established criteria, such as:

- the bid price
- non-price factors such as:
  - the experience and qualifications of the bidder in undertaking similar projects
  - the bidder's approach to project development and financing
  - the environmental impacts of the proposed project.

The utility then signs contracts with the winning bidders -- those that ranked the highest and that provide, in sum, the resource block required by the utility.

There are a number of variations on this theme. For example, utilities can conduct a bidding auction for generation resources, for improvements to the transmission and distribution (T&D) system, for DSM resources that improve end-use load management and efficiency, or for any combination or all of the above. The supply block that the utility requests can be for power (MW), for energy (MWh), or for both. Eligible bidders can include the following:

- for generation resources: the utility's generation subsidiary, independent power producers (private non-utility generators), and the utility's large customers (cogenerators)

- for T&D improvements: the utility's T&D subsidiary and independent T&D engineering and construction management enterprises

- for DSM resources: the utility's distribution subsidiary, energy service companies (ESCOs), and the utility's large customers.

Finally, the payment that the utility makes to successful bidders can be made up front (a one-time payment for the delivered resource block) or over time (as the electric resources are actually delivered to the utility).

All-source bidding is a special case in which bids are solicited and accepted for all electric resources at the same time. In this situation, both supply-side and DSM bids can be considered in meeting a utility's resource requirements in a systematic process for implementing the utility's integrated resource plan. All-source bidding also provides the benefit of being a market-based mechanism to identify and acquire electric resources, as compared to an approach that relies on the utility's own planning processes.

Competitive bidding has been employed by 84 utilities in North America over the last ten years. The results to date are quite notable in that roughly 16,500 MW of supply bids have been awarded through 116 auctions[1] and 425 MW of DSM bids have been awarded through 28 auctions[2] (both net of cancelled contracts).

Through the evaluation of many of the early bidding programs in North America, a number of lessons are generally accepted. On the supply-side, the approach was initially developed to control an over-development of the market for independent power. Nonetheless, many utilities continued to set the ceiling price for their auctions at their avoided cost, which in retrospect was too high. Thus, over-development of the market continued in some cases. On the other hand, the subsequent reduction of ceiling prices to a market clearing level has created some downward pressure on utilities' avoided costs. For example, in New York, avoided costs were redefined from an administrative calculation of the cost of utility generation, to the market's price of independent power generation. This trend has resulted in lower avoided costs.

A number of lessons have also been learned from DSM bidding programs. For example, while many of the early programs were open to both ESCOs and the utilities' large customers, the primary participant has been the ESCOs. DSM bid prices have ranged from $0.035 to $0.065/kWh (between 60% and 90% of utility avoided costs). It is generally recognized that

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[1] Robertson, H.E. *Tracking the Winners: The Performance of Supply-Side, Competitively-Bid Projects (1984-1994)*. Stockton, New Jersey, June 1994.

[2] Goldman, C.A. and M.S. Kito. *Review of Demand-Side Bidding Programs: Impacts, Costs, and Cost-Effectiveness*. Berkeley, California: Lawrence Berkeley Laboratory, May 1994.

ESCOs provide a "value-added" service compared to a utility's own DSM program offering (see below), which has been valued at $0.005 to $0.025/kWh.[3]

Lessons have also been learned from the all-source bidding programs. One result is that it is clear that different selection criteria should be used to judge supply-side and DSM bids. For example, a utility will usually examine the extent to which a supply-side project can be dispatched, which is generally not applicable to a DSM project. Supply-side and DSM resources also have different project development cycles and costs. For example, supply-side projects are generally more capital-intensive and take longer to construct. This observation has implications for reduced security requirements for DSM projects. The main lesson learned from all-source bidding programs is that they should be implemented through separate, parallel supply-side and DSM auctions, and not through a single integrated auction.

2.3.5 The Role of Energy Service Companies

Because ESCOs have been the predominant participant in DSM bidding programs in the United States, it is worth discussing the nature of their operations and the services that they typically provide. While there are many different business transactions offered by ESCOs, some generalizations can be made.

ESCOs generally provide services to their customers through energy performance contracts or "shared savings" transactions. In a performance contract, ESCOs will often provide project financing for most or all of the upfront capital costs. The ESCO then takes its fee out of the savings achieved by the project over time (typically five to ten years) Thus, the ESCO provides a guaranteed positive cashflow to its customer from the start of the project: if there are no energy savings, then no fee is paid. ESCOs also offer a comprehensive package of services that typically include:

- an energy audit or analysis of energy consumption in a facility with recommendations for improvements
- project design and engineering specifications for energy efficiency measures
- project financing for both capital and administrative costs
- construction management of the efficiency improvements

[3] Wolcott, D.R. and C.A. Goldman. "Moving Beyond Demand-Side Bidding: A More Constructive Role for Energy Service Companies." *Proceedings of the American Council for an Energy-Efficient Economy Summer Study*. Washington, DC, 1992.

- operations and maintenance of the energy efficiency measures over the life of the project
- a buy-out option, whereby the customer can acquire the project's assets during the contract or at its conclusion.

Through these shared savings transactions, ESCOs generally overcome a number of the critical market barriers that utility customers face in considering DSM investments. For example, ESCOs provide the technical and managerial expertise that customers often do not have themselves. As a result, ESCOs offer substantial management of performance risks that customers may not be willing to undertake. Finally, as noted, ESCOs often provide financial resources for the project that may be unavailable to a customer.

ESCOs present a number of advantages and disadvantages to utilities that are implementing DSM programs. On the plus side, ESCOs provide a valuable service of shifting the performance risk of DSM from the utilities and its ratepayers. In a DSM program implemented by the utility itself, this performance risk can result in additional costs (and higher rates) for the electric resource. Through ESCOs, utilities can control for this risk. ESCOs also ensure the reliability and persistence of the DSM savings generated by their projects. By the very nature of the shared savings transaction, in which the ESCO is paid a fee from the savings achieved over time, it is highly motivated to provide the operations and maintenance services needed to ensure that the savings persist. Finally, ESCOs provide an important private sector, market-based delivery mechanism for utility DSM resources. In sum, these advantages are generally recognized as providing the "value-added" that ESCOs can offer utilities in their DSM programs.

There have also been some disadvantages noted in ESCO operations in utility DSM programs. Most notable has been the tendency for "cream-skimming," which is the implementation of only the quickest payback, most highly profitable DSM measures. While this makes sense to the ESCO from a business point of view, it can be detrimental to utilities and their customers in terms of lost DSM opportunities. Performance contracts are also generally complex and difficult to understand, by their very nature as long-term agreements with complicated provisions.

2.3.6 Regulatory Incentives for DSM

Philippine utilities faces a critical problem relevant to the possible implementation of DSM, as do most other utilities in the world. The problem is that under current rate-setting practices, every kWh that the utility sells increases revenues, while every kWh that the utility does not sell decreases revenues. Utilities might sell less electricity for a number of reasons, e.g., mild weather, a downturn in the economy, or from DSM. Unfortunately, a reduction of revenues is a powerful disincentive to the utility to undertake DSM activities.

In the United States, a number of regulatory incentive mechanisms have been developed to mitigate this problem. For example, in some regulatory jurisdictions, utilities are allowed to recover in rates their investment costs in DSM as well as revenue losses caused by DSM. In some cases, utilities are even provided with a positive incentive in the form of extra profits for undertaking DSM, to the extent that it is the least-cost electric resource. Utilities in 31 of the 50 U.S. states are allowed DSM cost recovery, while utilities in 26 states can earn positive incentives.[4]

The are two mechanisms for recovering the costs of DSM in the United States: expensing and ratebasing. When the cost of DSM is expensed, the utility recovers 100% of the cost of the program during a short period of time, typically in one year. When the cost of DSM is ratebased, the cost is capitalized (listed as a utility investment) for a period that approximates the useful life of the DSM measure, and then a fraction of the full cost is recovered each year until the full cost is recovered. In both cases, the costs are recovered from customers through their electricity rates.

Discussions with representatives of the Philippines electric industry have revealed that the negative impact that DSM expenditures would have on revenues is a substantial deterrent to DSM implementation. Therefore, NAPOCOR and the distribution companies could be allowed to recover in rates those revenue losses on fixed costs from qualifying DSM expenditures (those expenditures meeting minimum qualifications or performance criteria).

Such utility incentive mechanisms could possibly be implemented in the Philippines through appropriate policy or regulatory authority, for example, in the Department Order on DSM that DOE is currently promulgating (see Section 5.1.1). Therefore, DSM costs and revenue losses could be recovered in the transfer tariffs that NAPOCOR charges the electric distribution companies, thus spreading those costs across all ratepayers in the country. Alternatively, the DSM costs could be recovered in the retail tariffs that the distribution companies charge their customers, thus spreading those costs across the ratepayers in their service territories. Going further, such costs could be recovered in retail tariffs by sector. For example, it may be decided that the costs of industrial DSM programs should only be charged to industrial customers. Finally, DSM costs could be recovered directly from customers participating in the utility's DSM program, perhaps through a loan or leasing mechanism.

For many years state regulatory commissions in the United States exhorted electric utilities to increase their DSM expenditures without providing the utilities any financial incentives to do so. This has changed. Many states now provide positive incentives to utilities to invest in DSM.

[4] Edison Electric Institute. *Integrated Resource Planning in the States: 1992 Sourcebook.* Washington, DC, 1992.

These incentives take many forms. For example, some states set specific performance targets (such as for cost-effectiveness and program participation rates), and then offer financial rewards through subsequent rate increases. Other states allow utilities to ratebase their expenditures and then earn a higher-than-normal rate of return on that investment. Other states provide utilities a share of the total resource savings achieved by their DSM programs. Experimentation continues with many alternative approaches to rewarding utilities for acquiring cost-effective DSM resources.

Regulators generally believe that such rewards are appropriate to compensate utilities for the increased risks of doing something new and relatively untested, such as implementing DSM programs. For the same reason, the distribution companies in the Philippines could be provided with financial incentives for implementing DSM consistent with the integrated resource plan. The precise formulation for these rate adjustments would be made by the Energy Regulatory Board.

For most utilities in the world, DSM (particularly DSM that focuses on reductions in energy use) is unconventional and antithetical to their normal course of business. For many, DSM is the opposite of what they think they should be doing. The Philippines will probably be no different than the rest of the world in this respect.

This predominant attitude toward DSM, however, is steadily changing, especially in the United States, where utility regulators have worked to make DSM a profitable utility activity. It may also change in the Philippines as the benefits of DSM become apparent. Initially, however, there is likely to be some resistance to DSM activity. Failure by any distribution company to participate in DSM activities recommended by the integrated resource plan will raise system-wide costs, even for those distribution companies that implement DSM programs.

It is difficult to judge how receptive each of the distribution companies will be to implementing the integrated resource plan's recommended DSM activities. But it is important to raise the issue, and perhaps to consider a measure that will dissuade distribution companies from refusing to participate as recommended. For example, a surcharge could be added to the wholesale electric rates charged to the non-participating utility. The annual surcharge could be set equal to an estimate of the additional costs imposed on the system as a result of the failure to participate. More precisely, it should be set equal to the annualized net present value of the increase in total resource costs imposed on the Philippines.

Regulatory incentive approaches in the United States provide a comparable mechanism in the form of a penalty for utilities that implement DSM programs that fail to meet pre-established performance criteria. Such an approach is probably premature in the Philippines; however, the surcharge for non-participation may be appropriate.

2.3.7 Rate Impacts of DSM

The impact of regulatory incentives for DSM in the United States has been dramatic. Many utilities now invest 1-2% of their gross annual revenues in DSM (the most aggressive utilities invest 5-6%) and earn 0.03-0.94% of gross annual revenues in utility incentives.[5] This level of investment and earnings has created a current DSM market in the U.S. of $2 billion/year that has resulted in 27,000 MW of demand reduction (5%) and 23,000 GWh/year of energy savings (1%). At this rate of implementation, the market in 2000 is projected to be $20 billion/year which would raise rates 5% and meet 30% of new load growth.[6]

However, recent developments in the U.S. electric utility industry call these projections into question. For example, U.S. utilities, which are now starting to confront deregulation and increased competition, are calling into question the role of IRP and DSM activities. Some utilities see no role for IRP and DSM, since the marketplace would automatically make resource decisions based on price competition that could not accommodate the rate impacts of DSM. Other utilities believe that IRP must still be practiced by electricity suppliers to maximize their profitability, and that DSM would be an important customer service for utilities seeking a competitive edge.

Whichever argument is true, the rate impacts of DSM have become an important issue in program design and implementation. In some states, large industrial customers have expressed concerns about how DSM programs affect electric rates. Rates can increase because DSM program costs must be recouped and because DSM programs reduce sales, leaving fewer revenues from which fixed costs can be recovered. On the other hand, DSM programs generally reduce customer bills because consumption decreases by more than rates increase. However, for customers who do not participate in DSM programs, consumption does not change and rate increases mean bill increases. Rate increases due to DSM are in fact quite modest, in the range of 0.5 to 3.0%.[7] But if a large industrial customer does not participate in DSM programs, such rate increases can raise annual bills by hundreds of thousands of dollars.

DSM incentives enter into the picture in two ways. First, incentives raise DSM costs and hence increase rate impacts. However, these effects are likely to be modest. For example, if a utility's DSM programs raise rates by 2% and an incentive equal to 10% of program costs is

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[5] Nadel, S.M., M.W. Reid, and D.R. Wolcott. *Regulatory Incentives for Demand-Side Management.* Washington, DC: American Council for an Energy-Efficient Economy, 1992.

[6] Hirst, E.*Electric Utility DSM Programs: 1990 Data and Forecasts to 2000.* Oak Ridge, Tennessee: Oak Ridge National Laboratory, 1992.

[7] Nadel, S. and M. Pyle. *Rate Impacts of DSM Programs: Looking Past the Rhetoric.* Washington, DC: American Council for an Energy-Efficient Economy, 1994.

earned, rates will increase by only an additional 0.2%. Second and more importantly, incentives can encourage utilities to increase DSM spending, which in turn adds to rate impacts. Thus, if a utility doubles its DSM expenditures, rates will tend to increase proportionately. Alternatively, increased spending will often result in increased customer participation in DSM programs, leaving fewer non-participants who will see their bills increase.

To the extent that customers oppose DSM programs on rate impact grounds, the debate has spilled over into proceedings on regulatory incentives. In order to contain the problem, it may be necessary for utilities to provide expanded DSM program offerings targeted specifically at the needs of rate-sensitive customers and to experiment with DSM programs in which participating customers pay the full cost of the programs through leasing and lending mechanisms.

2.3.8 The Need for Public Involvement

Public involvement is an essential element of IRP. Ratepayers, electric utilities, generating companies, DSM equipment manufacturers and vendors, environmental and consumer advocates, and the organizations that represent them should be involved throughout the process of developing and implementing a plan. Although public involvement will surely slow the process initially, the process and plan will be better for it, and the political support for the plan will be broader and stronger in the long run.

The DSM collaborative proposed in Section 5.1.2 may serve the need for public involvement by including participation by relevant parties, public review and comment on significant decisions and documents, and procedures for resolving disputes. However, the history of DSM collaboratives in the United States has generally received mixed reviews.[8] While public inputs into the planning process are important to develop programs that result in public acceptance, collaboratives tend to be expensive and are subject to being captured by public interest groups. They can also cause substantial delay in DSM planning and implementation, and therefore, ultimately in the achievement of DSM impacts.

2.3.9 Relationship of IRP and DSM

Because the Philippines does not yet have experience with DSM implementation, it's a chicken-and-egg type question of whether to proceed first with IRP or DSM: IRP would identify cost-effective DSM resources, but requires information such as estimated costs,

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[8] Raab, J. *Using Consensus Building to Improve Utility Regulation*. Washington, DC: American Council for an Energy-Efficient Economy, 1994.

benefits, and market penetration for the DSM options under consideration. This type of information is typically only available through actual DSM experience. An accelerated DSM program is proposed for the Philippines that does not rely on the outputs of an initial IRP evaluation for the following reasons:

- The mismatch of load growth and available capacity is so problematic in the Philippines that all potential means of providing electric services should be considered as quickly as possible.

- There is no experience with DSM in the Philippines that could be used as input to an IRP evaluation. The only way to accurately evaluate DSM within an IRP framework for the Philippines is to first conduct pilot programs that will provide information on the costs and benefits of DSM programs. IRP can subsequently be carried out as the results of initial DSM programs become available.

- Because no DSM programs have been conducted in the Philippines, the most promising efficiency opportunities have yet to be tapped. DSM will undoubtedly be part of any least-cost plan for the country; the key is identifying the most cost-effective programs. IRP will provide a framework to assess DSM programs as they are implemented.

In the near term, the results of DSM pilot programs can be used to conduct the IRP analysis. In the longer term, IRP can optimize the selection and mix of DSM programs and supply-side options. Therefore, DSM and IRP should proceed in parallel, the results of one feeding into the other. For example, once there are some successful DSM programs, acceptance of IRP concepts may increase as demand-side resources are shown to be real. Conversely, IRP can create a policy and regulatory framework that legitimizes DSM.

2.4 THE FRAMEWORK FOR DSM PROGRAM DESIGN AND IMPLEMENTATION

DSM program design and implementation follow several steps that are briefly presented below and are described in more detail in Section 5.1.3. These steps are typically conducted iteratively, e.g., the results of a pilot program may suggest changes to the full-scale 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.

- *Select appropriate DSM objectives.* Based on utility requirements, load shape objectives (see above) 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 the financial performance and specific operational needs of the utility, such as increased system utilization, capacity deferment, or reduced dependency on critical fuels.

- ***Acquire data and identify market segments.*** The purpose of DSM is to modify customer behavior. DSM programs must therefore focus on the technologies used by customers and must stimulate customers to act. 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 data needed can be acquired through a combination of customer surveys and focus groups, billing data analysis, and load research. In addition, these data can be used to establish a baseline against which net program impacts can be estimated.

- ***Conduct assessments of DSM potential.*** Based on load shape objectives and the characteristics of each target market segment, various DSM measures can be evaluated with respect to their economic and achievable potentials. Economic potential refers to the impact of measures if they were adopted wherever economically justified. Measures with promising economic potential can be packaged with delivery mechanisms and utility and participant incentives to constitute prototype programs. The achievable potential of a DSM program can then be assessed, taking into consideration the administrative costs of the program and the likely rate of customer participation. Achievable potential is generally less than economic potential because of the logistical considerations associated with program delivery.

- ***Design pilot programs.*** Pilot programs are designed to include a marketing approach, types and amounts of customer incentives, a delivery mechanism, and tracking, management and evaluation plans. An assessment of the technical, economic, and market uncertainties related to the impacts of particular DSM programs is also conducted, and approaches are identified to reduce the resulting risks and increase the likelihood of program success. Finally, financial analyses are performed to produce a "bankable" program acceptable for funding by multilateral development banks.

- ***Conduct pilot programs.*** If the economic potential and market penetration of DSM measures were known with certainty, there would be little risk associated with DSM program implementation. Unfortunately, where no DSM experience is available to provide these insights, risk reduction strategies must be employed to gain information about technical, economic, and market uncertainties. Pilot programs are effective in gaining further information when needed; in effect, they serve as additional market research activities. Pilot programs do not remove all uncertainty, but they do provide an important

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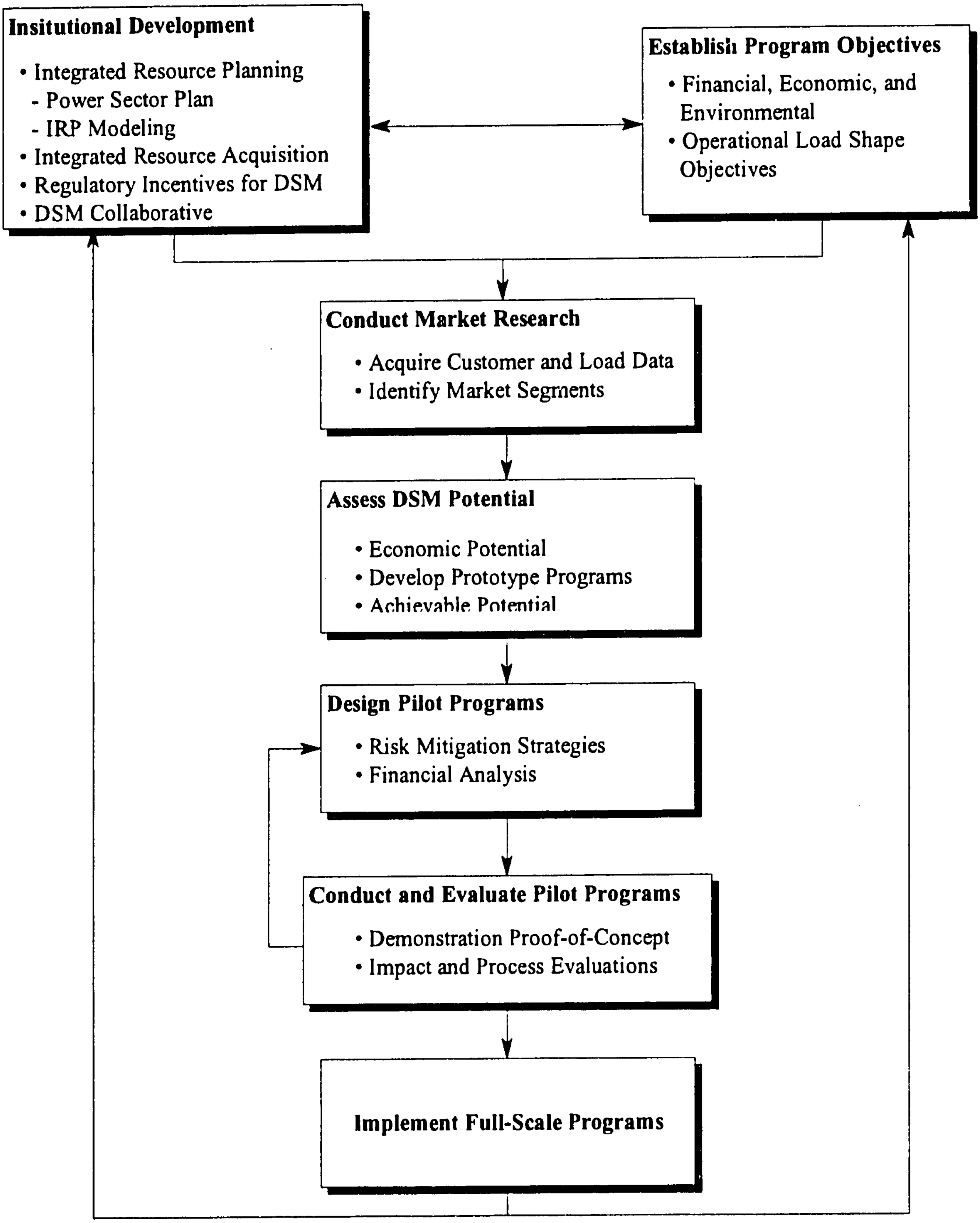
opportunity for demonstration and proof-of-concept. Successful pilots can convince utilities, regulators, and customers of the effectiveness and value of DSM programs.

- ***Evaluate pilot programs.*** If DSM programs are to be utilized as true utility resources that defer capacity and reduce generation, program impacts must be quantified in terms of energy and demand savings. Evaluation methods are also critical for establishing the exact level of incentives provided for program implementation or participation. Impact evaluations determine the change in energy consumption patterns that result from the program. Process evaluations examine the ways in which programs are marketed and delivered to determine how programs could be improved. Program evaluation also provides important feedback and suggestions for mid-course corrections.

- ***Implement full-scale programs.*** Based on the evaluation of pilot programs, programs can be redesigned to make them 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, and trade allies.

Exhibit 2-2 summarizes all the steps presented in this chapter that are the subject of this DSM Action Plan, including institutional development and DSM program design and implementation activities. Chapter 5 presents detailed recommendations regarding how these activities could be implemented in the Philippines.

Exhibit 2-2
Demand-Side Management Action Plan Steps



CHAPTER 3
DSM OBJECTIVES IN THE PHILIPPINES

Just as supply-side options are developed in response to specific system needs (e.g., baseload or peak load growth), demand-side resources must be defined in terms of how they meet system requirements. The formulation of DSM load shape objectives and the development of potential DSM programs to meet those objectives require an understanding of present and projected electricity consumption patterns. The specification of load shape objectives for the Philippines at this early stage of DSM development can be used to help illustrate the potential national benefits of DSM, and can guide future program design efforts.

3.1 LOAD SHAPE OBJECTIVES

As discussed in Chapter 2, DSM can be used to satisfy a wide range of load shape objectives, including load reduction, load shifting, or load growth. The selection of a particular set of objectives depends upon the anticipated resource needs of the utility.

Over the 1987-1991 period, electricity sales in the Philippines grew at an annual average rate of 6.3%, while peak demand grew at an annual average rate of 5.8%. Growth in electricity consumption has consistently exceeded the growth in gross domestic product (GDP), with demand elasticities in the 1.5 to 2.0 range, depending on the period analyzed.

Several developments resulted in a supply deficit in the country during the late 1980s and early 1990s, including:

- mothballing of the 620 MW Bataan nuclear power plant
- the power demand surge in the late 1980s brought about by strong foreign and domestic economic growth during that period
- the 1989-1990 drought, which reduced hydropower generation
- local opposition to three key thermal power plants, which delayed construction
- increasing forced outages of older oil-fired plants.

Within the last two years, the Government of the Philippines has taken steps to mitigate the supply deficit. Several diesel generators and combustion turbines were brought into service in the early 1990s to improve power availability, albeit at relatively high generating costs. In addition, as part of the Government's broader efforts to tap private sector resources, several build-own-transfer (BOT) power generation schemes have been completed, and others are planned.

Although the frequency of brownouts has been reduced through these steps, load forecasts suggest that another surge in demand (with an accompanying power deficit) may be on the horizon. NAPOCOR's Power Development Program for the period 1993-2005 is based on the strong economic growth projected by the National Economic Development Authority (NEDA). NEDA forecasts annual average GDP growth of 7.3% for the period 1993-1998 and 8.8% for 1999-2005 in response to the Government's plans for economic restructuring and the expected upturn in the global economy. Given the high demand elasticities observed in the Philippines in the past, NAPOCOR has projected annual average electricity sales growth of 10.6% during the period 1993-1998 and 11.8% for 1999-2005. Under these projections, NAPOCOR sales and peak demand would grow from 1992 levels of 24 TWh and 4,400 MW respectively, to 84 TWh and 15,100 MW in 2003, to 102 TWh and over 18,000 MW in 2005. Transmission and distribution investments for grid connection and upgrading over this same period are estimated at ₱91 billion. Because these forecasts are based solely on past relationships between economic activity and electricity consumption, and make no allowance for greater efficiency or load management, they provide a reasonable benchmark against which the impacts of a DSM program can be estimated.

Although the key assumptions regarding GDP growth and demand elasticity can be debated, continued strong growth in electricity demand is imminent. The magnitude of power demand growth envisioned in the Philippines is similar to what has occurred in other Southeast Asian nations. In Indonesia, for example, electricity sales increased from 6,500 GWh to 31,500 GWh between 1981 and 1992. Moreover, among the six countries of the Association of Southeast Asian Nations (ASEAN), the Philippines had the second-lowest per capita power consumption in 1990 (381 kWh per capita). The next-highest country, Thailand, had per capita consumption of 723 kWh, while Malaysia had consumption of 1,216 kWh per capita. Rapid power demand growth can be expected in the Philippines as the country begins to achieve the energy intensity of its neighbors.

The Philippines must therefore continue to aggressively acquire additional power resources. The 1993 Power Development Program lays out a supply-side expansion program, as shown in Exhibit 3-1. In addition, the Program calls for developing rehabilitation plans for old plants, streamlining the private power development process, and implementing DSM.

With such high levels of load growth and ambitious generation expansion plans, both peak clipping and strategic conservation are natural load shape objectives for DSM in the Philippines. Identifying the principal opportunities for achieving these objectives starts with an analysis of the composition of electricity demand.

Exhibit 3-2a

Sectoral Load Shapes for the Philippines

Average 1992 Day

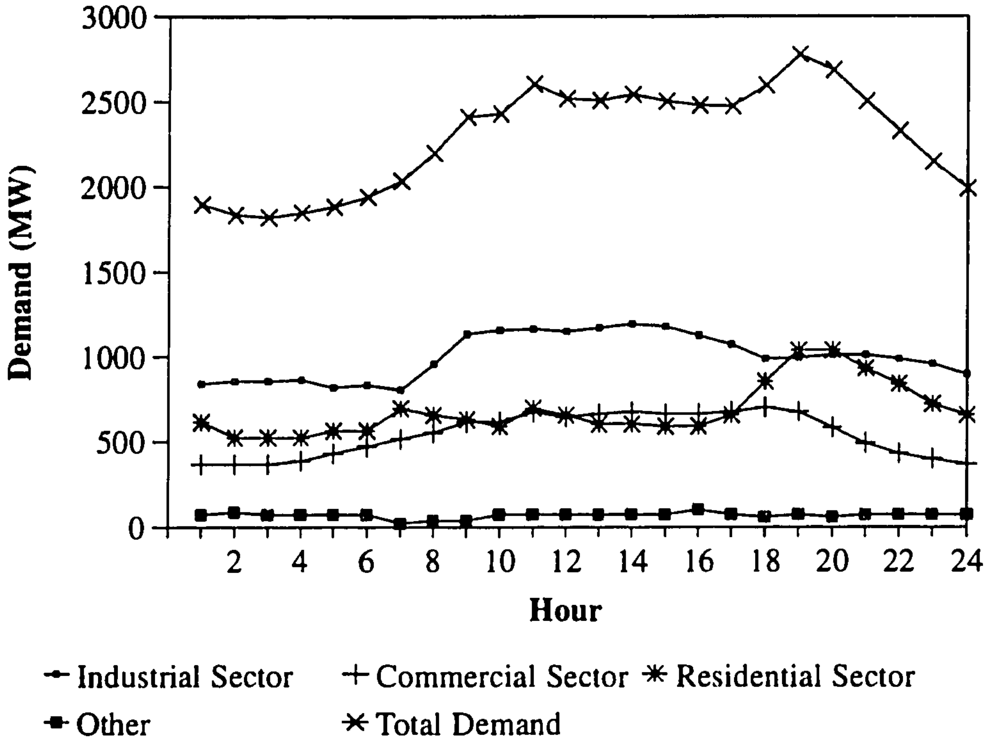


Exhibit 3-2b

Industrial Load Shape for the Philippines

Average 1992 Day

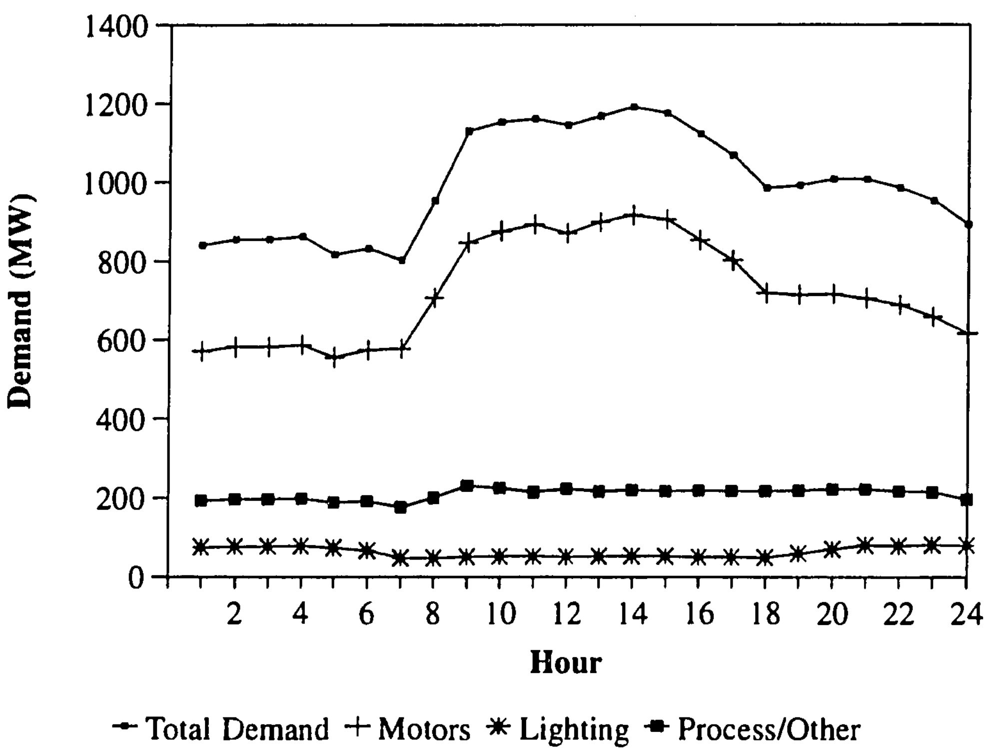


Exhibit 3-2c

Commercial Load Shape for the Philippines

Average 1992 Day

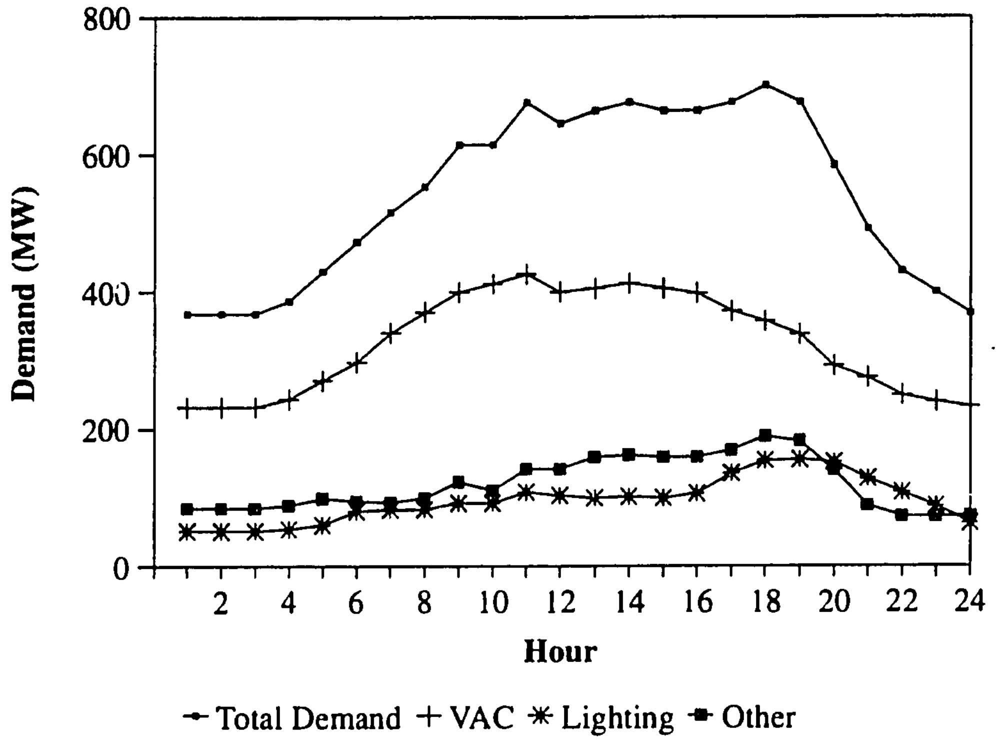


Exhibit 3-2d

Residential Load Shape for the Philippines

Average 1992 Day

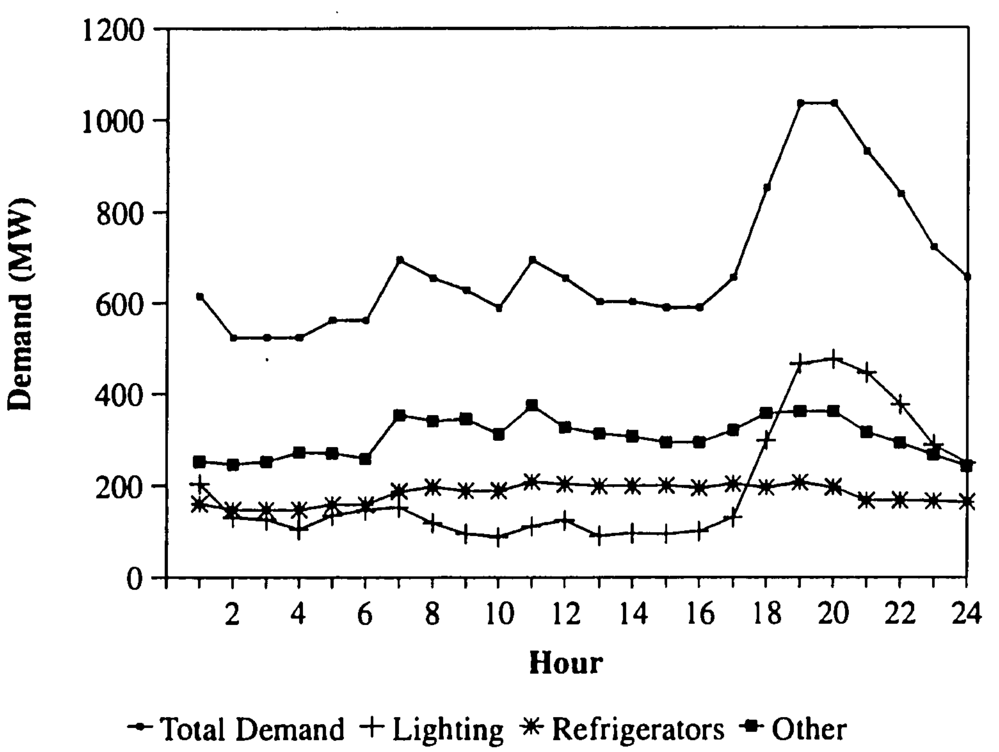


Exhibit 3-1
Summary of Capacity Additions (MW)

Year	Plant Type							
	Hydro	Geo	Coal	Other Baseload[1]	Diesel	GT	CC	Total
1993	-	170	-	-	293	130	555	1,148
1994	40	183	-	-	555	-	180	958
1995	-	60	300	-	100	-	-	460
1996	-	190	1,000	-	11	-	-	1,201
1997	-	675	300	-	6	-	-	981
1998	-	395	500	-	11	200	-	1,106
1999	380	-	700	600	6	100	-	1,786
2000	-	-	-	1,800	6	-	300	2,106
2001	224	-	-	900	-	200	600	1,924
2002	45	-	-	1,200	-	100	600	1,945
2003	-	-	-	2,100	-	100	-	2,200
2004	563	-	-	1,500	-	-	300	2,363
2005	620	-	-	1,500	-	100	300	2,520
Total	1,872	1,673	2,800	9,600	930	930	2,835	20,698

[1] Sites and types still to be identified.
Source: 1993 NAPOCOR Power Development Program.

3.2 THE COMPOSITION OF ELECTRICITY DEMAND

In the absence of rigorous load research, end-use load curves for the principal sectors and end-uses have been estimated based on a disaggregation of total consumption by sector, knowledge of Filipino consumption patterns, and experience in other countries. This analysis is described in further detail in Annex A. The following sectors and end-uses have been included in the analysis:

- Industrial

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- Motors
- Lighting
- Process/Other

▶ Commercial

- Heating, Ventilation, and Air Conditioning (HVAC)
- Lighting
- Other

▶ Residential

- Lighting
- Refrigeration
- Other

▶ Residual

The resulting load shapes (at the point of consumption) for each of the above sectors and end-uses are shown in Exhibit 3-2. These load shapes are only first-order approximations. They represent the national aggregate of demands on all of the main grid systems in the Philippines (e.g., Luzon, Visayas, Mindanao). Because the grids that make up the national electricity network have not been interconnected, more detailed assessment of demand-side resources should be carried for each grid individually because resource needs and DSM opportunities may vary among grids. One of the first activities of a DSM development program would be to carry out load research and collect data that would help to better determine the composition of electricity demand by end-use in the Philippines on a grid-by-grid basis.

Subsequent sections of this report illustrate the potential impacts of DSM programs on demand. It is assumed that total, sectoral, and end-use load curves retain their current general form, and that the relative sectoral and end-use consumption shares remain constant, but that total sales and peak demand levels grow at the rates estimated by NAPOCOR.

In fact, growing economic prosperity and urbanization will eventually affect load shapes and consumption shares. Exhibit 3-3 shows how sectoral shares have changed over the 1980-1990 period. A noticeable trend, common in many developing countries, is the increasing share of residential demand (although the residential share has fallen slightly from its 1990 value over the past few years). In addition, the residential load shape will probably flatten as household expenditures and, hence, non-lighting loads increase. Currently, national demand peaks in the evening, but a pattern of daytime peaks has already emerged in the major urban centers such as Manila. This trend may portend a possible shift in the national peak as commercial air conditioning and residential non-lighting loads take a relatively larger share of demand. Load research and other survey efforts will be critical in determining whether a structural shift in electricity consumption patterns is indeed underway. In the meantime, the assumption that consumption shares and load shapes remain unchanged serves as a reasonable approximation for this preliminary analysis.

Exhibit 3-3
Sectoral Consumption Shares for Selected Years
(values given in percent)

	1980	1985	1990
Residential	23.4	28.2	31.4
Commercial	22.9	21.4	21.6
Industrial	46.0	41.8	42.9
Other	7.8	8.7	4.1

Source: Asian Development Bank, *Electric Utilities Data Book for the Asian and Pacific Region, 1993.*

CHAPTER 4
POTENTIAL DSM PROGRAMS AND IMPACTS

Designing DSM programs and estimating their impacts will require additional information on electricity consumption patterns in the Philippines as well as on the decision-making characteristics of the nation's consumers. Nonetheless, based on experience in other countries and a preliminary understanding of the structure of electricity demand in the Philippines (see Chapter 3), a few potential programs are described below to illustrate the possible costs and benefits of DSM in Philippines. An assessment of these illustrative programs suggests that DSM could serve as a significant and cost-effective power sector resource in the Philippines.

The next chapter lays out an action plan for the more rigorous development of DSM programs. This plan takes into account the provisional program costs presented here to estimate the funding requirements for full-scale implementation.

The following programs are considered:

- Industrial
  - Time-of-use tariffs
  - Interruptible and curtailable tariffs
  - Motor efficiency programs
  - Adjustable-speed drive (ASD) programs
- Commercial
  - Ventilation and air conditioning (VAC) efficiency programs
  - Lighting efficiency programs
- Residential
  - Refrigerator efficiency programs
  - Lighting efficiency programs.

Each of these potential programs is described below in terms of its design, its energy and capacity savings, and the budget necessary to implement the program. Detailed technical, economic, and market assumptions for each of these programs are given in Annex B. The budget requirement is based on the expected costs to the utility or other sponsoring agency, while economic costs are given in Annex B to show the cost-effectiveness of the programs. It is assumed that the first full year of implementation is 1998, and that the programs end at the end of 2003. Energy and demand impacts are reported for the mid-way point in program implementation (the end of 2000) and at the end of program implementation. Future impacts (reported as percentages) are calculated as percentages of 1992 consumption and demand.

4.1 INDUSTRIAL PROGRAMS

The industrial sector is the largest single electricity-consuming sector in the Philippines, accounting for approximately 44% of total consumption and 36% of the system peak demand. Based on experience in other countries, it is estimated that 74% of industrial consumption is attributable to motors and motor systems (compressors, fans, pumps, etc.), 20% to process and other loads, and 6% to lighting. As in many countries, the industrial sector in the Philippines offers some of the largest and most immediate DSM benefits.

The following program descriptions focus on technical and economic issues. However, marketing issues and the utility's overall approach to program dissemination will also be critical factors in program success. If the utilities are to overcome the suspicions of consumers (especially industrial consumers) regarding utility effectiveness and motivations, they must go beyond purely financial incentives and develop a true partnership with consumers. This partnership can be established through a variety of initiatives such as industry/utility roundtables to discuss topics of mutual interest, and promoting an energy managers association for training and recognition of good practice.

4.1.1 Time-of-Use Tariffs

Currently NAPOCOR and the distribution companies offer their large industrial consumers two-part tariffs that charge for energy and contracted demand. However, more sophisticated tariff measures are available to encourage load shifting. Time-of-use (TOU) tariffs provide incentives for consumers to shift demand from on-peak to off-peak periods by offering the consumer lower electricity prices during the off-peak periods. Although residential demand may in fact contribute more to the national peak, the industrial sector would probably be the most responsive to changes in a tariff structure designed to encourage load shifting and reflect the economic value of power. TOU programs may be implemented on a mandatory or voluntary basis.

Program Design

The design of TOU tariffs relies on analyses that are far beyond the scope of this action plan. Rather than specify a particular set of rates here, it is assumed that a tariff structure can be designed that will achieve results similar to those implemented in other countries.

Experience in other countries suggests that the introduction of well-designed TOU tariffs alone may be insufficient to induce significant load shape modification. Many consumers initially need help in understanding the impact of tariff revisions on their bills, and in developing and implementing appropriate responses. Thus, TOU programs, particularly those with innovative components such as real-time or peak-activated pricing, require marketing and technical assistance to consumers to make them effective DSM measures. The program proposed here includes technical assistance to help firms shift load and reduce their costs under the TOU tariff option. The program would be marketed on a personal basis; utility representatives would visit larger industrial consumers and discuss with managers ways to take advantage of the TOU tariffs offered. These representatives provide on-going technical assistance to participants to help them optimize their response to the new tariff structure.

Program Impacts

Expected impacts vary greatly from one industrial subsector to another. Overall, demand savings are estimated to be 7.5% of industrial demand over peak periods (7 to 9 p.m.), and annual energy savings are estimated to be 0.9% of total annual industrial energy consumption by the end of the program. (As noted earlier in this chapter, these percentages represent the portions of 1992 consumption and demand). These impacts are consistent with experience in the United States and Mexico. Exhibit 4-1 summarizes the estimated impacts of the assumed TOU program. This program (along with the interruptible program described next) offers the largest impacts of all programs presented here.

Exhibit 4-1
Industrial TOU Tariffs
Energy and Demand Impacts by Year

	2000	2003
Net Energy Saved (GWh)	27.3	81.8
% of Sectoral Consumption	0.3%	0.9%
Peak Reduction (MW)	24.9	74.5
% of Sectoral Demand	2.5%	7.5%

Program Budget

The program budget excludes the costs that would be incurred by the customer to take advantage of the program (e.g., the cost of control systems). As discussed in Annex B, the design of the program, and training of utility marketing and technical assistance staff amounts to $100,000; direct program costs (TOU meters, marketing and technical assistance) are estimated at $6,000 per participant. The largest industrial consumers would be targeted for participation. It is assumed that the program gains 300 participants over the first three years, and 900 participants by the end of the sixth year. The total program budget would be $5.5 million.

4.1.2 Interruptible and Curtailable Tariffs

Interruptible and curtailable (I&C) tariffs allow the utility to interrupt or reduce service to those consumers using the rate in order to reduce demand during critical periods. Consumers subscribing to the tariff benefit from reduced rates. Load interruption is generally facilitated by a phone call from the dispatch center to the participating customer; compliance is verified after the fact by reviewing TOU meter readings. I&C programs in other countries have typically required consumers to offer a minimum interruptible load of 500 kW or more to be eligible.

The recent power supply deficit in the Philippines caused many industrial consumers to purchase stand-by generating units. A recent unattributed study (*Survey of the Self-Generating Capability of Selected Industries in Luzon*) suggests that approximately 42% of industrial enterprises are capable of self-generating. On the Luzon grid alone, this represents slightly more than 1,000 MW of capacity. This large base of installed industrial generators makes an interruptible rate program the most promising single DSM program in the Philippines.

In the past, distribution companies would interrupt service without notice, but the interruptions were often so regular that no notice was necessary. I&C programs differ from this situation in several important ways. The implementation of an I&C tariff program transforms service interruptions from an emergency measure with high economic costs to a power sector resource that minimizes economic costs. I&C programs provide organized procedures for load shedding that can help maintain good customer relations. Moreover, by providing customers with advance notice (from as little as a few minutes to as much as a day depending on program options), the impact of service interruptions on customer operations can be minimized for those customers with stand-by generation, and the overall economic cost of interruption is minimized.

Program Design

As with TOU tariffs, a specific I&C tariff schedule is not proposed here. Similarly, it is assumed that a set of I&C rates can be implemented that achieve results comparable to those in other countries that have already implemented I&C programs. Whereas mandatory TOU rates may be practical, I&C programs should remain voluntary because of the potential for costly disruptions of industrial processes. As with the TOU programs, this program also includes personal marketing and technical assistance.

I&C rate programs may be marketed directly to individual consumers. Another approach is to develop load co-operatives. Load co-ops are groups of consumers that coordinate their load interruptions so as to bring the rate benefits of I&C programs to the entire group with fewer interruptions than if they had signed up individually.

Program Impacts

Because of the widespread ownership of standby generators, it is assumed here that I&C programs could yield a capacity benefit equivalent to 20% of industrial demand during peak periods (7 to 9 p.m.) by the end of the year 2003. Energy savings commensurate with this interruption would also accrue to the utility. This impact is consistent with experience in the United States. A summary of energy and demand impacts is given in Exhibit 4-2, based on the analysis in Annex B.

Exhibit 4-2
Industrial I&C Tariffs
Energy and Demand Impacts by Year

	2000	2003
Net Energy Saved (GWh)	72.70	218.10
% of Sectoral Consumption	0.8%	2.5%
Peak Reduction (MW)	66.2	198.6
% of Sectoral Demand	6.7%	20.0%

Program Budget

The program would be targeted at consumers that already have stand-by generators. The principal costs of the program would be TOU metering equipment to monitor customer compliance with curtailment periods, and program marketing and technical assistance. Three hundred enterprises are estimated to participate in the program by the end of 2003. Assuming that metering costs are $1,000 per participant, that marketing and technical assistance costs amount to $5,000 per participant, and that program design and staff training costs amount to $100,000, the total cost of the program over the six-year implementation period would amount to $1.9 million.

4.1.3 Motor and Drive Programs

Industrial motors and motor systems account for 32% of all electricity consumption in the Philippines, and 26% of system peak demand (this is the largest single share of peak demand among all end-uses considered in this analysis). Motor efficiency and adjustable-speed drive (ASD) programs may therefore represent a significant demand-side resource, in terms of both peak reduction and overall energy conservation.

Motor efficiency programs entail the replacement or retrofit of standard motors with more efficient motors, with the long-term goal of transforming the motor market so that high-efficiency motors become standard equipment. ASD programs target motors with varying loads. ASDs improve the match between motor power consumption and motor work load by controlling the frequency and/or voltage of the motor's power supply.

Program Design

Motor programs typically utilize rebates that offset the additional costs of purchasing a high-efficiency motor. These rebates may be paid either to consumers, retail vendors, or even importers and manufacturers; vendor involvement is essential for motor market transformation. The most successful programs have relied on direct personal marketing to consumers as well as motor vendors, importers, and manufacturers. In a typical motor efficiency program, the utility defines what constitutes a high-efficiency motor by adopting an efficiency measurement standard and setting an efficiency threshold; purchases or sales of those motors often automatically qualify for rebates. Because the selection of ASDs is much more site-specific, ASDs are often installed as part of a customized program (discussed below), although they may be promoted as part of a broader motor and drive program.

Identifying good industrial candidates is an important part of program implementation. Some utilities, such as the Companhia Energetica de Sao Paulo in Brazil, are developing extensive databases of industrial motor installations within their service territories. The CESP database, for example, is part of an expert system at the heart of their Fleximotor motor efficiency program, which identifies those customers who could exchange motors with others so that everyone has optimally-sized motors.

Given the further industrial growth expected in the Philippines, new purchases rather than retrofits or replacements will provide the predominant opportunity for the use of improved motors. In addition, many motors will be rewound rather than replaced. Poor rewinding practices can reduce motor efficiency by several percent. Therefore, programs should also be implemented which target rewinding workshops to help them adopt practices that preserve efficiency to the greatest extent possible. This is an element of the motors program currently being implemented in Mexico.

Program Impacts

Based on the analysis in Annex B, Exhibit 4-3 summarizes the cumulative impacts that could be envisioned for an industrial motor and drive program. By 2003, the program would reduce industrial electricity demand and consumption by 0.6%. The estimated impacts reflect relatively low penetration rates, which are consistent with early experience elsewhere. More recent motor programs, however, have achieved impressive results; for example, BC Hydro, a Canadian utility, implemented a program that attained 64% participation over just four years of implementation.

V2

Program Budget

Exhibit 4-3
Industrial Motor & Drive Programs
Energy and Demand Impacts by Year

	2000	2003
Net Energy Saved (GWh)	17.5	52.5
% of Sectoral Consumption	0.2%	0.6%
Peak Reduction (MW)	2.0	6.0
% of Sectoral Demand	0.2%	0.6%

It is assumed that the average rebate for high-efficiency motors is $10/kW of motor size. If 83% of the total program savings are attributable to high-efficiency motors, and if average savings from the use of these motors is 4%, then by the end of the program some 125-200 MW of high-efficiency motors will have been installed, and rebates worth roughly $1.6 million will have been paid. Similarly, if ASDs account for the remaining 17% of savings, then the 30% average savings attributable to each ASD suggests that between 3.5 and 5 MW of ASDs will be installed. If the average ASD rebate is $50/kW (about one-quarter of the total cost), a total of $200,000 of ASD rebates will have been paid by the end of the program. A $300,000 allowance is made for program design, staff training, and marketing. The total program budget therefore amounts to $2.1 million.

4.1.4 Other Potential Industrial Programs

Several other industrial programs may be worthwhile in the Philippines. Because there are insufficient data for estimating the costs and benefits of these programs, the programs are simply described below. These programs should be considered during the design of future data collection and program design activities.

Power Factor Improvement

Low power factor indicates excessive reactive loads, which in effect use up generation, transmission, and distribution capacity without providing useful electric services. Inductive loads, such as most motors, often reduce power factor to the range between 0.8 and 0.9. Some inductive loads, such as certain types of electric furnaces, may have power factors as low as 0.3. The most common means of correcting low power factor are:

- *On-site capacitor banks.* 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 capacitors will remain unchanged. Capacitors are usually added at each piece of low power factor equipment, ahead of groups of motors or at main services.

- *On-site switched capacitors.* Plants equipped with very large intermittent inductive loads, such as large motors or inductive furnaces, may require switched capacitors, which are utilized only when the motor load is on. Such capacitors can be controlled from the substation depending on the measured power factor. The switching feature is only required if the capacitors needed are so large that they cause an undesirable leading power factor during times when inductive loads are off.

- *Utility distribution line capacitors.* Utilities can install capacitors on their own lines where it is not practical to measure power factor or to assess charges to owners. For instance, capacitor banks are often installed on utility poles in residential neighborhoods.

The cost and effectiveness of capacitor use depend on the prevailing power factor in different parts of the system, the locations where capacitors are to be installed, and the mounting, enclosure, voltage and capacitance required. Evaluating the maximum potential technical impact and economic viability requires detailed engineering and economic studies of particular consumers and portions of the distribution system.

Direct Load Control

Direct load control (DLC) is the ability of the utility to control consumer end-use equipment, usually to simply turn it on and off. Experience in the United States and elsewhere suggests that commercial and industrial consumers are reluctant to participate in such programs. I&C pricing programs may be more appropriate because the customer retains the option to continue to consume power during the curtailment period and simply pay a penalty. DLC generally does not permit such flexibility.

Opportunities may exist for load control in residential air conditioning or water heating, among others. For example, the Sacramento Municipal Utility District in California is able to reduce peak demand by 10% with a residential air conditioner DLC program alone. However, there does not appear to be sufficient saturation of these appliances in the Philippines at this time to warrant the implementation of a residential DLC program. Furthermore, remote control technologies may face considerable problems under Filipino conditions. Power line carriers cannot be transmitted through transformers, dedicated phone lines may be impractical, and radio transmitters are costly. Consequently, DLC programs are not considered further at this time.

Improved Industrial Processes

Arc furnaces, smelters, and electrolytic processes are often promising candidates for DSM measures. The Philippines processes large amounts of non-ferrous metals, including copper and gold. Frequently, there is substantial DSM or energy efficiency potential associated with metal mining and processing. However, measures to realize this potential are not considered here because further information on the processes used is needed to assess DSM potential.

Energy Management Audits and Customized Programs

Energy management audits entail site visits by utility personnel or contractors who typically review DSM potential in the various electric systems at that facility and recommend cost-effective measures. Customized programs allow consumers (with the assistance of utility representatives) to present proposals to the utility for energy saving or load management measures. Both of these programs typically involve some degree of cost sharing between the agency or utility sponsoring the program and the participating customer.

Energy management audits and customized programs may promote measures that are already promoted under other programs. In addition, they may identify opportunities not covered by other programs, such as low cost/no cost "housekeeping" measures or other customer-specific measures such as cool storage for air conditioning load management. Further market research on customer consumption patterns will be necessary to estimate the costs and savings potential associated with these other measures.

Audits could be conducted using a "mass production" approach in which generic energy measures are promoted on the basis of market research findings. Instead of conducting comprehensive audits of a limited number of facilities, the "mass production" approach targets a limited number of generic measures that can be replicated across an entire industry. This approach has been successfully implemented in China, Pakistan, Egypt, and Morocco. These programs could also make use of revolving funds to help customers finance the measures.

Lighting Efficiency Programs

Although lighting is assumed to account for only 6% of industrial consumption, savings can reach 75% depending on the technologies used. This technical potential, as well as the relatively high program penetration rates achieved in other countries, make lighting programs more important than lighting's share of sectoral consumption might suggest. Unfortunately, little data are available on the industrial lighting technologies currently in use in Philippines.

The following measures are suggested for consideration:

(a) replacing incandescent bulbs with compact fluorescent lamps (CFL)

(b) replacing standard fluorescent tube lamps with energy-saving fluorescent tube lamps

(c) replacing standard fluorescent ballasts with high-efficiency magnetic or electronic ballasts

(d) installing optical reflectors and removing lamps that are no longer required

(e) replacing mercury vapor high-intensity discharge (HID) lamps with sodium HID lamps, or large incandescent lamps with mercury halide lamps.

Although direct installation typically achieves the highest penetration rates, the additional costs of administering a direct installation program make many of the above measures uneconomical if that delivery mechanism were to be used. The attractiveness of participation in an industrial lighting program can be enhanced by providing the participating consumer with more general lighting advice, which will not only improve lighting efficiency but improve lighting quality as well.

In industry, measures (b), (c), and (e) are usually the most applicable. The bulk of these measures will yield savings of between 10 and 30%, with some retrofits reaching 60% (e.g., mercury halide replacements of large incandescent lamps). Assuming that technical potential amounts to 25% of lighting consumption, that economic potential is half of technical potential, and that participation would reach enterprises accounting for 20% of industrial lighting demand, savings would reach 0.2% of total industrial sales. While this appears to be a rather significant contribution, further data on industrial lighting technologies used in the Philippines should be collected before pursuing industrial lighting programs.

4.2 COMMERCIAL PROGRAMS

The commercial sector accounts for approximately 24% of electricity sales and 24% of system peak demand in the Philippines. As discussed in Annex A, it is estimated that 60% of commercial load is attributable to ventilation and air conditioning (VAC), 15% to lighting, and 25% to other loads.

4.2.1 VAC Efficiency Programs

As in the other ASEAN countries, economic development in the Philippines has been accompanied by changes in the commercial building stock. Large air conditioned office buildings and shopping complexes are replacing traditional, less energy-intensive low-rise buildings and small markets. Air conditioning has emerged as the largest single commercial end-use by far in this sector, and represents an estimated 12% of system peak demand.

Program Design

Work carried out under the ASEAN-USAID Buildings Energy Conservation Project indicates that the following measures are the most promising for reducing air conditioning loads:

- raising setpoint temperatures to 25.5°C
- reducing air conditioning operating time
- minimizing outside air intake, often through changing pulleys on fans
- installing variable air-volume (VAV) controls
- installing heat exchangers
- reducing air leakage and infiltration
- using efficient, properly sized chillers, compressors, pumps, and motors
- properly maintaining air handling units and mechanical equipment.

These measures could be delivered using rebates, training, audits, and information dissemination. Trade allies, such as air conditioning equipment vendors and architects, could receive training and rebates for promoting high-efficiency and properly sized VAC equipment. Information, audits, rebates, or direct installation could be provided to the consumers directly. Information and audit programs would be particularly important for no cost/low cost measures such as increased set point temperatures.

Program Impacts

The cost-effective savings attributable to these measures range from 1 to 13% of total building consumption. As discussed in Annex B, the average savings per participant are assumed to be 17% of VAC consumption. By the end of the program, consumers representing 9% of sales are assumed to participate, so total annual savings in the last year of the program represent 1.5% of total VAC consumption. These impacts are summarized in Exhibit 4-4.

Program Budget

Program overheads are assumed to amount to $200,000 over the life of the program. In the industrial sector, 0.4% of the consumers account for 33% of consumption. It is assumed that in the commercial sector, 0.2% of the consumers (1,000 customers) represent 9% of consumption. If total marketing, rebate and audit costs amount to $5,000 per participant on average, the cost of the program to the sponsoring utility or agency will be $5.2 million.

4.2.2 Lighting Efficiency Programs

As with industrial lighting, savings of up to 75% are possible for individual installations, and high participation rates make commercial lighting programs attractive.

Exhibit 4-4
Commercial VAC Programs
Energy and Demand Impacts by Year

	2000	2003
Net Energy Saved (GWh)	16.1	42.9
% of Sectoral Consumption	0.3%	0.9%
Peak Reduction (MW)	1.9	5.1
% of Sectoral Demand	0.3%	0.8%

Program Design

The following measures are commonly used in commercial lighting programs:

- replacing incandescent bulbs with compact fluorescent lamps (CFLs)
- replacing standard fluorescent tube lamps with energy-saving fluorescent tube lamps
- replacing standard fluorescent ballasts with high-efficiency magnetic or electronic ballasts
- installing optical reflectors and removing lamps that are no longer required
- installing occupancy sensors, timers, and daylighting controls.

Low-pressure sodium lighting was included among the industrial lighting measures, but is not included here because of unsuitable color rendition and lower incidence of use in the commercial sector. Future data collection may reveal that in fact there is significant scope for this measure or for high-pressure sodium lamps, which offer better color rendition.

Program Impacts

Exhibit 4-5 shows the expected energy and demand impacts of a commercial lighting program based on the analysis in Annex B. The average economic savings potential is estimated at 40% per customer, and customers representing 10% of commercial lighting consumption are assumed to participate by the end of the program.

Program Budget

These impacts imply that approximately 325,000 m^2 of floor space is covered during the first three years of the program, and 540,000 m^2 during the last three years. Assuming a cost to the sponsoring utility or agency of $5/$m^2$, the total program budget becomes $4.5 million (including $200,000 for marketing and administration).

Exhibit 4-5
Commercial Lighting Programs
Energy and Demand Impacts by Year

	2000	2003
Net Energy Saved (GWh)	14.3	33.6
% of Sectoral Consumption	0.3%	0.7%
Peak Reduction (MW)	2.6	6.2
% of Sectoral Demand	0.4%	0.9%

4.2.3 Other Potential Commercial Programs

Although the two programs proposed above will incorporate many of the cost-effective DSM measures relevant to the commercial sector, other measures such as building design and thermal storage remain. There are insufficient data at the present time to determine whether separate programs for these measures would be worthwhile in the Philippines, but they are discussed briefly below to provide an overview of their possible design and benefits. Future data collection efforts can help collect the necessary data.

New Construction

Because of the growth in the building stock, new construction programs offer large, immediate, and lasting DSM opportunities. The greatest efficiency gains can be had at least cost when measures are incorporated into building designs before the onset of construction. New commercial construction is a major source of load growth throughout the dynamic economies of Southeast Asia, and offers a one-time opportunity to achieve considerable savings with high persistence. DSM programs that target the efficiency of new construction are critical if these opportunities are not to be lost.

DSM new construction programs in the United States are typically programs that encourage trade allies such as builders to exceed mandatory building energy performance standards for new construction. The Philippines has already adopted a set of building energy standards that can serve as a basis for such a program. In addition to the VAC and lighting measures discussed above, builders can make use of passive solar designs, daylighting, better construction materials, etc. to reach incentive levels of performance. Therefore, the program can take advantage of savings opportunities not targeted by other programs.

Architects or builders would file their mandatory building file compliance plans along with the agency or utility sponsoring the program. This utility or agency would then apply pre-determined methods to assess the degree to which the plans exceed the mandatory efficiency levels, and would pay incentives on that basis (perhaps after inspection of the structures as built). Incentives for exceeding those standards would be set according to the value of energy conservation impacts over and above those corresponding to code compliance.

Thermal Storage

Thermal storage in the Philippines would be limited to cooling storage, which involves producing chilled water or ice during off-peak periods, and then using this stored water or ice to help meet building cooling requirements during peak periods. This is a load management measure that allows the primary cooling system to be turned off or reduced during peak periods.

For existing buildings, the potential for thermal storage will depend in part on the cost of retrofitting these systems, and whether or not there is even sufficient space at sites for these systems. Thermal storage is typically easier to implement and more cost-effective when incorporated in new building designs. This measure requires further engineering pre-feasibility studies, including building surveys.

4.3 RESIDENTIAL PROGRAMS

The residential sector accounts for 30% of total electricity consumption, but 37% of system peak demand. Lighting accounts for 28% of total residential sales, refrigeration 27%, ironing 12%, and other miscellaneous end-uses the remaining third. None of these miscellaneous end-uses account for more than 10% of total residential consumption.

4.3.1 Refrigerator Efficiency Programs

Residential refrigerators account for 8% of total electricity consumption and 7.5% of peak system demand. Refrigerator efficiency improvements therefore offer both energy and capacity saving benefits.

Program Design

Studies conducted by the Lawrence Berkeley Laboratory[1] identify three strategies for improving household appliance efficiency:

- *The Downstream Approach.* This approach provides better information to consumers regarding appliance efficiency and relative economic benefits. Many countries have found that the most effective means of providing this information is to test appliances and label each with a measure of the absolute cost of energy expected for the appliance as well as its rating relative to other appliances in the same category. Appliance labelling programs are now being prepared in the Philippines.

- *The Midstream Approach.* This approach is used in many DSM programs in the United States. It encourages the sale of high-efficiency appliances through rebates offered to vendors and/or consumers for those appliances.

- *The Upstream Approach.* This approach entails the government or utility working directly with manufacturers and importers to ensure that appliances offered for sale meet at least minimum efficiency standards.

Following this taxonomy of program types, the program would entail three components to encourage the use of the more-efficient domestic refrigerators:

- testing and labelling of all refrigerators to be sold, so consumers would be aware of the energy costs associated with that particular model, both in absolute terms and relative to other models in that class

- rebates to trade allies (e.g., appliance retailers) to help encourage the sale of these improved models

- incentives to manufacturers and assemblers in the Philippines to incorporate more-efficient designs in their production.

Program Impacts

Based on the assumptions described in Annex B, the estimated energy and demand impacts of a refrigeration program are shown in Exhibit 4-6. These impacts imply that approximately 1.9

[1] Schipper, L., A. Meier, and S. Meyers. "Household Electricity Use in ASEAN Countries: The Upstream Strategy for Greater Efficiency." Paper presented at the FINESSE Workshop, Kuala Lumpur, Malaysia, October 1991.

million high-efficiency refrigerators are disseminated over the six years of the program. It is assumed that 800,000 are distributed during the first three years of the program and 1.1 million during the last three years.

Exhibit 4-6
Residential Refrigerator Programs
Energy and Demand Impacts by Year

	2000	2003
Net Energy Saved (GWh)	150.4	357.1
% of Sectoral Consumption	2.5%	6.0%
Peak Reduction (MW)	19.6	46.6
% of Sectoral Demand	1.9%	4.5%

Program Budget

It is assumed that the sponsoring utility or agency pays half of the incremental cost of high-efficiency refrigerators to either manufacturers or consumers. This comes to $57 million, with another $0.5 million allocated for labelling and other administrative costs.

4.3.2 High-Efficiency Lighting Programs

Residential lighting accounts for 8% of total energy consumption and 17% of system peak demand in the Philippines. Because of the disproportionate contribution of residential lighting to peak system demand, lighting efficiency measures can yield substantial peak clipping benefits.

Incandescent lighting accounts for approximately 53% of residential lighting demand. As pointed out in Annex B, incandescent lighting presents the most promising opportunity for residential lighting efficiency improvements. In particular, the use of compact fluorescent lamps (CFLs) in place of standard incandescent bulbs can save up to 75% of the energy that would have otherwise been consumed by those bulbs.

Programs can also be designed to improve lighting efficiency for fluorescent tube lighting. For example, the Electricity Generating Authority of Thailand worked with fluorescent lamp manufacturers to have them voluntarily phase out 40 W tube sales and instead produce only 36 W lamps. Market research conducted during the early stages of the DSM development process can help determine whether similar programs may be appropriate in the Philippines. For the purposes of this illustrative analysis of potential programs, only CFL measures are considered for residential lighting.

Certain technical issues regarding CFLs must be addressed before embarking on a large scale program. First, electronically ballasted CFLs can introduce substantial harmonic distortion into a power system. If substantial CFL penetration were to occur in areas where lighting is the significant peak energy demand (e.g., rural areas), transformer overloading could occur if the harmonic distortion becomes great enough. To prevent this, a harmonic distortion testing procedure and standard can be introduced. Some utilities in the United States are already doing so. Only CFLs that meet these standards should be promoted.

A second issue is the potential power factor effect of CFLs. In particular, magnetically ballasted CFLs (which are usually cheaper) may be characterized by poor power factors. As with the issue of harmonic distortion, this issue can be addressed by adopting a testing procedure and acceptable standard of performance for which CFLs must be certified.

A third issue is the effect of voltage fluctuations on CFL lifetime. In a small-scale pilot program in Jakarta, Indonesia, approximately 20% of CFLs installed in households burned out within the first few months of installation. This may have been caused by an inability to handle the voltage fluctuations. Again, a solution would be to determine the range of voltage fluctuations experienced in different parts of the Philippines power systems and adopt a testing procedure and performance standard for CFLs to help ensure suitable performance. Early failure can jeopardize the prospects for CFLs since the public will come to see them as an inferior technology.

Program Design

This program could rely on three delivery mechanisms:

- The direct installation of CFLs to replace incandescent bulbs in households. Installation would be paid for by the utility or other sponsoring agency, and would be conducted by either that agency or a subcontractor. It is assumed that the program pays part of the cost of the lamp and that the rest is recovered through the customers' bills. Although this aggressive delivery mechanism will likely yield the highest participation, it is the most costly approach.

- Rebates for the purchase of CFLs, either directly from the sponsoring agency or from regular lighting vendors. Although potentially cheaper than direct installation, this program allows more possibilities for fraud or improper installation.

- Information-only programs that explain the benefits of CFL use to consumers, who then purchase CFLs without further incentives.

Potential Impacts

Even using conservative assumptions, the potential impacts of a residential lighting program could be significant. Impacts are given in Exhibit 4-7. These impacts correspond to the installation of 600,000 CFLs over the first three years of the program by all of the delivery mechanisms described above, and 1,200,000 over the last three years.

Program Budget

Assuming training and design costs of $200,000, a labor and administration cost of $3 per installation for direct installation lamps, plus a rebate or subsidy of $3 for each lamp delivered through both direct installation and rebates, the total cost of the program over its six-year life is $7.4 million.

Exhibit 4-7
Residential Lighting Programs
Energy and Demand Impacts by Year

	2000	2003
Net Energy Saved (GWh)	65.6	196.8
% of Sectoral Consumption	1.1%	3.3%
Peak Reduction (MW)	18.0	54.0
% of Sectoral Demand	1.7%	5.2%

4.3.3 Other Residential Programs

Improved Air Conditioners

Air conditioners represent about 4% of total household electricity consumption in the Philippines. As with refrigerators, air conditioner ownership is increasing rapidly. Also like refrigerators, these appliances offer opportunities for significant efficiency improvements.

The World Bank's ESMAP report estimates that comparable air conditioners manufactured in the United States could reduce electricity consumption by 15-35% over standard window air conditioners manufactured in the Philippines. Programs similar to those described above for refrigerators could also be applied to air conditioners.

New Construction

Residential new construction programs can be designed that are similar to the program described for the commercial and public sectors. Such programs could focus on multi-family dwellings or could encompass single-family housing as well. However, even rudimentary proposals for a residential new construction program require additional information on the current and forecast housing stock, and the level of energy efficiency that will be required by building codes.

Appliance Labelling

An appliance labelling program is already being prepared for the Philippines. By providing consumers with more information on the energy consumption and resulting life-cycle costs of various appliances (including air conditioners and refrigerators), it is expected that they will make purchasing decisions that will encourage them to select the most-efficient units. This program would complement the other programs described here.

4.4 SUMMARY OF PROGRAM COSTS, BENEFITS, AND BUDGETS

Exhibit 4-8 summarizes the energy and peak demand savings, budget costs (the amounts that the sponsoring agency would spend for the program), and economic costs of each program. Budget costs and energy and capacity savings are taken from the preceding sections of this chapter, while economic costs are taken from Annex B. The economic costs include administrative overhead costs. Exhibit 4-9 shows the impact of these DSM programs on the average daily consumption load shape forecast for the year 2003. Exhibit 4-10 presents the cost/benefit analysis for the menu of programs described in this chapter.

Exhibit 4-8
Summary of Program Costs and Impacts

Program	Energy Savings, GWh	Peak Demand Savings, MW	Budget Cost	Economic Cost
Industrial TOU Tariffs	81.8	74.5	$5.5 million	$14.5 million
Industrial I&C Tariffs	218.1	198.6	$1.9 million	$5.1 million
Industrial Motors & Drives	52.5	6.0	$2.1 million	$4.5 million
Commercial VAC	42.9	5.1	$5.2 million	$10.2 million
Commercial Lighting	33.6	6.2	$4.5 million	$13.2 million
Residential Refrigerators	357.1	46.6	$57.5 million	$114.5 million
Residential Lighting	196.8	54.0	$7.4 million	$27.2 million
TOTAL	982.7	391.0	$84.1 million	$189.2 million

Note: Annual energy and peak demand savings are reported for 2003 (the last year of the program), and are measured at the point of consumption.

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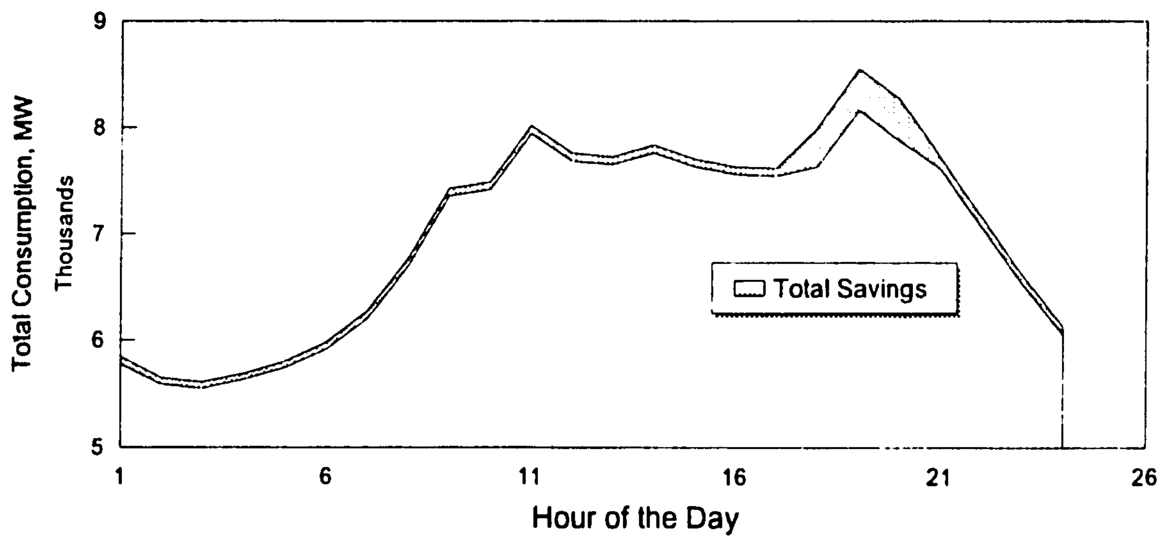
Exhibit 4-9
DSM Impacts in 2003



The budget for the sponsoring utility or agency amounts to $84.1 million for the first six years of full-scale implementation. The difference between this value and the economic cost of the programs is in effect the cost to participants.

Although the impacts of the industrial tariff programs are large, they have been very conservatively estimated based on experience in the United States. However, the rapid growth of industrial demand and the familiarity of industrial enterprises with standby generation suggest that impacts from these programs could be much larger in the Philippines. For example, an additional I&C program could be targetted towards smaller consumers, with interruptible loads on the order of 100 to 500 kW. Several hundred participants from this category (out of 24,000 current industrial customers) could easily double I&C benefits. Similarly, it should be possible to develop TOU pricing strategies that encourage far greater load shifting than the 83 kW currently estimated for each participant, or to expand the program (perhaps on a mandatory basis) well beyond the 900 participants currently envisioned. In this sense, then, the impacts of the rate programs have been more conservatively assessed than the impacts of other programs.

Because of the coincidence with system peak load, it is not surprizing that the rate programs and residential lighting efficiency improvements yield the largest demand savings.

Exhibit 4-10: Economic Analysis of Potential DSM Programs for the Philippines

Activity/Program	1995	1996	1997	1998	1999	2000	2001	2002	2003
Phase I:	1,000,000	1,000,000							
Phase 2: Pilot Programs	1,783,333	3,566,667	3,566,667	1,783,333					
Industrial TOU Tariffs									
Cost:				1,700,000	1,600,000	1,600,000	3,200,000	3,200,000	3,200,000
Benefits:									
MW Saved				8.3	16.6	24.8	41.4	57.9	74.5
GWh Saved				9.1	18.2	27.3	45.4	63.6	81.8
Industrial I&C Tariffs									
Cost:				655,556	555,556	555,556	1,111,111	1,111,111	1,111,111
Benefits:									
MW Saved				22.1	44.1	66.2	110.3	154.5	198.6
GWh Saved				24.2	48.5	72.7	121.2	169.6	218.1
Industrial Motors & Drives									
Cost:				588,889	488,889	488,889	977,778	977,778	977,778
Benefits:									
MW Saved				0.7	1.3	2.0	3.3	4.7	6.0
GWh Saved				5.8	11.7	17.5	29.2	40.8	52.5
Commercial VAC									
Cost:				1,222,222	1,122,222	1,122,222	2,244,444	2,244,444	2,244,444
Benefits:									
MW Saved				0.6	1.1	1.7	2.8	4.0	5.1
GWh Saved				4.8	9.5	14.3	23.8	33.4	42.9
Commercial Lighting									
Cost:				1,737,500	1,637,500	1,637,500	2,729,167	2,729,167	2,729,167
Benefits:									
MW Saved				0.8	1.6	2.3	3.6	4.9	6.2
GWh Saved				4.2	8.4	12.6	19.6	26.6	33.6
Residential Refrigerators									
Cost:				16,156,140	16,056,140	16,056,140	22,077,193	22,077,193	22,077,193
Benefits:									
MW Saved				6.5	13.1	19.6	28.6	37.6	46.6
GWh Saved				50.1	100.2	150.4	219.3	288.2	357.1
Residential Lighting									
Cost:				3,111,111	3,011,111	3,011,111	6,022,222	6,022,222	6,022,222
Benefits:									
MW Saved				6.0	12.0	18.0	30.0	42.0	54.0
GWh Saved				21.9	43.7	65.6	109.3	153.1	196.8
Total Cost	2,783,333	4,566,667	3,566,667	26,954,751	24,471,418	24,471,418	38,361,915	38,361,915	38,361,915
Value of Total MW Saved				13,599,480	27,198,959	40,798,439	66,238,811	91,679,184	117,119,556
Value of Total GWh Saved				5,044,544	10,089,088	15,133,632	23,848,288	32,562,944	41,277,600
Net Annual Savings/(Cost)	(2,783,333)	(4,566,667)	(3,566,667)	(8,310,728)	12,816,629	31,460,652	51,725,184	85,880,212	120,035,241

Assumptions	
Cost of Energy, $/kWh	0.042
Cost of Gen. & Trans. Capacity, $/kW	257
Cost of Distr. Capacity, $/kW	147
Real Discount Rate	10%

Results	
Economic Real Internal Rate of Return	75.2%
Economic Net Present Value	128,570,010

Refrigerator programs, on the other hand, offer disproportionately large savings for both demand and energy. This points to the power of market transformation as a means of efficiency improvement, particularly in an economy with rapidly growing stocks of capital equipment. Most residential appliances are amenable to market transformation efforts, as are industrial motors. This should be one of the key approaches integrated in future DSM activities in the Philippines.

The savings estimated for these programs by the end of 2003 amount to 4.6% of average daily peak demand and 1.6% of total annual consumption forecast for that year.[2] This is an aggressive target when compared to the experience in the United States. In 1990 (about a decade after the introduction of DSM), DSM programs in the United States reduced demand by 4.9%.[3] In the more progressive U.S. utilities such as the Sacramento Municipal Utility District and the City of Austin (Texas) Municipal Utility, demand savings have reached 10-12% of peak demand. However, these programs rely to a large extent on residential direct load control for their savings, an option that would have very limited impact in the Philippines. Moreover, if the load growth forecast for the Philippines were equal to the 2.6% load growth experienced in the United States during the 1980s, DSM demand savings in the Philippines would represent 10.6% of average daily peak demand in 2003.

Although DSM programs must be developed in response to local conditions, the experience in the United States and elsewhere holds lessons that can accelerate the pace of DSM implementation in the Philippines. Although the scenario spelled out above is aggressive, it is not unrealistic. Moreover, since these programs represent the first tranche of full-scale DSM activities in the Philippines, savings can be expected to increase rapidly in subsequent programs that will benefit from the experience of these early programs. Early DSM programs that are characterized by high customer satisfaction will accelerate participation as the vast majority of consumers who are initially reluctant to participate become more comfortable with these programs, and utilities come to see DSM as a form of customer service. Peak demand savings of 10% would be possible by 2010.

These programs are economically justified, yielding a real economic internal rate of return (IRR) of 75.2% and a net present value of $129 million. In fact, this is a lower bound on the IRR because the benefits of a program are counted only over its life, even though the measures will yield benefits long past this period. The cost of the first two phases of DSM development has been included in the cost of the programs. These costs are based on the

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[2] Future demand and consumption were projected using NAPOCOR's projection of average annual sales growth of 10.77% over the period 1992-2005, as reported in the 1992 Power Development Program. The bases for these projections were the 1992 average daily peak demand and annual sales measured at the point of consumption, as reported in Annex A.

[3] Hirst, E., *Electric Utility DSM Programs: 1990 Data and Forecasts to 2000*, ORNL/CON-347, Oak Ridge, Tennessee: Oak Ridge National Laboratory, 1992.

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analysis presented in the next chapter. In addition, first-year program costs are $100,000 higher than in the subequent year to cover program design. The remaining economic costs have been distributed over the life of the program corresponding to the realization of program benefits.

Chapter 5
The Foundation for DSM Implementation

A comprehensive, three-phase, nine-year DSM program is proposed for the Philippines. Exhibit 5-1 presents an overall timeline and budget for all three phases. Details on the activities of each phase are presented in this chapter.

The first phase of the program, institutional development and program design, entails the creation of an appropriate institutional framework for DSM implementation, the collection of necessary data, and the design of specific DSM pilot programs. The second phase entails pilot program implementation to reduce the risks associated with the full-scale implementation of proposed programs, facilitate program improvements before full-scale implementation, and demonstrate the effectiveness of proposed programs. The third phase entails the full-scale implementation and evaluation of DSM programs, building upon the experience gained through the pilot programs. The scope, costs, and benefits of DSM program components are summarized for each phase.

5.1 Phase I: Institutional Development and Program Design

The initial work needed to introduce DSM in the Philippines will be accomplished over the course of approximately two years and will provide a roadmap for pilot program and full-scale DSM implementation. The initial work will include both institutional development and program design components.

5.1.1 The Current Institutional Setting

The regulation and operation of the power sector in the Philippines is characterized by a number of well-defined and relatively mature government institutions and private organizations. And yet, 1994 is a year of change because important initiatives have been proposed that would radically alter the make-up of power sector entities and the conduct of business between them. These changes may have significant implications for the consideration and implementation of DSM as a power sector resource. This section presents a brief review of the *status quo* of the roles and responsibilities of relevant power sector entities, followed by a discussion of current initiatives that may change the *status quo*. In both cases, the focus is on the relevance to the implementation of DSM.

Exhibit 5-1
Timetable for DSM Activities

Activity	Budget	1995	1996	1997	1998	1999	2000	2001	2002	2003
Phase I: Inst. Development & Program Design	$2 million									
Phase II: Pilot Programs	$10.7 million									
Phase III: Full-Scale Implementation	$84.1 million									

The Philippines Power Sector Today

The federal ***Department of Energy (DOE)*** is the lead agency in setting energy policy and coordinating energy efficiency activities in the Philippines. DOE was created through Republic Act No. 7638 of 1992, "An Act Creating the Department of Energy..." in which the following *Declaration of Policy* was stated in Section 2:

> It is hereby declared the policy of the State:
>
> (a) to ensure a continuous, adequate, and economic supply of energy with the end in view of ultimately achieving self-reliance in the country's energy requirements through the integrated and intensive exploration, production, management, and development of the country's indigenous energy resources, and through the judicious conservation, renewal, and efficient utilization of energy to keep pace with the country's growth and economic development and taking into consideration the active participation of the private sector in the various areas of energy resource development; and
>
> (b) to rationalize, integrate, and coordinate the various programs of the Government towards self-sufficiency and enhanced productivity in power and energy without sacrificing ecological concerns.

Section 4 of the Act gives the mandate to carry out the above policy to DOE, "which shall prepare, integrate, coordinate, supervise, and control all plans, programs, projects, and activities of the Government relative to energy exploration, development, utilization, distribution, and conservation."

Section 5 of the Act goes on to state DOE's *Powers and Functions* relevant to DSM:

> The Department shall have the following powers and functions:
>
> (a) Formulate policies for the planning and implementation of a comprehensive program for the efficient supply and economical use of energy consistent with the approved national economic plan and with the policies on environmental protection and conservation and maintenance of ecological balance, and provide a mechanism for the integration, rationalization, and coordination of the various energy programs of the Government; and
>
> (g) Formulate and implement programs, including a system of providing incentives and penalties, for the judicious and efficient use of energy in all energy-consuming sectors of the economy.

Through these and other authorities provided in the Act, DOE conducts the following activities relevant to DSM:

- Administers a number of ***energy efficiency programs***, as described in Section 1.3 of this report.

- Develops and annually updates the ***Philippines Energy Plan***. In the 1993 Plan, DSM programs were identified as a means of accomplishing the following policy strategies: 1) intensify the promotion of energy conservation and energy-efficient technologies, 2) restructure tariffs to encourage efficient electricity use, and 3) integrate environmental concerns in the planning and implementation of energy projects.

- Provides leadership for the ***Energy Sector Action Plan (ESAP)*** process that was established in 1992, under the direction of the Energy Coordinating Council, to install policy reforms in the energy sector that would enable the Government to achieve its medium-term economic and social development objectives. Relevant to DSM, the current ESAP mentions the following actions that are being pursued: 1) restructuring of power rates to reflect as closely as possible the actual costs of generation and distribution, including distribution tariffs that should provide proper signals to users to encourage electricity use during off-peak hours, 2) formulation of energy efficiency standards for power-intensive appliances such as lighting, refrigeration, air-conditioning and other electrical uses, and 3) introduction of a bill before Congress to institutionalize energy conservation and enhance the efficient use of energy (see below).

- Recently created a ***DSM Working Group*** that meets periodically to share information on DSM programs and activities. Chaired by DOE's Undersecretary for Power, the group originally met in November 1993 and was composed of representatives of Philippine government and utility organizations directly responsible for DSM implementation. However, after meeting approximately monthly during 1994, the group appears to be slowly expanding to include other relevant organizations. As such, the DSM Working Group could be considered the beginning of a collaborative process for the design and implementation of DSM programs (see the next section).

The federal ***Energy Regulatory Board (ERB)*** is a quasi-independent regulatory agency that obtained its original authority through Executive Order No. 172 of 1986. The DOE Act of 1992 clarified ERB's authority to apply exclusively to the regulation of energy tariffs and prices, including those of private, investor-owned utilities, as well as the publicly-owned National Power Corporation and electric cooperatives. After the issuance of Executive Order No. 215 of 1987, which allowed for the development of private power generation facilities, ERB's jurisdiction has also included the regulation of power purchase agreements from private producers.

ERB operates through an evidentiary process of proceedings and rule-makings, focused exclusively on rate-making issues. Thus, this regulator is not in a position to initiate major reforms relevant to DSM, but can react to petitions from utilities under its jurisdiction for that purpose. In anticipation of that role, ERB has been considering how it might facilitate a collaborative process for the development and approval of utility DSM programs, with assistance from the World Bank (see Section 1.3 of this report). ERB believes that such a collaborative process, involving the participation of DOE, consumer and environmental advocates, and other interested parties, could mitigate opposition to DSM programs, especially regarding the potential rate impacts of DSM.

The ***National Power Corporation (NAPOCOR)*** is a government-owned and controlled corporation that was given its contemporary authority under Presidential Decree No. 40 of 1972 to build and operate electric generating plants and transmission facilities. While Executive Order No. 215 of 1987 opened up generation to private producers, NAPOCOR still retains the responsibility to plan for the strategic and rational development of the country's power system.

Relevant to DSM, NAPOCOR is carrying out the following activities:

- Develops and updates annually the ***Power Development Program (PDP)***. The PDP presents the results of NAPOCOR's 15-year load forecasting and supply planning analyses for each of its major grids (Luzon, Visayas, and Mindanao). The PDP serves as the basis for NAPOCOR's power system investment program including generation, transmission, and grid intertie facilities. Currently, the Asian Development Bank's Long-Term Power System Planning Study (see Section 1.3 of this report) has the goal of introducing modern load forecasting and integrated resource planning (IRP) techniques at NAPOCOR. This project could lay the foundation for NAPOCOR to adopt end-use load forecasting methods and resource planning techniques that consider cost-effective DSM resources.

- 'Initiates ***tariff reform petitions*** for consideration by ERB. NAPOCOR has previously undertaken cost-of-service and long-run marginal cost (LRMC) studies (the latest one was in 1990). As a result, NAPOCOR currently has a major tariff reform petition pending at ERB, which would implement some LRMC concepts for its wholesale tariffs. For example, NAPOCOR seeks to substantially strengthen its demand charge (while revenue-neutral to NAPOCOR, the new demand charge would account for 30% of NAPOCOR's revenues as compared to 2% under the current demand charge).

- Re-instating ***minimum level contracts*** by July 1994 with all NAPOCOR customers (such tariffs were suspended in 1986). These contracts will establish a take-or-pay minimum level for demand and energy, based on negotiations that take historical consumption into account. The tariff also provides for an allowance (50% of base energy consumption for non-utility customers and 20% for utility customers) above which customers pay a significant penalty (three times the wholesale rate). The contract minimum level is subject to annual renegotiation.

The ***distribution companies*** in the Philippines are both publicly and privately owned. By far, the largest of these is MERALCO, an investor-owned utility which serves 78% of the highly urbanized load on Luzon (61% of the entire country's load). There are 15 other private distribution companies, as well as 120 small public electric cooperatives and 11 municipal utilities. Most of the smaller private distribution companies belong to PEPOA (the Philippines Electric Plant Owners Association), a professional and trade group.

It is generally recognized that the distribution companies will be the focus of DSM program design and implementation, which is logical given their role in the partially-disaggregated system of the Philippines of selling power to most retail customers (except for roughly 180 customers that NAPOCOR sells to directly). Indeed, the ERB is basically waiting for a petition from a distribution company to initiate the consideration of DSM program issues, such as cost-recovery in rates. In anticipation of this role, the distribution companies are gearing up to initiate DSM pilot projects. MERALCO has circulated draft terms of reference for this purpose, but has yet to secure a source of funding. CEPALCO is initiating an investigation of industrial DSM potential with the assistance of the U.S. Trade and Development Agency (see Section 1.3 of this report).

Current Power Sector Initiatives

A number of developments have been proposed in the Philippines that could have a material influence on the roles and responsibilities of the power sector entities discussed above. The following initiatives are particularly relevant to the implementation of DSM programs:

A bill was introduced before the 1993 Congress ***"To Institutionalize Energy Conservation and Enhance Efficient Use of Energy"*** (Senate Bill No 447 and House Bill No. 5734). This proposed law would provide sweeping authorities under the *Policy Declaration* that "It is hereby declared the policy of the State to institutionalize energy conservation and enhance the efficient use of energy in order to ensure availability of energy supplies required to support the country's economic and social goals." Specifically relevant to DSM (and ignoring authorities that already exist under the DOE Act of 1992), the bill would:

- empower DOE to conduct energy audits in the industrial and commercial sectors, set consumption standards for electric machinery and equipment, require large commercial and industrial establishments to submit annual electric consumption and production statistics (previous authority for DOE to collect these data expired in 1990), set energy use standards for large commercial and industrial facilities and require them to employ energy managers, and regulate the use of air conditioners

- require comprehensive labelling of electric appliances to show their energy requirements and consumption efficiency

- introduce energy conservation curricula into the educational system

- direct government-owned and controlled financial institutions (e.g., the Development Bank of the Philippines) to set aside funds for concessional lending for energy conservation projects

- require all federal government agencies to adopt energy conservation measures in their own operations.

A new version of the bill has been reintroduced before the 1994 Congress which contains three new significant provisions relevant to DSM:

- DOE's responsibility to plan, develop, and implement overall national energy conservation programs and activities would be done "with emphasis on Integrated Resource Planning (IRP) ..."

- DOE would have the authority to require electric generation and distribution companies to implement DSM programs by providing rebates, extending loans, providing technical assistance, introducing time-of-use rates, and disseminating information.

- Energy management systems, variable air volume systems, adjustable speed drives, and energy-efficient motors would be exempt for five years from all duties and taxes for imported equipment not available domestically, or would receive a 100% tax credit for equipment manufactured domestically.

DOE has drafted a Department Order on ***"Instituting Integrated Resource Planning Including Demand-Side Management by Electric Utilities."*** DOE has taken this step based on the belief that it has existing legal authority under the DOE Act of 1992 to order DSM activities. A initial draft order was issued for review and comment in April 1994, and a final order is pending as of this writing. Citing the authorities in the DOE Act, the current draft (Draft #3, June 1994) provides the following directives:

- all electric utilities would conduct integrated resource planning and submit biennial IRPs to DOE (NAPOCOR and the electric cooperatives) and ERB (the private distribution companies)

- NAPOCOR would be authorized to implement its IRP through power purchases, by funding DSM, and by assisting the development of energy efficiency standards

- the distribution companies would be authorized to invest in DSM

- ERB would consider rate adjustment mechanisms that would allow NAPOCOR and the distribution companies to recover DSM costs in rates, including revenue losses, to make "DSM expenditures and investments at least as profitable as supply-side expenditures and investments"

- ERB would be authorized to impose rate surcharges on any distribution company that fails to implement DSM according to its IRP

- ERB would implement a number of ratemaking standards including tariffs by customer class based on marginal cost of service, time-of-use rates by day and season, interruptible rates, and a prohibition on the use of declining block rates

- DOE would develop procedures for broad public participation in the IRP process.

Efforts to ***restructure the power sector and to privatize NAPOCOR*** have gained momentum. The original impetus for this development is found in Section 5 of the DOE Act of 1992, which states that DOE shall:

> (b) ... include a policy direction towards the privatization of government agencies related to energy, deregulation of the power and energy industry, and reduction of dependency on oil-fired plants;
>
> (c) ... endeavor to provide for an environment conducive to free and active private sector participation and investment in all energy activities;
>
> ... institute the programs and timetable of deregulation of appropriate energy projects and activities of the energy industry; and
>
> (j) Encourage private enterprises engaged in energy projects, including corporations, cooperatives, and similar collective organizations, to broaden the base of their ownership and thereby encourage the widest public ownership of energy-oriented corporations.

These provisions have been interpreted to apply to the privatization of NAPOCOR, as called for in the Energy Sector Action Plan (ESAP) as one of its key policy initiatives. A preliminary study of privatization options was completed in November 1992, and a DOE-led Power Sector Restructuring Group was established. A final power sector restructuring and NAPOCOR privatization plan was recently completed by RCG/Hagler Bailly under the same USAID-sponsored technical assistance project through which this *DSM Action Plan* was developed.

The reader is referred to the final report, *Restructuring and Privatization of the Electricity Industry in the Philippines* (August 1994) by Hagler Bailly for DOE and USAID, for a complete description of the recommended approach to NAPOCOR's privatization. The key provisions of the recommended approach, as they affect the implementation of DSM, are described below.

After a number of different options were considered, an approach for restructuring the Philippines power sector and privatizing NAPOCOR was recommended. It is called the "Unbundled Function/Decentralized Planning/Inter-Utility Operations Integration" approach. This approach introduces competition in both the purchasing and selling of electric resources, involves extensive unbundling of power system functions, and places power planning and procurement responsibilities largely on the distribution companies.

This last point is a key feature of the plan and most relevant to the implementation of DSM. The responsibility to plan and provide for power supplies would shift from NAPOCOR to the distribution utilities, which must prepare IRPs to identify the most cost-effective supply-side and DSM alternatives to meet customer requirements. Both DSM and power supplies would be contracted by the distribution companies based on all-source competitive bidding procedures. With the advent of all-source bidding, utility customers would be motivated to initiate DSM activities and/or contract with energy services companies (ESCOs) to develop and sell their DSM resources to the distribution company. Through this process, it is expected that both utility DSM and ESCOs delivering DSM resources to the utility will grow in importance as IRP principles demonstrate the validity of DSM in the resource acquisition process. These resource planning and acquisition activities of the distribution companies would be regulated by ERB.

Each distribution company's market-based IRPs would then be aggregated to the national level to ensure that planning results are consistent with inter-utility coordination agreements. This aggregation would be coordinated by PlanCo, a system planning subsidiary of TransCo, the successor to NAPOCOR PlanCo would evaluate the distribution company IRPs to assess the sufficiency of load forecasts, adequacy of reserve margins, impact on transmission requirements and constraints, optimality of siting decisions, and consistency with national policy objectives and directives. PlanCo would then integrate all the distribution company IRPs into a national power sector plan, under the oversight and approval of DOE. Note, however, that neither the process nor the results would bear any similarity to NAPOCOR's current Power Development Program (PDP) activities.

The proposed approach to power sector restructuring and NAPOCOR privatization would be implemented in a three-phase process. In the first phase (1994 to 1998), most of the resource planning and acquisition responsibilities would be quickly decentralized to the distribution companies. Substantial effort during this phase would be required to strengthen the capabilities of the distribution companies to perform this new function and to test it out through demonstrations and pilot projects. During the second (1998 to 1999), the results of these initial efforts would be evaluated and mid-course corrections made where necessary. In the third phase (1999 to 2004), the transition to a fully competitive electricity market (including competition between supply-side and DSM resources) would be complete, and IRP would be widely practiced and fully decentralized.

5.1.2 Institutional Development Activities

A vital component to realizing the potential benefits of DSM in the Philippines is the creation of a supportive institutional framework that allows government agencies, the utilities, and other public and private institutions to plan, implement, evaluate, and sustain DSM programs. The process of developing institutional mechanisms will further define DSM objectives, as well as the roles and responsibilities of relevant organizations. The tasks discussed below could be carried out as some of the first activities in implementing DSM in the Philippines:

Establish a Policy Framework

A clear statement of government policy is required to establish the legitimacy of DSM in power sector planning and resource acquisition activities. Such a policy statement is necessary to marshall the enthusiastic participation of relevant government agencies and to remove disincentives that utilities currently face when considering DSM implementation.

While the DOE Act certainly contains a number of supportive statements regarding the efficient utilization of energy, it provides no specific authority relevant to DSM programs. The new version of the proposed Energy Conservation Bill (S.B. 447/H.B. 5734) does contain specific authorities relevant to IRP and DSM, as noted above. Some observers in the Philippines have stated that the Energy Conservation Bill is the appropriate vehicle for establishing the necessary policy direction. However, it could require engaging a potentially long and possibly unsuccessful political process to gain passage of the bill.

Alternatively, a consensus was reached at the DSM/IRP Roundtable that DOE currently has the authority under the DOE Act to promulgate DSM policy. A clear opinion was expressed that the development of the draft Department Order on DSM represents the best near-term solution for establishing the necessary policy framework. Therefore, the Department Order could be finalized and officially issued as soon as possible.

The Department Order has been widely circulated in draft form for review and comment by many interested parties in the government and utility sectors. As a result of the review process, additional language may be proposed to clarify and strengthen the authorities provided. Toward that end, the following suggestions are offered on the Department Order that reflect some of the comments already made:

1. The introduction of IRP could be phased-in over two to four years, starting with NAPOCOR (building on the PDP process) and extending to the distribution companies, consistent with their new planning and resource acquisition role envisioned in the *Privatization Study*.

2. The IRP requirements and rate authorities should apply equally to NAPOCOR and the distribution companies, e.g., the surcharge for failing to implement DSM. It should be clear that the surcharge is non-recoverable in rates and would collect in a fund that would be used to provide positive incentives to utilities successfully implementing DSM.

3. ERB could be given general authority to implement various tariff reforms, without detailing specific proposals in the Department Order.

4. The mechanics for NAPOCOR and the distribution companies to submit IRPs and develop DSM programs should be clarified, e.g., to grant implicit approval for resources already committed and to provide for coordination between DOE and ERB.

In addition to promulgating the Department Order, DOE could undertake a number of other policy initiatives, consistent with existing authority under the DOE Act, to support the development of IRP and DSM. For example, DOE could:

- conduct a testing program for all household and office electrical appliances to determine their energy efficiency ratings

- determine appropriate minimum energy efficiency standards for all electrical appliances and equipment manufactured in or imported into the Philippines and coordinate with the Bureau of Product Standards to enforce the standards as mandatory

- coordinate all donor funds (loans and grants) to provide training, technical assistance, and commodities to government and utility organizations required to carry out the IRP and DSM activities under the Department Order.

The process of establishing a policy framework for DSM would be carried out by DOE, with advice from ERB, the utilities, and other interested parties. This activity could proceed as soon as possible in 1994 and would not require any additional financial resources beyond the direct costs to DOE and other participants in the normal course of their current work. The last point mentioned above (coordination of donor funds) is an especially critical task for DOE to carry out expeditiously, given the large amount of donor interest in DSM as described in Section 1.3, and given the ambitious program of DSM activities for DOE, ERB, NAPOCOR, and the distribution companies presented in this *DSM Action Plan*.

Initiate a DSM Collaborative Process

The concept of a DSM collaborative process was introduced in the Philippines by the World Bank's Alternative Energy Unit/Asia Technical Department (ASTAE) at its October 1993 Regulatory DSM Workshop and Open Forum held at ERB (see Section 1.3 for details). A collaborative process allows all relevant and interested parties to participate in an informal deliberation on DSM program design and implementation issues. Participants at the DSM/IRP Roundtable acknowledged that a collaborative process could possibly provide a constructive means to engage different views and to mitigate possible opposition to the presentation of DSM program proposals in regulatory proceedings. Such concern for the influence of intervenors in DSM proceedings before ERB could be warranted given the strong political opposition to energy rate increases by consumer groups in the Philippines.

As a result of its Regulatory DSM Workshop, the World Bank/ASTAE presented a *DSM Collaborative Action Plan* that proposes a number of activities to facilitate the development of a regulatory framework and design of DSM programs. For example, the DSM Collaborative would establish a "twinning" arrangement for the exchange of technical expertise between ERB and a North American regulatory commission which has had experience with DSM collaboratives (ERB would be an observer of the Collaborative, but would not be officially involved in its deliberations). The DSM Collaborative would also provide training on DSM to non-utility and non-governmental organizations involved in utility issues, and would assist all parties in the process to develop positions on regulatory issues and to design DSM programs. The consensus reached through the collaborative process would be presented in periodic reports to ERB, and then finally in a petition from the utilities to ERB for regulatory changes and DSM programs based on the reports. These petitions would initiate an ERB proceeding and rule-making, the results of which would clarify the operational status of DSM for the utilities

The World Bank/ASTAE also conducted a Utility DSM Workshop in June 1994 that provided DOE and utility participants with an opportunity to consider their respective roles in the proposed collaborative process. While the results were inconclusive, DOE's DSM Working Group was identified as a resource that could be expanded and mobilized to serve as the convener of the collaborative This activity could start before the end of 1994 if financial resources are secured from the World Bank/ASTAE to support the collaborative, and would extend over a 12- to 18-month period. The World Bank/ASTAE estimated that a budget of $275,000 would be necessary to support the activities of the DSM Collaborative. This amount would provide for the services of a technical assistance consultant ($225,000) in addition to a professional, independent local facilitator of the Collaborative ($50,000).

Introduce Integrated Resource Planning to the Distribution Companies

The recommended privatization scenario (see previous section) would transfer most responsibilities for utility planning to the distribution companies. This transition would occur as the distribution companies become directly responsible for the "obligation to connect and serve" in Phase I of the restructuring process. And yet, the distribution utilities have had little need in the past to conduct load forecasts (except MERALCO) and develop their own resource plans; this activity was always carried out by NAPOCOR. This status of centralized planning activities was confirmed during the DSM/IRP Roundtable, notwithstanding the impacts of Executive Order 215 in opening up electric generation to independent suppliers.

Therefore, an important task would be to provide the distribution companies with the training, models and organizational development support necessary to create their own IRP capabilities. The ADB's Long-Term Power System Planning Study is providing information and training on IRP methods to DOE, NAPOCOR, and MERALCO. It is also introducing a limited IRP methodology to NAPOCOR that would treat "pseudo DSM" resources as hydro plants in WASP, the model NAPOCOR has been using for supply expansion studies.[1] This project is a good first step for building IRP capabilities at NAPOCOR which could ultimately be transferred to the distribution companies. Such an approach may also be adequate for PlanCo's role of coordinating the aggregation of distribution company IRPs to the national level (see the previous section). However, the distribution companies will need more sophisticated IRP methodologies that allow the discrete comparison of specific DSM resources with specific competing supply-side resources (as discussed in Section 2.3 of this report). For example, such capability will be essential to evaluate proposed projects that distribution companies review in response to their all-source competitive bidding solicitations (see below).

The introduction of IRP capabilities may not be too difficult for MERALCO, which as a consequence of its size, has staff and modeling capabilities conducive to utility planning. However, the development of IRP capabilities at the smaller distribution companies could pose a significant challenge. Therefore, consideration could be given to establishing IRP capabilities at PEPOA, which could then provide planning services and conduct professional

[1] SRC International. *Long-Term Power Planning Study. Project Interim Report.* Melbourne, Australia, July 8, 1994.

development activities for its membership (this approach of using PEPOA to serve the needs of the smaller distribution companies is adopted for all the other institutional development and program design activities of this *DSM Action Plan*). The cost for this activity is estimated to be $200,000, based on the assumption that a state-of-the-art end-use load forecasting model (e.g., EPRI's HELM) and IRP model (e.g., EPRI's IRP-Manager) would be licensed (including intensive hands-on training and support) for $100,000 for use at MERALCO and PEPOA. The support would also include organizational development assistance to help the utilities to consider how to structure their operations to implement the IRP process. This activity could start in 1995 and proceed for a period of time consistent with Phase 1 of the restructuring and privatization plan.

Implement All-Source Competitive Bidding at the Distribution Companies

As discussed in Section 2.3, IRP entails not only integrated resource planning but also integrated resource acquisition. The process of all-source competitive bidding allows supply-side and DSM resources to compete not only in computer models, but more importantly, in the marketplace. The restructuring and privatization plan anticipates the introduction of all-source competitive bidding processes at the distribution companies as a means to acquire electric resources consistent with their IRPs.

Within the context of this scenario, all-source bidding could be implemented in the Philippines as follows:

- The distribution companies would solicit annual bids for power.

- Eligible bidders for supply-side resources would include generation companies, independent power producers, and large electric customers.

- Eligible bidders for DSM resources would be ESCOs and large electric customers.

- Bids would include the price offered for the electric resource, the amount of the resource, a deadline to deliver the resource to the distribution companies, and security for the timely and reliable delivery of the resource.

- The distribution companies would evaluate and rank-order the bids based on price and non-price factors as discussed in Section 2.3.

- The distribution companies would then contract for the highest-ranked electric resources and would pay the bid price for those resources over the year through power purchase agreements with the generation and independent power companies, and large electric customers, and other payments for DSM to the

ESCOs and large electric customers. These contracts could be either short-term (one year) or long-term (e.g., five to ten years) based on the distribution companies' assessment of resource needs.

The key attribute of this approach is that a market-based mechanism provides for the acquisition of electric resources to meet the distribution companies' requirements on an integrated resource planning basis.

Competitive bidding for electric resources is usually conducted in close coordination with the IRP process. For example, often a utility will first conduct an IRP analysis to produce a proxy set of anticipated resources that are used to initiate the bidding process. Then, IRP models are used to evaluate and rank-order bids when they are received. The bid results then provide market-based data for the next cycle of IRP analysis. Therefore, many of the skills in administering a bid solicitation are drawn from IRP activities. However, there are other important skills and functions that the distribution utilities will have to master to conduct a bidding program. For example, engineering analyses of project specifications will be required, financial analyses of project development plans will be undertaken, and contract negotiation and risk analysis skills will be essential.

Once again, staff with these skills may be more readily available at MERALCO than in the smaller distribution companies. As with the IRP requirements, PEPOA could play a similar role in providing bidding services and professional development opportunities to the smaller distribution companies that comprise its membership. This task is estimated to cost $150,000, assuming that three person-months (at $25,000 per month, including all travel and incidental expenses) of technical assistance would be provided to MERALCO and PEPOA for the design, implementation, and evaluation of the first all-source competitive bidding cycle at each utility. This activity could start in 1995 and proceed for a period of time consistent with Phase I of the restructuring and privatization plan.

Broker Energy Service Company Business Opportunities

A potentially serious limitation may be the lack of experience of Philippine businesses in providing the equipment and services called for under DSM programs. While there are a number of engineering and mechanical contractors and vendors of energy-efficient equipment in the Philippines, they may not be prepared to do business with utilities and their customers to implement DSM programs. Energy service companies (ESCOs), a well-established industry for implementing utility DSM programs in North America, are virtually non-existent in the Philippines (see Section 2.3 for a description of ESCO activities).

A critical program design component of this *DSM Action Plan* provides for the implementation of DSM programs by private sector contractors such as ESCOs. Therefore, a significant institutional development task would be for DOE to identify local businesses that could provide DSM technologies and services and establish a database of such firms. The database would also include international ESCOs that are active or have expressed an interest in doing business in the Asia Pacific region. DOE could then provide ESCO training and business development activities that will support the linking of the Philippine firms through joint ventures with international ESCOs, which can be sources of equipment, capital and know-how.

This approach to DSM program implementation will tap the entrepreneurial spirit that is found only in the private sector. It will also provide important business and economic development benefits to the Philippines. As the global economy becomes more competitive and interdependent, this approach will strengthen the capabilities of Philippine firms to thrive and contribute to the improvement of the energy sector. It is estimated that the development of DOE's ESCO database and business brokering service would cost $50,000 for database software, periodic surveys of ESCOs in the Philippines and abroad, and participation in international ESCO trade events. After the database and brokering service have been established, DOE could continue the activity as one of its energy efficiency programs.

Reform NAPOCOR Tariffs

The full range of electric utility rate-making in the Philippines is beyond the scope of this *DSM Action Plan*. Nonetheless, the level and configuration of NAPOCOR's and the distribution companies' tariffs have significant implications for determining the extent to which DSM can be considered a cost-effective electric resource. For example, an accurate estimation of utility avoided costs, based on long-run marginal cost principles, is essential to determine the economically efficient mix of resources needed in the future, including DSM. To the extent that subsidies exist in rates or cross-subsidization exists between rate classes, economically efficient resource decisions and investment allocations will be compromised.

Important changes are anticipated in rate-making in the Philippines with the introduction of the proposed approach to restructuring the power sector and privatizing NAPOCOR. Tariffs throughout the entire sector will evolve to become more market-based, and should naturally move to LRMC levels as a consequence of investment and operating cost recovery requirements for the least-cost resources selected through competitive processes. Nonetheless, NAPOCOR's tariffs will continue to play an important role during the transition period, especially to the extent that they are reflected in the distribution companies' retail tariffs.

Therefore, ERB could consider implementing tariff reforms and other initiatives that would be consistent with LRMC principles, would anticipate the transition to a competitive power sector market, and would support appropriate consideration of DSM's position in the resource mix. These reforms are:

- ***Extend LRMC Principles in NAPOCOR's Current Tariff Petition before ERB***. The current petition introduces a substantially strengthened demand charge, which is certainly a step in the right direction. However, this change is limited in scope and the impact of the demand charge could be increased. Additional reform could be accomplished through significant strengthening of time-of-use (TOU) rates that are differentiated by day and season. Differentials among peak, shoulder, and off-peak could be increased to approach the actual short-run marginal costs of providing power during those periods of the day and year. Such a development would give an appropriate price signal to the distribution utilities, which would then be motivated to introduce TOU and interruptible rates to their customers, such as those proposed for the industrial sector in Chapter 4 of this report. Such rates could also apply directly to NAPOCOR's non-utility customers. While the development of such rates would be revenue-neutral to NAPOCOR, there still could be political resistance because there would be winners and losers in the process.

- ***Modify the Contract Minimum Tariff*** (see the previous section). This tariff was reinstated for all of NAPOCOR'S customers in July 1994 after eight years of suspension. The current purpose of the tariff is to provide revenue stability for NAPOCOR. As important, a future purpose of the tariff will be to protect NAPOCOR from stranded asset risks in the new industry structure. Under the recommended privatization approach, NAPOCOR will no longer have a monopoly in generation, and it will need to protect its investments by requiring its customers to project their needs and contract for their requirements. In fact, the distribution utilities will have to go through a similar long-term contracting process for all their generation requirements. However, relevant to DSM, the take-or-pay minimum level introduces a potential disincentive for efficient energy consumption. If customers must consume a certain amount of energy and power or else pay for it, they may not be highly motivated to conserve electricity or use it more efficiently. This issue could be a problem for NAPOCOR's non-utility customers as well as all electric customers in the Philippines to the extent that the rate is passed through by the distribution companies. For this reason, ERB might consider modifying the reinstatement of this tariff so that NAPOCOR would exempt from the tariff those customers who participate in DSM programs. Such a move would immediately turn the tariff around from being a disincentive to being an additional incentive for customer participation in DSM programs.

- ***Establish Regulatory Policies for DSM***. ERB will be in the position to establish a number of regulatory policies relevant to DSM program design and implementation. The anticipated mechanism for such policy making is expected to be ERB orders at the conclusion of proceedings initiated by utility petitions for regulatory treatment of proposed DSM programs. The main issues that ERB will decide are discussed in the following sections on DSM program design. They include the: 1) establishment of an appropriate benefit/cost test to determine the cost-effectiveness of DSM resources, 2) determination of acceptable DSM cost-recovery mechanisms, and 3) provision for independent evaluations of DSM costs, benefits, and impacts.

These DSM rate reform and regulatory policy initiatives could be accomplished relatively quickly, within the first six months of Phase I of the DSM program's implementation. A budget of $75,000 would be assigned to ERB to provide for assistance in modeling the impacts of these reforms and policies on utility rates and revenues.

5.1.3 Program Design Activities

Concurrent with the performance of the institutional development tasks discussed in the previous section, activities can proceed that lay the foundation for DSM program design. These activities could follow the structure presented in Exhibit 5-2 and described below. It is anticipated that the DSM Collaborative would play a key role in each of these program design tasks, which will ensure that the resulting DSM program is effective and will provide additional training opportunities for Collaborative participants.

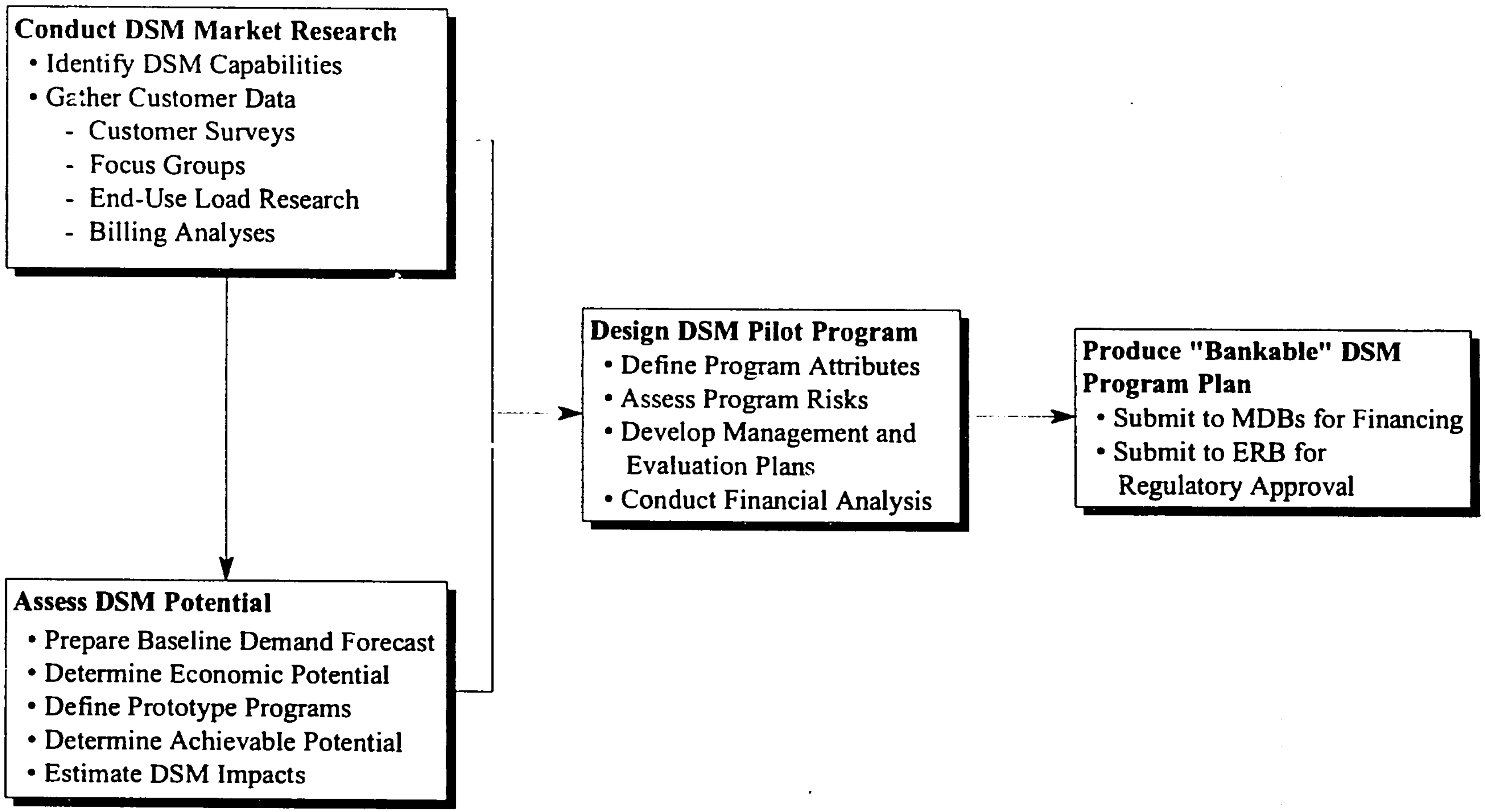
Conduct DSM Market Research

More knowledge needs to be gained about the Philippine energy efficiency industry and electricity consumers. DOE has conducted some important work in this regard, such as the World Bank/ESMAP Household Energy Strategy Study, which will provide a critical baseline for the data collection effort. Nonetheless, additional data on consumer behavior, perceptions, and values are required for the identification of promising DSM measures and programs. Surveys of end-use equipment stocks and utilization, as well as DSM equipment availability, would be included in this work. Load research, focus groups, analyses of billing data, customer surveys, and other market research techniques could be carried out during the early stages of DSM program preparation to complement data already available. Two specific market research needs have been identified:

Identify DSM Capabilities in the Philippines. A number of energy-efficient technologies that could be promoted through DSM programs are currently marketed and sold in the Philippines. Other products are available throughout the Asia Pacific region that could enter the Philippine market if distributors believed that they could be sold. For example, compact fluorescent light bulbs, energy-efficient motors and air conditioning units, and energy management controls are generally available in the region. The challenge for the implementation of utility DSM programs is to make sure that adequate supplies of these products are in the distribution pipelines of various companies when the programs are offered

Exhibit 5-2

Overview of DSM Program Design Activities



Some utilities in North America were embarrassed to announce large DSM programs for products that were generally available, only to find that they were not distributed in the utility's particular market. A remedy for this problem could be for DOE to contact DSM equipment manufacturers and vendors to describe the policy context and the potential size of the DSM market in the Philippines. DOE could establish a database of such firms, and products and make such information available to the distribution utilities as they start to design and implement their DSM programs. This information could lay the foundation for the utility provision of manufacturer incentives (the so-called "Golden Carrot" approach), as described for the residential refrigerator program in Chapter 4. Thus, even more efficient equipment could be "leap-frogged" into the Philippine market through the influence of DSM programs. This activity would be carried out by DOE in year two of Phase I, and would cost $50,000 for database software, periodic surveys of DSM equipment manufacturers in the Philippines and abroad, and participation in international DSM equipment trade events.

Gather End-Use Load Research and Other Customer Data. Load research refers to the acquisition of electric consumption data over time, typically through the use of power monitors, to generate daily load profiles for different days of the week or seasons of the year. End-use load research provides load profiles of particular end-use equipment, while whole-premise load research entails the acquisition and processing of data on a customer's entire load. Because end-use and whole-premise load research can be costly, advanced data collection methods could be employed to leverage these high-quality data from less costly data sources. One way of leveraging load research data is to use them to calibrate engineering and statistical models, which rely on less costly data derived from sources such as customer surveys and billing analyses.

The data collected in this task could be compiled in a comprehensive library of end-use load shapes that could be accessed by the utilities to help characterize the principal market segments to be targeted by DSM programs. These data would also improve the disaggregation of current demand by sector and end-use to help identify candidate DSM measures. Finally, end-use load data will provide important inputs to the end-use load forecasting techniques that were recommended for adoption by the distribution companies (see the previous section). This data collection effort would build on activities underway in the Philippines. For example, NAPOCOR is currently installing modern meters for all its customers under a transmission loan from the World Bank and the Japanese Export/Import Bank. These meters will provide NAPOCOR with daily customer load shape data. Similarly, MERALCO has initiated a billing analysis project.

Load research is often carried out with complementary customer surveys that identify appliance stocks and gain insights into customer behavior, attitudes, and values. Like any other commercial enterprise, DSM programs must be designed to provide customers with what they want. This fact forces utilities to adopt a customer service and marketing mentality, made more important by the introduction of competitive forces anticipated in the restructuring of the Philippine power sector. Ignoring this need can result in DSM programs with low customer participation rates and low energy savings levels. Thus, market research also includes customer interviews and focus groups as a way to learn what would motivate customers to participate in DSM programs.

The market research task would focus on the needs of the distribution companies. The data to be collected include end-use load profiles by market segment, socioeconomic and financial characterizations of each market segment, information on existing equipment stocks (such as age, make, utilization, and efficiency), billing data, and responses of customers from principal market segments to possible DSM strategies. Local firms are expected to be involved in all aspects of this data collection activity. There would be four market research tasks: 1) customer surveys to detail equipment stocks, 2) focus groups to assess customer attitudes, 3) load research to generate load profiles, and 4) billing analysis to complement the load research and customer surveys. For each of these activities, there would be subtasks for sample design, survey instrument preparation, field testing (except for billing data), data acquisition, and data processing. The budget for this task would be $500,000, split equally between MERALCO and PEPOA, which would serve the needs of the smaller distribution companies. Each $250,000 budget would be allocated to the four tasks as follows: customer surveys ($50,000), focus groups ($50,000), load research, including power monitoring equipment ($100,000), and billing analyses ($50,000). Work under this task would be performed over the entire two years of Phase I.

Assess DSM Potential at the Distribution Companies

The process of assessing DSM potential goes through a number of steps, including: 1) preparing a baseline demand forecast, 2) screening the costs and savings of DSM measures to determine the economic DSM potential, 3) defining prototype programs, making assumptions about administrative costs and customer participation rates, and 4) screening the costs and savings of the prototype programs to determine the achievable DSM potential and total DSM impacts. Below is a detailed discussion of the DSM assessment process:

Because DSM measures are implemented over time, expected changes in demand patterns must be taken into account. Therefore, a baseline demand forecast is prepared, reflecting an analysis of current and historical load patterns and the preliminary load research results from the Market Research task. In addition to helping distinguish the most promising DSM measures, the baseline load forecast provides a benchmark against which DSM program impacts can be estimated. This activity would build upon existing studies, such as the most recent load forecast developed by NAPOCOR.

The economic potential of each DSM measure is then assessed to determine which are the most promising measures. These estimates of economic potential are displayed in a DSM supply curve that shows the total amount of electricity that each measure can save at a particular cost. The DSM supply curve is then used to prioritize measures and furnish an upper bound on potential DSM impacts.

In order to convert economically feasible potential into an understanding of achievable savings, DSM program delivery mechanisms are defined. Exhibit 5-3 summarizes delivery mechanisms for DSM programs. These mechanisms must take into account current market imperfections and barriers as well as the adequacy of existing institutions and market infrastructures to maximize the savings potential to be realized. Preliminary results of the Market Research task would provide important information to inform the selection of program delivery mechanisms.

Measures that offer acceptable economic potential are then bundled with selected delivery mechanisms and institutional arrangements to form the basis of prototype programs. The goal is to develop delivery mechanisms for each prototype program that maximize customer participation and the likelihood that the savings persist, while minimizing administrative costs.

The achievable potential for each prototype DSM program is then determined through benefit/cost analyses conducted from the different perspectives of each of the parties involved, i.e., the utility and its customers. A societal benefit/cost test is also conducted that takes into account the avoided environmental costs provided by DSM. Prototype programs are then prioritized on the basis of the benefit/cost results and the total achievable DSM impact is estimated. The results of the DSM assessment form the basis for designing specific DSM programs and can also be compared with supply-side resources in an IRP analysis.

Through the ADB's Long-Term Power System Planning Study, DSM assessments are being conducted for NAPOCOR, MERALCO, and the other distribution companies as a whole. This effort will undoubtedly make an important contribution to understanding the potential for DSM at national and regional levels in the Philippines. It is important to understand what the DSM potential is at the distribution companies because: 1) the distribution companies have the primary responsibility for implementing DSM with their customers, 2) this role will be enhanced to include planning responsibilities under the proposed power sector restructuring scenario, and 3) multilateral development bank (MDB) power sector loans that include investments for DSM will most likely focus on opportunities at the distribution companies, as compared to the national level.

Therefore, the focus of this task is to introduce detailed DSM assessments for each of the distribution companies. Consistent with the Market Research task presented above, the budget for DSM assessment would be $400,000, split equally between MERALCO and PEPOA, which would serve the needs of the smaller distribution companies. Each $200,000 budget would be allocated to the four DSM assessment tasks as follows: baseline forecast and economic potential ($50,000), prototype programs ($100,000), and achievable potential ($50,000). A special additional task would allocate $100,000 to the Philippine Department of

Exhibit 5-3
Delivery Mechanisms for DSM Programs

Delivery mechanisms for DSM programs range from centralized approaches in which the utility is responsible for identifying opportunities and installing measures on the customer's side of the meter, to decentralized approaches in which the utility only provides incentives for customers, who are then responsible for identifying DSM opportunities and deciding how they wish to implement them.

Direct installation is the most centralized approach. In its simplest form, direct installation entails utility staff visiting customers and physically installing equipment that will modify customer 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 (ESCOs)*** may contract with utilities in much the same way as an independent power producer, but instead of producing power, will provide a certain level of reduction in peak demand and energy consumption. ESCO staff are responsible for identifying the DSM opportunities and gaining the cooperation of the customer. ***Trade allies*** are typically equipment vendors or builders who come in contact with DSM programs in the course of their primary business. For example, utilities might pay air conditioning retailers for each high-efficiency unit they sell, or might provide property developers with incentives to adopt high-efficiency designs, even though they may be more expensive on a capital cost basis.

Utilities may offer ***direct incentives to customers***. ***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 customers to purchase more efficient end-use equipment that the customer might not have otherwise purchased because of its higher capital cost. Alternatively, a utility can offer ***loans*** to customers to purchase more efficient equipment, or ***lease*** such equipment to them at attractive rates. Utilities can also offer customers ***shared savings programs*** in which the utility would make payments to customers commensurate with the benefits that accrue to the utility as a result of changes in customer consumption patterns. Finally, utilities can provide ***information-only programs*** that simply describe how customers can modify their consumption and the benefits that will accrue with these modifications.

In sum, financial incentives for customers can be packaged with personal marketing contact and/or technical assistance from either the utility or a contractor to help the customer take advantage of particular DSM opportunities. Similarly, delivery can be administered, and customer actions verified, by either the utility itself or a contractor acting on its behalf.

Environment and Natural Resources (DENR), which would work with DOE to determine the generic environmental costs of all power sector resources in the Philippines. These data would be required to conduct the societal benefit/cost analyses of DSM programs as well as the IRP analyses. Therefore, the total cost for this task would be $500,000. Work under this task would be performed over a one-year period, starting at the beginning of Phase I.

Perform Preliminary DSM Pilot Program Design

With the completion of the DSM Assessment, the preliminary design of DSM pilot programs can commence. The pilot programs would be drawn from the highest-priority prototype programs that defined the achievable potential in the last step of the assessment process. Preliminary DSM pilot program design is accomplished through the following steps: 1) the pilot program is defined in terms of its marketing approach, types and amounts of customer incentives, and delivery mechanism, 2) an assessment of program risks is conducted, 3) a management and evaluation plan is defined, and 4) financial analyses are performed to produce a "bankable" program acceptable for funding by the MDBs. The DSM assessment process is discussed in detail below.

The prototype programs and delivery mechanisms identified in the DSM assessment are "fleshed out" into detailed descriptions of the pilot programs and how they will be implemented. Specific methods to market and promote the programs are defined, including information dissemination and customer outreach techniques. The nature of any customer incentives (such as rebates or loans) is outlined. The procedures for delivering the program to the utility's customers are researched, such as direct installation by utility staff, or reliance on contractors and ESCOs.

There is currently no DSM experience in the Philippines that can be used to gauge the actual impacts of program implementation. Simply applying results from DSM programs in other countries ignores the unique characteristics of Philippine society and energy consumption patterns. Despite the substantial information that will be available from the Market Research task, significant technical, economic, and market uncertainties will remain. Each element of uncertainty introduces risks to program implementation in that the program may not achieve its expected results.

An important component of pilot program design is an assessment of those risks in order to 1) quantify expected program impacts by explicitly considering the ranges within which technical, economic, and market uncertainties may lie, and 2) help in establish priorities for addressing those uncertainties in pilot program design (see Exhibit 5-4 for a summary of the types of uncertainties that are typically addressed in DSM program design). For example, despite all the technical analyses of the DSM assessment process, it may be determined that the most important goals of a pilot program are driven by non-technical criteria such as limiting the overall program objectives to ensure success, seeking early success during program implementation, obtaining high media visibility for the program, or providing political benefits to selected constituencies. Pilot programs can narrow the uncertainty around the most influential variables and lead to higher-precision estimates of savings potential. Once the priorities and value of specific pilot programs have been established, they can be designed in greater detail.

Exhibit 5-4
Types of Uncertainty in DSM Program Design

There are four types of uncertainty in DSM program design, each of which can reduce the accuracy of estimates of program impacts. Inaccurate estimates of program impacts can lead to the misallocation of resources or the design of programs that ultimately prove to be ineffective. Risk reduction strategies can be used, however, to mitigate the potential influences of these uncertainties in DSM program design.

Technical uncertainty arises from many factors, predominantly the lack of detailed, accurate information on the targeted applications and the variability of operational factors that characterize those applications. For example, consider an industrial motive power optimization program that consists of motor replacements, the installation of variable-speed drives, power factor correction, line-balancing, the use of synthetic lubricants, and improved maintenance of conveyors, fans and other process equipment. Accurately estimating the savings potential of this program would require knowledge of 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, and part-load performance). It would also be important to know something about current maintenance practices, and the ability to effect savings by modifying the processes that the motors drive (e.g., trimming pump impellers). All of these variables represent a distribution of values. In selecting point estimates to reflect "average" or "typical" values in performing the savings analysis, it would be possible to choose values that do not approximate their true means or capture their variability.

Economic uncertainty results from the variability or lack of understanding of factors that determine the financial attractiveness of customer participation in DSM programs. For example, discount rates may vary widely among market segments, so that measures that appear attractive to some customers do not appear worthwhile to others.

Market uncertainty results from the range of potential customer responses to DSM programs. Knowing the technical impact of a DSM measure among all customers for whom it would be economically attractive is insufficient to accurately estimate program impacts. For instance, it may take time for customers to find out about or understand DSM programs. Limited resources may be available for program delivery, so that not all customers who wish to participate can. Such factors can slow the market penetration or customer acceptance of DSM programs.

Uncertainty regarding the persistence of measures adds the time dimension to DSM programs. The adoption of a measure does not ensure its consistent use. There is no assurance that customers will not revert to their previous consumption patterns when a program expires or a piece of high-efficiency equipment is replaced.

Because each of these factors influences savings potential to different degrees, the value of having more detailed or accurate information 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.

Timely and accurate information on program impacts is likewise required if DSM is to prove itself as a valid utility resource in the Philippines. Evaluation activities are critical to measure the savings of DSM programs (through impact evaluations) and to identify potential improvements in program delivery (through process evaluations). These activities employ techniques similar to those developed in the Market Research task (e.g., statistical billing analyses, customer surveys, load research). Evaluation activities are typically built into pilot program design from the start of program implementation. In addition to evaluation methodologies, plans are spelled out for establishing information and transaction monitoring and tracking systems, for ensuring quality control during program implementation, and in facilitating the organizational development of utility management and staff. This last step is required to create the administration mechanisms, customer service and marketing capabilities, and contracting services necessary for implementing a DSM program.

The final step is to mold the DSM pilot program design into a "bankable" plan that will meet the loan criteria of the MDBs. This process entails conducting a financial analysis of the program, including consideration of taxes, import tariffs, foreign exchange, and loan requirements. Other sources of capital required for program implementation are identified, as are the utility's own costs and proposed cost recovery mechanisms. The result is an investment program and timetable that will be capable of passing the MDB's loan appraisal process. This plan will be circulated among multilateral and bilateral financing agencies for consideration. It is also the plan that the utility would submit to ERB to initiate the regulatory proceeding and rule-making for the DSM program.

Once again, the focus of this task is to develop preliminary DSM pilot program designs at the distribution companies. Consistent with the DSM Assessment task presented above, the budget for pilot program design would be $200,000, split equally between MERALCO and PEPOA, which would serve the needs of the smaller distribution companies. Each $100,000 budget would be allocated equally among the four pilot program design tasks. Work under this task would be performed over a six-month period, at the end of Phase I.

5.1.4 Institutional Development and Program Design Timetable and Budget

The Phase I schedule and budget are presented in Exhibit 5-5. The total cost of Phase I is estimated to be $2.0 million, with $750,000 allocated to institutional development activities and $1,250,000 allocated to program design activities. These figures include funding for contingencies. The activities of Phase I would be conducted over a two-year period. These tasks would be carried out by a core team of consultants residing in the Philippines for the duration of Phase I, working closely with the participants in the DSM Collaborative, including DOE, ERB, NAPOCOR, the distribution utilities, and local contractors. The consulting team would define and execute the individual tasks in consultation with the DSM Collaborative. Because of the breadth of expertise required, core team expertise would be supplemented by short-term advisors specializing in particular aspects of individual tasks.

Exhibit 5-5
Budget and Timetable for Phase I: Institutional Development and Program Design Activities

Activities	Budget ($)	2	4	6	8	10	12	14	16	18	20	22	24
		Months											
INSTITUTIONAL DEVELOPMENT													
Establish Policy Framework	0	(Pre-Phase I)											
Initiate Collaborative Process	275,000	■	■	■	■	■	■	■	■	■			
Introduce IRP	200,000				■	■	■	■	■	■	■	■	■
Implement All-Source Bidding	150,000				■	■	■	■	■	■	■	■	■
Broker ESCO Businesses	50,000	■	■	■	■	■	■						
Reform NAPOCOR Tariffs	75,000	■	■	■									
SUBTOTAL	**750,000**												
PROGRAM DESIGN													
Conduct Market Research	550,000	■	■	■	■	■	■	■	■	■	■	■	■
Assess DSM Potential	500,000	■	■	■	■	■	■						
Design Pilot Programs	200,000							■	■	■			
SUBTOTAL	**1,250,000**												
PHASE I TOTAL	**2,000,000**												

The Government of the Philippines would provide in-kind contributions for the Phase I activities, such as the salaries of government employees participating in the DSM Collaborative, support staff, office space, etc. These in-kind contributions are not reflected in the budget figures in Exhibit 5-5.

5.2 PHASE II: PILOT PROGRAM IMPLEMENTATION

The preceding phase aimed to identify the most promising DSM measures and programs, compile customer and technology data, and establish an institutional framework for DSM implementation. This phase provides the actual DSM field experience necessary to determine the future role of DSM in the Philippines and to develop the capability of Filipino utilities and agencies to design, implement, and evaluate DSM projects. Experience with pilot-scale programs will remove the uncertainty surrounding key program parameters (e.g., participation rates) and thereby reduce the risk associated with full-scale implementation. The principal components of this phase include:

- Detailed Program Design
- Tracking System Development
- Program Marketing and Measure Delivery
- Program Evaluation

At the end of this phase, Filipino authorities would know whether DSM should be implemented on a large scale, and if so, how it should be done. In particular, this experience will provide them with a firm understanding of the extent to which DSM can reduce future load growth in a cost-effective manner, as well as the tools for doing so.

5.2.1 Pilot Program Activities

This phase entails the following tasks for each of the programs identified in the preceding phase:

- ***Detailed program design based on earlier conceptual designs and market research.*** This task will specify in detail the target markets, incentives, marketing strategies, installation, tracking and evaluation procedures, management and administration of each program. It will result in the preparation of a comprehensive procedures manual for each program that will guide utility staff and contractors in implementation. To ensure that the subsequent evaluation is possible and meaningful, this task will integrate the design of program evaluation.

- ***Tracking system development.*** Computer-based tracking systems must be developed that can be integrated with existing utility information technology. These systems must be used to monitor program implementation status, support evaluation, track costs, manage equipment inventories, identify promising customers to target for participation, and support quality assurance and quality control of customer interactions, transactions processing, and resource (e.g., field team) scheduling.

- ***Equipment procurement.*** A wide range of hardware and software will be needed for program implementation, even on a pilot basis. Obvious items include the actual measures to be installed (e.g., CFLs). Other items to be included are computer hardware and software, and meters for evaluation measurements.

- ***Program marketing.*** Even though pilot programs may be limited in geographical scope or the number of eligible customers, they provide an excellent opportunity to develop and test various marketing strategies. These can rely on several media, including door-to-door visits and other personal contacts, and advertising in print, radio, and TV.

- ***Measure installation.*** For some programs, such as rebate programs, the installation of the program will be the responsibility of the customer. In other cases, though, the utility or other sponsoring agency will have to either install the measure or hire a contractor to do so. Direct installation programs are one example.

- ***Program evaluation.*** Evaluation design and metering equipment procurement will have been carried out under preceding tasks. At the end of the program, both impact and process evaluations must be carried out to determine the value of the program and ways in which it can be improved.

Training in each of these areas will have been carried out in the preceding phase.

To prepare a preliminary estimate of the scope and cost of this phase, it is assumed that pilot programs will be carried out for each of the programs described in Chapter 4. These programs are:

- Industrial TOU Tariffs
- Industrial I&C Tariffs
- Industrial Motors & Drives Program
- Commercial Lighting Efficiency
- Commercial VAC Programs
- Residential Refrigerator Efficiency

- Residential Lighting Efficiency

5.2.2 Pilot Program Timetable and Budget

The timetable and budget for the pilot program phase is based on the following tasks and assumptions:

1. ***Detailed program design.*** Detailed design begins with the conceptual designs formulated during the preceding phase, and develops them further, paying particular attention to the procedures that utility and contractor staff must follow for implementation. The principal output of this task is a comprehensive procedures manual for each program which will serve as a reference for all staff involved in program implementation. Two staff-months of detailed design time are allocated for each program. Given a cost of $25,000 per staff-month (including any related travel costs), the total cost of this task is $350,000. It is expected that this task can be completed over a period of four months by a team of program design experts.

2. ***Tracking system development.*** This task entails several activities, including functional specification of the tracking system, assessment of existing management information systems, and billing databases used by the utility, determining computer hardware and software needs, actually developing the tracking software, and preparing tracking system documentation and operating manuals. It is expected the first three activities will require one staff-month of professional time, and that actual system development and documentation will take a total of seven staff-months. This could be carried out over a period of four months at a cost of $200,000.

3. ***Equipment procurement.*** Once the tracking system configuration has been identified and programs designed in detail, equipment can be procured. One staff-month of time is required to oversee the entire procurement process, which is assumed to last six months after the detailed program design has been completed. An example of a procurement list is given in Exhibit 5-6. The total list adds up to $5,345,000. Including a 10% contingency and the one staff-month, the total for this task is approximately $5.9 million.

4. ***Program marketing.*** The design of a marketing program is expected to take one staff-month per program. In addition, the use of media to market the pilot programs is estimated to cost $200,000. The total marketing cost is therefore $375,000. This task begins four months prior to the kick-off of installation activities and continues throughout the life of the pilot programs.

Exhibit 5-6
Procurement List for Pilot Programs

	Programs	Items to be Procured	Cost
Industrial Programs	Tariff Programs	200 electronic TOU meters	$200,000
	Motors & Drives	20 ASDs averaging 100 kW each	$500,000
		200 high-efficiency motors averaging 75 kW each	$750,000
Commercial Programs	VAC Programs	Miscellaneous testing equipment	$50,000
		Control systems and miscellaneous hardware	$500,000
	Lighting Programs	5,000 electronic ballasts	$750,000
		10,000 high-efficiency fluorescent lamps	$25,000
		100 control systems	$100,000
		10,000 CFLs	$150,000
		1,000 reflectors	$30,000
		1,000 T-8 systems	$75,000
Residential Programs	Refrigerator Programs	Testing equipment	$5,000
		5,000 high-efficiency rebates	$300,000
	Lighting Programs	100,000 CFLs	$1,500,000
Miscellaneous	Tracking system hardware and software		$100,000
	30 power loggers		$150,000
	200 TOU loggers		$60,000
	Miscellaneous computer hardware and software		$100,000

5. ***Measure installation.*** It is estimated that the delivery of the above measures will require 100 staff-years of technicians and administrators over the 20-month installation period. Given an average cost of $36,000 per year for these staff, the total cost for delivery comes to $3.6 million.

6. ***Program evaluation.*** Evaluation experts will be expected to spend two staff-months during the installation period to ensure that there is adequate data collection to support subsequent evaluation. After the installation period is over, there will be a lag of two months while the remaining data are compiled. Impact and process evaluations will then be carried out during the remaining four months of the pilot program. These evaluations will are estimated to require 10 staff-months, so that the total budget for this task amounts to $300,000.

The timetable and budget for these tasks are summarized in Exhibit 5-7. The total budget for the pilot programs comes to approximately $10.7 million. Unlike the budget for full-scale implementation given in Exhibit 4-8, it is assumed that for the pilot programs, the sponsoring utility or agency alone absorbs the full cost of the measures.

5.3 PHASE III: FULL-SCALE IMPLEMENTATION

Full-scale implementation will consist of many of the same tasks as the pilot programs, namely:

- program marketing
- improvement and expansion of the tracking system
- measure installation
- periodic impact and process evaluations of the programs
- revision of the program designs and load shape objectives as necessary.

Full-scale implementation of the project will be carried out over a six-year period, 1998 through 2003. The programs to be carried out will depend upon the results of the pilot programs. It is likely, though, that programs such as those described in Chapter 4 will constitute this phase. An illustrative budget for the full-scale implementation of these programs was given in Exhibit 4-8, and the timetable for implementation is given in Exhibit 5-1.

Exhibit 5-7
Timetable for Pilot Program Activities

Activity	Budget	Month 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1. Detailed program design	$350,000	■	■	■	■																																
2. Tracking system development	$200,000				■	■	■	■																													
3. Equipment procurement	$5.9 million					■	■	■	■	■	■																										
4. Program marketing	$375,000							■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■							
5. Measure installation	$3.6 million											■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■						
6. Program evaluation	$300,000																■									■								■	■	■	■

ANNEX A
DERIVATION OF SECTORAL AND END-USE LOAD SHAPES

In countries with a single utility or tariff schedule, estimates of sectoral energy consumption can often be derived solely from sales data. In the Philippines, however, there are numerous distribution companies, each with its own set of tariff classes. The largest distribution company, Meralco, serves Manila and surrounding regions, and accounts for roughly 61% of the nation's total electricity consumption. Consumption data for Meralco cannot be extrapolated to all of the Philippines because the mix and consumption patterns of Meralco customers differ from those in the rest of the country. For example, average consumption per consumer is much higher for Meralco than other distribution companies in the Philippines.

Exhibit A-1 presents estimates of sectoral electricity consumption by source. Total sales reported in this exhibit are lower than in the 1993 NAPOCOR Power Development Program (PDP) because the PDP reports NAPOCOR sales to large industrial consumers and distribution companies, and not sales to the end-user as reported here. The difference between the PDP figures and these values is, in effect, distribution losses.

There are no primary data for the Philippines on industrial end-use shares. However, data from other countries can serve as a guide. Motors represent 78.3% of industrial electricity consumption in the United States, 73.7% in India, 70.7% in the Sao Paulo (Brazil) utility, and some 75% in Thailand. For some countries, the percentage can be much higher, reflecting the absence of primary industries that rely on electrolytic processes and intensive process heating. In general, though, for a diversified economy such as the Philippines', motors account for 70-80% of total industrial electricity consumption. Similarly, lighting accounts for between 5 and 10%. It is therefore assumed that in the Philippines, motors account for 74% of industrial demand, lighting 6%, and other end-uses (including process loads) 20%.

Some primary data are available on commercial end-uses. Energy consumption was analyzed in 24 Filipino office buildings, 8 hotels, 8 hospitals, and 4 shopping complexes under the ASEAN-USAID Buildings Energy Conservation Project. The results are summarized in Exhibit A-2. Based on these results, it is estimated that 60% of total commercial consumption is attributable to HVAC, 15% to lighting, and 25% to other loads. This is consistent with experience in the United States (taking into account climatic differences) and other Southeast Asian nations.

Primary data are also available for the residential sector. In 1989, a household energy consumption survey was undertaken with the assistance of the joint UNDP/World Bank Energy Sector Management Assistance Program (ESMAP). Among other things, the household survey estimated the electricity consumption of principal residential end-uses.

Exhibit A-1
1992 Sectoral Electricity Consumption and Customers by Source

	Residential	Commercial	Industrial	Other	Total
NPC					
No. of customers	-	-	94	NA	94
Annual consumption, GWh	-	-	2,884	NA	2,884
Meralco					
No. of customers, 000's	1,935	201	11	NA	2,147
Annual consumption, GWh	3,941	3,816	4,430	92	12,279
Rural Electric Co-ops*					
No. of customers, 000's	3,156	250	11	55	3,472
Annual consumption, GWh	1,411	588	830	159	2,988
Private Utilities					
No. of customers, 000's	475	64	3	7	549
Annual consumption, GWh	611	342	607	341	1,901
Philippines Total					
No. of customers, 000's	5,566	515	24	NA	6,105
Annual consumption, GWh	5,963	4,746	8,751	592	20,052

* Commercial includes public buildings.

Note: Self-generating industry has been omitted; 1990 estimates indicate these industries represent 4% of total national consumption.

Source: Philippines Department of Energy, 1994.

Exhibit A-3 summarizes the findings of the study.

Lighting and refrigeration together account for more than half of total residential electricity consumption in the Philippines. The referenced report breaks down the "other" end-use category into eight sub-categories. The next-most important end-use after refrigeration is ironing, accounting for 12.5% of total household consumption. These data also support the observation that as households become more well-off (e.g., NCR and other urban households have, on average, much higher expenditures than rural households), electricity consumption increases significantly and the lighting share falls.

Exhibit A-2
Electricity Consumption in Filipino Buildings
(all values in percent)

	HVAC	Light	Other
Offices	61.2	22.5	15.6
Hotels	63.9	16.2	18.2
Hospitals	56.1	6.6	34.5
Supermarkets	58.9	6.6	34.5

Source: Lawrence Berkeley Laboratory. *ASEAN-USAID Buildings Energy Conservation Project Final Report - Vol. III: Audits.* LBL-32380. Berkeley, California, June 1992.

These sectoral and end-use data were used together with generic load shapes for each end-use to generate end-use load curves. The generic load shapes were based on load research in other countries and an understanding of electricity consumption patterns in the Philippines. For example, activity in commercial enterprises picks up rapidly starting around 5 a.m., reaches a plateau around 10 a.m. that lasts until about 5 p.m., and then declines gradually until about midnight. In households, demand picks up around 5 a.m., peaks around 7, and then declines and levels off for the rest of the day, until evening. Starting around 5, lighting and cooking loads start up; the evening peak occurs around 7 p.m. and falls off until about midnight.

Exhibit A-3
Residential Electricity End-Use Shares
(all values in percent)

	NCR	Other Urban	Rural	Philip-pines
Lighting	19.8	28.0	42.5	28.4
Refriger-ation	27.4	29.0	23.8	27.0
Other	52.8	43.0	33.7	44.6
kWh/household/month	158	78	44	79

NCR - National Capital Region

Source: World Bank, ESMAP. *Philippines: Defining an Energy Strategy for the Household Sector.* Washington DC, September 1992.

These scaled load shapes were checked to ensure that they add to the total national load shape. The national load shape was approximated by the average daily system load shape for the Luzon grid.[1] This system load shape was normalized and then scaled by total sales. Thus, the total system load shape represents demand at the point of consumption, and assumes that losses are constant regardless of system load. Although this approach does not guarantee the accuracy of each end-use load shape, it at least ensures that all the individual load shapes comprise a single coherent and consistent scenario of electricity demand composition.

[1] The Luzon grid accounted for 74% of NAPOCOR's peak demand in 1992. Although other grids in the Philippines likely have a more accentuated evening peak due to a larger percentage of residential load, the use of the Luzon data alone was felt to be a reasonable approximation for this preliminary analysis.

ANNEX B
PROGRAM DESIGN AND IMPACT ASSUMPTIONS

This annex provides background assumptions and describes the analyses employed in Chapter 4 for program design and impact estimates. These assumptions are not necessarily intended to reflect actual conditions in the Philippines or justify specific programs; rather, they constitute a plausible scenario of DSM programs and impacts, which in turn is used to illustrate the types of costs and benefits that could be associated with DSM implementation in the Philippines. These assumptions will no doubt change as more data (especially from pilot programs) become available for the Philippines.

The cost/benefit analysis of each program is carried out in economic terms. Financial analysis of these programs from the perspectives of the sponsoring utilities, participating customers, and all consumers cannot be conducted until a regulatory framework is in place that stipulates how program costs are allocated among the utility, consumers, and participants. It is asserted, however, that if a program is economically justified, there exists some regulatory framework that will make the program attractive to all relevant parties. The development of such a framework within the Philippines context will be one of the challenges of the Master Plan activity proposed in Chapter 5.

Economic cost-effectiveness is determined using a variant of the total resource cost test. A program is cost-effective if the benefit/cost ratio is greater than one. "Costs" are defined as the present value of the economic costs of the measure, its delivery, and overall program administration. "Benefits" include the present value of energy and capacity displaced by the use of the measure. All costs and benefits are expressed in 1994 US dollars. Energy and capacity costs are given in Exhibit B-1 for the point of consumption (i.e., taking into account transmission and distribution losses).

Program impacts are determined through a three-step process. First, the total number of technically feasible installations of the measure is estimated. Next, the number of technically feasible installations for which the measure is economically cost-effective is estimated. Finally, the gradual installation of measures in economically-justified cases is estimated using either market penetration rates from similar programs in other countries, or from estimates of the maximum number of installations that could be realistically expected given the logistical requirements of the program and the available delivery capacity.

B.1 INDUSTRIAL PROGRAMS

B.1.1 TOU Tariffs

Time-differentiated electricity pricing can be an effective tool for load shifting, and to a limited extent, for strategic conservation. TOU tariffs typically shift demand from on-peak to off-peak periods by offering the consumer lower electricity prices during the off-peak periods. TOU rates often reduce annual energy consumption as well, because some consumers will not shift load, but will instead respond to the rates through greater efficiency. In the United States, 55% of investor-owned utilities and 15% of publicly-owned utilities offer voluntary TOU rates to their customers.

Exhibit B-1
Energy and Capacity Costs

Energy cost: US $0.042/kWh

Generation and transmission capacity cost: US $21.45/kW-month

Distribution capacity cost: US $12.37/kW-month (included only for commercial and residential consumers)

Source: Energy Regulatory Board. *Energy Pricing and Regulatory Policy Study.* December 1992.

Notes:

(1) Costs reported in the cited source were escalated by 5% annually for three years to bring them from 1991 values to 1994 values.

(2) The values given above are the average sales/peak demand weighted values from the Luzon, Visayas, and Mindanao grids (p. 3-93).

(3) Energy costs for each grid are the simple averages of dry-season and wet-season, peak and off-peak at medium-voltage (MV) (p. 3-93).

(4) Capacity costs are taken at the MV level for generation and transmission capacity costs; distribution capacity costs were taken as the difference between MV and low-voltage capacity costs as reported for Meralco (p. 3-118).

Proposed Measure

As noted in the main text, a specific TOU structure is not proposed here; instead, it is assumed that a scheme can be implemented that achieves results comparable to programs implemented in other countries. The rates and time periods may be established in advance; alternatively, innovative pricing programs such as real-time or peak-activated prices may be used. Although TOU rates have usually been offered on a voluntary basis, it may be appropriate for NAPOCOR and distribution companies with large industrial loads to mandate the use of such tariffs.

The implementation of the measure requires the installation of TOU meters. In addition, it is assumed that the measure is accompanied by technical assistance to help participating customers reduce their peak period demands as much as possible.

Maximum Technical Impact

According to the Comision Federal de Electricidad, the TOU tariff introduced in Mexico in 1991 resulted in a 500 MW peak load decrease, or just under 7% of industrial demand during the peak period (4 to 5 p.m.).[1] In the United States, the Electric Power Research Institute (EPRI) estimates that in 1990, TOU rates resulted in a 1.4% reduction in peak industrial demand, and a 0.13% reduction in annual energy consumption, despite the fact that only a fraction of U.S. utilities offer these rates.[2] These savings are expected to reach 3.5% and 0.34%, respectively, by 2000. Another study of a large U.S. utility revealed a 7.5% decrease in peak demand among customers with more than 5 MW of demand.[3] A comprehensive study of several U.S. utilities indicated an average peak demand reduction of only 1% for high-voltage consumers, but for certain industries the average was as high as 6.4%.[4]

The impact of TOU tariffs in the Philippines will depend on the potential savings to firms for adopting the rates, which in turn depends on such factors as the ability and cost to reschedule operations, and the on- and off-peak tariff levels. This information can only be obtained through surveys of individual industrial establishments. Given that industries which are likely to be very responsive to TOU rates (e.g., textiles) dominate the industrial sector in the Philippines, it is assumed here that TOU tariffs will save 7.5% of industrial demand during the period of system peak, and 0.9% of annual energy consumption in participating facilities.

Economic Potential

The cost of developing a TOU rate program and training utility marketing and technical assistance staff is assumed to be $100,000. Marketing and technical assistance costs are estimated to be $5,000 per participating facility, and the installation of electronic TOU meters is estimated to cost $1,000 per participating facility. In addition, it is assumed the average participant spends $10,000 for control systems to help take advantage of the rates. The total economic cost per participant would therefore be about $16,000 (as opposed to the utility's share of $6,000, which is reported in the main text).

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[1] USAID Office of Energy. *Mexico: Demand-Side Management in the Industrial Sector.* Washington, DC, September 1991.

[2] EPRI. *Impact of Demand-Side Management on Future Customer Electricity Demand: An Update.* Palo Alto, California, 1990.

[3] EPRI. *Customer Response to Rate Options.*, CU-7131. Palo Alto, California, 1991.

[4] Action, J.P. and Park, R.E. *Response to Time of Day Electricity Rates by Large Business Customers: Reconciling Conflicting Evidence.*, R-2477-NSF, Santa Monica, California: The RAND Corporation, 1987.

During the period of the national peak, the average industrial consumer load is about 40 kW, and the average annual consumption is 365 MWh. However, NAPOCOR's 94 direct consumers alone represent one-third of total industrial electricity consumption. It is estimated that for each of these consumers, load at system peak is approximately 4 MW and annual consumption is 31 GWh. It is assumed that the 900 largest industrial consumers have an average load of 500 kW at system peak and an average annual consumption of 4 GWh. A 7.5% reduction in present total industrial load at system peak would be equivalent to an average reduction of 83 kW for each participant, and will thus yield capacity savings valued at approximately $21,000/year. Annual energy savings of 0.9% of total industrial consumption would be equivalent to savings of 88 MWh for each of these participants, with a value of $3,700/year. Clearly, the project is economically cost-effective (but not necessarily financially cost-effective) for the participating industrial consumers. (Financial cost-effectiveness will depend upon the tariff structure adopted.)

Market Penetration

It is assumed that the program phases in the mandatory use of TOU rates for the 900 largest industrial consumers. Market penetration is estimated to increase from one-third at the end of the first three years to 100% of this group by the end of the sixth year.

B.1.2 Interruptible Tariffs

Interruptible and curtailable (I&C) rates allow the utility to interrupt or reduce service during critical periods for those customers using the rate. Customers on the rate benefit from rate discounts. I&C programs offered elsewhere typically set a minimum interruptible load of 500 kW or more to be eligible for the program. A 1988 survey conducted in the United States by EPRI found that by 1990, approximately 75% of U.S. utilities would offer I&C rates. Load cooperatives, in which several industrial consumers join together to coordinate load scheduling, have become common in the United States. They are not, however, as widespread as they could be: most utilities there have not promoted them because of excess capacity.

Proposed Measures

As with the TOU rates discussed above, specific I&C rates are not proposed here. Instead, it is assumed that rates can be designed and implemented that yield savings similar to those achieved in other countries. Given the stand-by generators installed by many industrial customers during the power deficit of the last several years, I&C rates could be particularly popular in the Philippines. The rates could be "sold" to individual customers or to load cooperatives; an example of a load cooperative is given in Annex C.

Typically, I&C rate programs stipulate that the utility will notify the consumer of the service interruption request some time in advance. Shorter advance times may be reflected in lower tariffs; limits are also placed on the frequency and duration of interruptions. A TOU meter at the customer's premises will subsequently be used to verify compliance with the service interruption request. If the request was not fulfilled, the program will usually provide for a stiff penalty to the consumer. As with the TOU rates, it is envisioned that this program would include technical assistance to consumers to help them understand the value of participation in the program, and to assist them in formulating strategies to allow them to qualify for the lowest I&C rates in a cost-effective manner and without compromising their operations.

Maximum Technical Impact

In 1990, EPRI estimated that in the United States, industrial I&C rates reduced industrial peak demand by 4.7%. This reduction is expected to grow to nearly 6% by the year 2000. There were no significant energy savings reported for these programs. However, in the Philippines, the ownership of stand-by generators is widespread because of the recurring brownouts that occurred over the past few years. The existence of these generators should make it possible to enroll far more consumers in an interruptible program. One survey on Luzon suggests that there is over 1,000 MW of stand-by generator capacity on that island alone, accounting for over 42% of industrial consumers there. It is assumed here that over the course of the program, there is a 20% reduction in industrial demand during the peak period. Utility energy savings of 2.5% of industrial consumption are attributed to the program commensurate with these interruptions (although this will be made up to a large extent by those enterprises which self-generate during interruptions).

Economic Potential

It is assumed that the 20% reduction in industrial demand is achieved by an average of 667 kW of load interruption/self-generation for each participant. The economic costs of the program are assumed to be similar to those for TOU tariff programs: $100,000 for program design and training, and $6,000 per participant for meter installation, marketing, and technical assistance. In addition, there would be the cost of running the stand-by generators (which themselves are sunk costs). The operating costs of these generators are estimated to be $10,000 per participant per year ($667 kW x assumed 100 hours/year of interruption x assumed cost of 15 cents/kWh). Benefits amount to $172,000 annually ($21.45/kW-month x 12 months/year x 667 kW/MW). This is an extremely favorable benefit/cost ratio, even if the participant remains in the program only for one year.

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Market Penetration

Given the assumptions that the average participant has an interruptible load of 667 kW, and that total savings reach 20% of current industrial demand during system peak, approximately 300 enterprises would participate in the program by the end of 2003. It is assumed that one-third of these customers are participating by the year 2000.

B.1.3 Motor and Drive Programs

Industrial motor consumption represents 32% of total annual electricity consumption and 26% of the national peak. Motor improvements could provide a substantial amount of strategic conservation as well as peak reduction. Initially, participation in motors programs in other countries did not live up to the high estimates of technical and economic potential. However, in the last few years, utilities have drawn on the lessons of early motors programs, and participation rates have increased accordingly.

Proposed Measures

Two measures are considered:

- ***High-efficiency motors.*** High-efficiency motors are made with better quality materials, improved bearings and fans, and superior windings. These motors typically cost 20 to 40% more than standard motors. The energy saved through the use of these motors varies from 2 to 8%, with the larger savings in the smaller horsepower ranges.

- ***Adjustable-speed drives.*** Motor efficiency is generally highest when motors operate within 50% of their rated loads. For many applications, though, the load placed on the motor varies over time. Motors driving pumps, fans, and cooling systems typically encounter significant load variations. For appropriate applications, ASDs can reduce energy consumption 20 to 40%, but may cost two to five times as much as the motor on which they are used.

Motor downsizing can also reduce energy consumption. However, the increase in efficiency from the operation of a properly sized motor may be only a marginal improvement when the lower efficiency of smaller motors is taken into account. Furthermore, motor downsizing would likely be most effective if it is carried out as part of the two measures described above. Therefore, a separate motor downsizing program is not considered here.

It is assumed that industrial motor programs would be administered as rebate programs, involving both customers and trade allies. Although more aggressive program delivery alternatives can be employed such as the CESP Fleximotor program in Brazil, the effectiveness of such programs in the Philippines can be judged only after more rigorous program design and perhaps pilot programs.

Maximum Technical Impact

An analysis of motor utilization in the United States indicates that 20 to 40% of motors may be suitable for ASD applications.[5] It is assumed that for the Philippines, 30% of motors are technically suitable for ASDs and that 90% of motors could be replaced with higher-efficiency models. Given average savings of 30% for ASDs and 4% for high-efficiency motors, the total technical potential becomes 12.6% of the total industrial motor load.

Economic Potential

Exhibit B-2 indicates the economic attractiveness of individual high-efficiency motor replacements (or new installations) and ASD installations, with allowances for installation and program marketing and delivery costs. High-efficiency motors are justified except for instances of small motors (< 3 kW) and low annual average load factors (< 0.5). ASDs are justified except for small motors, because larger motors will usually have load factors higher than those necessary to justify the measure. Because small motors may well account for half of total motor energy consumption, the economic potential for high-efficiency motors is estimated to be half of the corresponding technical potential, or approximately 1.8% of industrial motor load. Because ASDs are not cost-effective for low load factor motors, it is estimated that the economic potential is only one-quarter of the technical potential, or 2.3% of industrial motor load.

For the purposes of estimating the economic costs of these measures, it is assumed that the cost of an ASD is $250/kW, and the incremental cost of a high-efficiency motor is $20/kW.

Market Penetration

Early motor efficiency programs were often characterized by poor participation rates, i.e., less than 5%. More recently, though, participation rates have increased as utilities have taken advantage of lessons from past experience. Participation rates in the 20 to 40% range are not

[5] Nadel, S. et al. *Energy-Efficient Motor Systems: A Handbook on Technology, Program, and Policy Opportunities.* American Council for an Energy-Efficient Economy, Washington, DC, 1992.

Exhibit B–2: Economic Assessment of Industrial Motor & Drive Programs

Assumptions

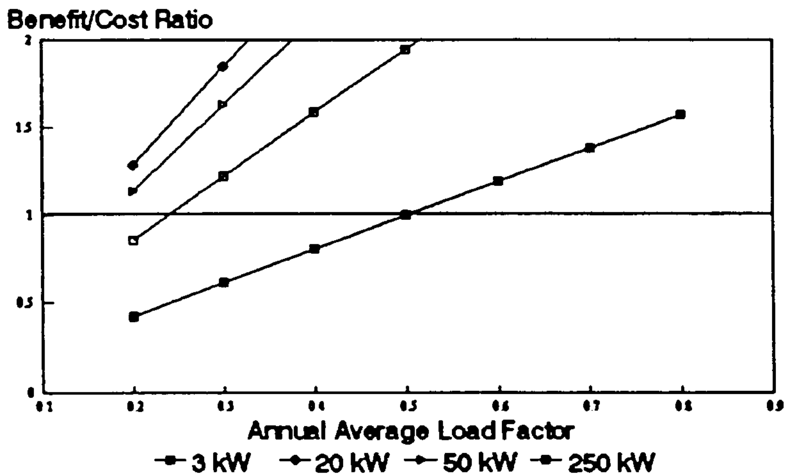
Real discount rate	10.0%
Economic Energy Cost ($/kWh)	0.042
Economic Capacity Cost ($/kW–yr)	21.45

	High Efficiency Motors*				ASDs			
Units	per motor	per motor	per motor	per motor	per motor	per motor	per motor	per motor
Motor Power (kW)	3	20	50	250	3	20	50	250
Cost of Measure ($)	120	300	750	3,750	2,500	5,500	10,000	40,000
Cost of Installation & Admin. ($)	100	100	100	100	1,000	3,000	3,000	5,000
Life of Measure (years)	15	15	15	15	15	15	15	15
Energy Savings	5%	4%	3%	2%	30%	30%	30%	30%
Coincidence Factor	0.4	0.5	0.5	0.6	0.4	0.5	0.5	0.6

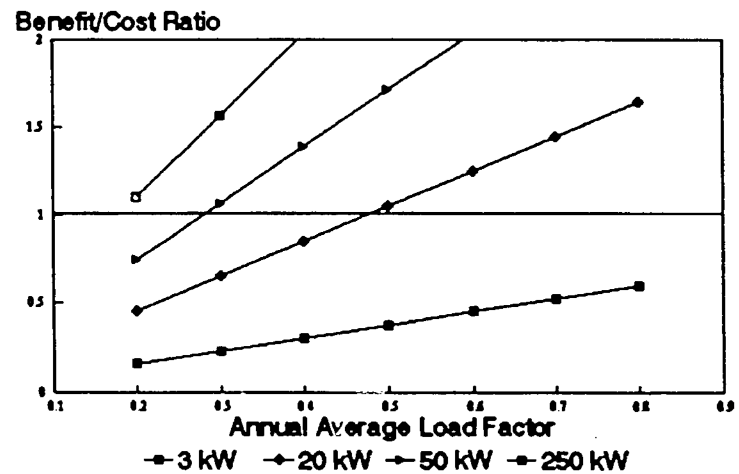
* High efficiency motor costs are incremental costs, i.e. the cost premium for high efficiency over standard motors. This corresponds to replacements and new motor purchases, not retrofits.

Results

Economic Evaluation of High Efficiency Motors



Economic Evaluation of ASDs



uncommon;[6] BC Hydro, a Canadian utility, has achieved 64% participation with its motor efficiency program over a four-year period. ASDs, on the other hand, have not enjoyed the same success because of the complexity of selecting and installing ASDs and their cost.

Based on the estimate of economic potential, the average motor efficiency participant reduces motor consumption by 1.8%. If the program enrolls consumers representing 30% of total industrial load,[7] cumulative savings will reach 0.5% of total industrial consumption. If ASD programs reach only one-tenth the customers of the motor efficiency program, ASDs will save 0.1% of total industrial demand. The total cumulative savings of the combined motor efficiency and ASD programs would therefore be 0.6%. It is assumed that one-third of these savings occur during the first three years of the program, and the remaining two-thirds occur during the last three years.

B.2 COMMERCIAL PROGRAMS

B.2.1 VAC Programs

In the United States, VAC programs (or more broadly, HVAC programs) are typically bundled with other commercial and industrial measures such as lighting or motor efficiency in a customized or energy audit program. Because of the prominence of VAC among commercial end-uses in the Philippines, it is discussed as a stand-alone program, although there is no reason that it cannot be combined with other measures in the Philippines.

Proposed Measures

Work carried out under the ASEAN-USAID Buildings Energy Conservation Project indicates that the following measures are the most promising for reducing air conditioning loads:

- raising setpoint temperatures to 25.5°C
- reducing air conditioning operating time
- minimizing outside air intake, often through changing pulleys on fans
- installing variable air-volume controls
- installing heat exchangers
- reducing air leakage and infiltration
- using efficient, properly sized chillers, compressors, pumps, and motors

6 Nadel, S. et al. *Achieving High Participation Rates: Lessons Taught by Successful DSM Programs*. American Council for an Energy-Efficient Economy, Washington, DC, January 1994.

7 This will be far fewer than 30% of all industrial consumers because the larger consumers will be targeted first; the 100 largest consumers represent over one-third of all industrial consumption.

- properly maintaining air handling units and mechanical equipment.

Economic Potential

According to the USAID-ASEAN study, the cost-effective savings attributable to these measures range from 1 to 13% of total building energy consumption. Work carried out by the American Council for an Energy Efficient Economy suggests that in the United States, cost-effective improvements could reduce HVAC consumption by as much as 50%. It is assumed here that cost-effective VAC measures would save 10% of commercial consumption, or 17% of VAC load. For the purposes of estimating economic costs, it is assumed that these measures cost $10,000 per participant.

Market Penetration

Programs of this type in the United States have achieved penetration rates of around 1% per year of program operation. These programs have focused on rebates for new or replacement equipment; hence, low penetration rates are expected because eligible consumers are likely to participate only when they must add or replace a piece of VAC equipment. Expanded programs that target measures other than efficient mechanical equipment (e.g., changing temperature setpoints or reducing infiltration) could be promoted through audits and other customized information for consumers, and would be expected to reach higher participation rates.

As in the industrial sector, a small fraction of consumers represent the majority of demand. By targeting large commercial consumers, impacts may be maximized. It is assumed that participating customers represent 1% of commercial demand for each year during the first three years of the program, and 2% per year for the last three years. By the end of the program, cumulative participants account for 9% of total commercial demand. It is assumed that this represents 1,000 consumers.

B.2.2 Lighting Efficiency Programs

In addition to the relatively high technical savings achievable with certain commercial lighting measures, participation rates for can exceed 50%, depending on program design. The three principal modes of program delivery are direct installation, rebates, and information. In addition, energy service companies will sometimes contract with consumers on a shared savings basis, but the results of these programs have been mixed.

Proposed Measures

Lighting programs involve replacing lamps and/or ballasts with higher-efficiency versions as well as delamping and installing fixture reflectors and lighting controls. Occupancy sensors and timers can be effective lighting control measures, particularly in hotels and office buildings. The selection of measures depends upon current lighting equipment stock, in terms of the technologies currently used, the applications and usage, and age.

Economic Potential

Building audits carried out for the Philippines under the ASEAN-USAID Buildings Energy Conservation Project found that average lighting power densities varied from 10.7 W/m^2 in hospital rooms to 19.3 W/m^2 in offices. Retail space would likely be higher than in offices. It is assumed that the average for the building stock is 17 W/m^2.

A study of the potential for commercial lighting improvements in the United States concluded that the maximum economic savings potential for a combination of fluorescent, incandescent, ballast, fixture, and controls measures is 59% in the year 2030.[8] Economic potential is less for a shorter time horizon (e.g., by 2005) because there is less time available for measures that rely on replacements or new stock additions. It is therefore assumed that the economic potential is 40% for comprehensive commercial lighting measures in the Philippines over the specified time horizon.

The initial economic cost of these measures would be around \$30/m^2, while the incremental economic cost of high-efficiency measures over standard equipment would be around \$5/m^2. Because the program would entail a mix of retrofit and replacement measures, it is assumed that the average economic cost is \$15/m^2.

Market Penetration

Market penetration will vary greatly depending on the type of delivery mechanism adopted. Information-only programs may achieve only a few percent participation, whereas direct installation programs have reached over 40% participation. It is assumed here that the program targets large customers with an aggressive marketing and delivery strategy (e.g direct installation), and thereby achieves cumulative participation from customers representing 10% of commercial lighting consumption. Commercial lighting consumption is therefore reduced

[8] Atkinson, B.A. et al. *Analysis of Federal Policy Options for Improving U.S. Lighting Energy Efficiency: Commercial and Residential Buildings*. LBL-31469. Lawrence Berkeley Laboratory, Berkeley, California, 1992.

by 4% by the end of the program. It is assumed that savings of 1.5% occur midway through the program.

B.3 RESIDENTIAL PROGRAMS

The residential sector accounts for nearly 30% of total electricity consumption in the Philippines. Because of evening lighting loads, it is the source of 35% of peak demand.

B.3.1 Refrigerator Efficiency Programs

Residential refrigerators account for 8% of total electricity consumption in the Philippines. Because they also account for 7.5% of peak demand, refrigerator efficiency improvements can also yield capacity savings.

Although the ESMAP household energy study did not measure refrigerator consumption, it presented a preliminary assessment of efficiency and potential programs.[9] That work provides the foundation for the current discussion.

Proposed Measures

According to a report from Lawrence Berkeley Laboratory,[10] the principal methods for increasing refrigerator efficiency are to use polyurethane foam instead of fiberglass insulation, increase the thickness of the insulation, use a more efficient compressor, and improve door gaskets. Analyses in the United States of options for improving refrigerator efficiency indicate that electricity use can be reduced by 30-40% with a 15-20% increase in manufacturing costs.

Refrigerators that incorporate these measures can be promoted in three ways:

- testing and labelling of all refrigerators to be sold, so consumers would be aware of the energy costs associated with that particular model, both in absolute terms and relative to other models in that class

- rebates to trade allies, e.g., appliance retailers, to help encourage the sale of these improved models

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9 ESMAP, op. cit., Chapter 4.

10 Meyers, S., et al. *Energy Efficiency and Household Electric Appliances in Developing and Newly Industrialized Countries*. LBL-29678. Berkeley, California, Lawrence Berkeley Laboratory, 1990.

- incentives to manufacturers and assemblers in the Philippines to incorporate more efficient designs in their production.

Economic Potential

According to the ESMAP study, the average refrigerator in the Philippines consumes some 650 kWh/year, has a lifetime of 15 years, and costs around $400. A 30% reduction in energy consumption is valued at approximately $20/year (650 kWh/year x 30% savings x $0.042/kWh + 150 W power demand x $257/kW-year capacity value x 0.3 coincidence factor). A 15% increase in price is $60. This "investment" yields a 33% real internal rate of return.

It is expected that refrigerators are replaced with more efficient models only upon the end of their life. Over the six years of the program, it is assumed that one-quarter of all refrigerators are replaced. In addition, it is assumed that the number of new refrigerators purchased during that period is equal to half the number existing at the start of the period (corresponding to a 7% annual growth rate over six years, consistent with the robust economic forecast by NEDA). Therefore, the total economic potential, as a percentage of total refrigerator consumption prior to the start of the program, is 22.5%.

Market Penetration

It is assumed that by using the three program types described above, the achievable potential will equal the economic potential. In particular, "upstream" programs can drastically change the energy consuming characteristics of the total refrigerator stock, because all new refrigerators will be more efficient. Given total savings of 362 GWh/year in 2005 and savings per unit of 195 kWh/year, a total of 1.9 million high-efficiency refrigerators will be purchased over the life of this program.

B.3.2 Lighting Efficiency Programs

In many countries, residential lighting is the predominant component of system peak demand. Residential lighting efficiency programs are well established in Canada, the United States, and Western Europe. Programs are now planned or underway in Thailand, Indonesia, and Mexico, as well as the Philippines.

Residential lighting accounts for 8% of total electricity consumption in the Philippines. Because it also accounts for 17% of peak demand, lighting efficiency improvements can yield substantial capacity savings.

The ESMAP household energy study cited above also considered residential lighting efficiency measures. That work, in particular the assessment of the lighting market, provides the foundation for the current discussion.

Proposed Measures

Given the use of both fluorescent and incandescent lighting in Filipino households, several measures are possible, including:

- replacement of incandescent bulbs with compact fluorescent lamps, which can save 75% of the electricity consumed by incandescent bulbs
- replacement of low-efficiency fluorescent lamps with high-efficiency models, which can save 10%
- replacement of standard magnetic ballasts with high-efficiency magnetic or electronic ballasts, which can save up to 25% of power consumption, especially when used in conjunction with T-8 fluorescent lamps.

The principal ways of delivering these measures include information programs, rebates, and direct installation.

Economic Potential

Currently, slightly more than half of all Filipino households use electricity, and virtually all of these have electric lighting. According to the ESMAP household energy consumption survey, the average electrified household consumes 180 kWh/year for incandescent lighting and 161 kWh/year for fluorescent lighting. The ESMAP study shows that compact fluorescent lamps (CFLs) are attractively economically, even replacing incandescent bulbs used as little as 2 hours/day. For fluorescent lamps used in households, improved lamps and ballasts can reduce power consumption from an estimated 27 W to 22 W. However, assuming this measure costs more than $10, then it would be marginally cost-effective at best. Therefore, this program focuses on the use of CFLs.

In Indonesia, CFLs could cost effectively replace incandescent lighting representing approximately one-third of all residential incandescent lighting consumption.[11] Assuming the same proportion for the Philippines, the economic savings potential for residential CFLs is

[11] RCG/Hagler Bailly. *Indonesia Power XXIII: Technical Report for Appraisal of the DSM Component*. Prepared for the Asian Development Bank, 1993.

\?p

13% (0.33 share of incandescent consumption for which CFLs would be economically justified x 180/(180+161) share of incandescents out of total residential lighting x 0.75 technical savings for replacing incandescents with CFLs). The total incremental economic cost for each CFL is assumed to be $15.

Market Penetration

Market penetration will vary with the type of delivery mechanism employed. It is assumed that direct installation programs can install an average of 100,000 CFLs per year during the first three years of the program, and an average of 200,000 CFLs per year during the last three years, so that 900,000 CFLs can be installed through direct installation. It is assumed that rebate and information programs combined achieve similar participation. If the average CFL replaces a 40 W incandescent bulb, total program savings will reach 54 MW, or 11.6% of 1992 peak residential lighting consumption.

ANNEX C
DSM EXPERIENCE AND INITIATIVES IN NORTH AMERICA AND ASEAN

C.1 THE NORTH AMERICAN EXPERIENCE

This section describes the experience of U.S. and Canadian utilities and a coalition of private U.S. facilities in implementing DSM initiatives in the industrial, commercial, and residential sectors. It presents the coalition's response to a utility's load management activities for industrial and commercial customers, and utility programs for motors and drives, lighting, HVAC, and refrigeration. Hagler Bailly is indebted to The Results Center of IRT Environment, Inc., which publishes profiles of successful DSM programs, from which much of the following information on North American programs was drawn.

C.1.1 Industrial Programs

Interruptible Rates

California Energy Coalition (CEC) Load Management Activities

The CEC is a non-profit organization that coordinates curtailments of electrical services on behalf of several large commercial and industrial facilities in California. Its eleven members include a variety of organizations such as a large insurance company, a hotel, a sanitation facility, and office complexes.

CEC can be thought of as a third-party broker for load management. It represents its members in negotiations with Southern California Edison (SCE) and then oversees the member companies' daily load management operations.

Through a network of interactive computer systems, CEC can dispatch load-off line, thereby reducing the utility's on-peak system load. A central computer links all of CEC's members to the utility control center. Upon receiving a request for load reduction, this computer determines the proportionate load reduction for each member in order to meet SCE's request. A load reduction strategy is then defined and members are notified of their respective targets. If a member cannot fulfill its assigned load reduction, the system automatically reallocates that load to other members based on a pre-existing priority agreement.

It is CEC's responsibility to achieve the overall curtailment level requested by the utility. During the curtailment, however, SCE is not aware of the level of each member's involvement in the curtailment efforts.

While many of CEC's load curtailment measures simply defer electricity use to off-peak hours, others (such as reducing hallway lighting levels) do not result in any take-back during off-peak hours. Thus, CEC's actions help its members to lower their overall electricity consumption.

SCE pays CEC $6.90/kW per month for the amount of capacity that CEC has available for the four months of summer, regardless of whether a curtailment is put into effect. In 1991, SCE paid CEC $364,899 for an average peak capacity contribution of 13,977 kW. Of this fee, CEC retained 15% for its management activities and 5% for future enhancements of its operations. The remaining 85% was distributed among CEC members based on their prorated share of overall capacity. If a member fails to meet its aggregate firm service level, it will be assessed a penalty of $27.60/kW.

To join CEC, it schedules an initial meeting with the representatives of the interested facility/organization to learn about CEC and its membership requirements. A walk through of the facility is also conducted during the first meeting, which enables CEC staff to learn about the facility's energy consumption patterns and opportunities for energy conservation. Next, CEC provides the potential member with information on the cost of joining the coalition, the member's commitment to CEC, and the annual benefits its membership will yield. Members repay their initiation fees to CEC through the energy savings they realize.

Members' commitment to CEC usually entails an agreement to curtail their loads by an average of 10% as many as 15 times a year for up to 6 hours at a time. If they exceed their commitment levels, members are compensated through a prorated share of the resulting incentives. CEC members attend meetings every other month to discuss opportunities for higher levels of energy management and to share valuable experiences.

CEC's current membership is organized into three cooperatives: The Southern California Coalition, The South Bay Energy Coalition, and The Southern California Energy Coalition II. Each summer month, CEC reaches a coincident peak level for each of these cooperatives. This peak level is measured during SCE's on-peak tariff period, and the utility pays the margin between CEC's monthly coincident peak demand and the firm service level established each May 1.

One of the most important lessons learned from the energy cooperative activities of CEC is that a third-party broker can effectively provide the utility with reliable load reduction when it is most needed. CEC has not only helped SCE attain its desired system loads but has also provided several large commercial and industrial users in California with low-cost load management strategies and improved energy consumption patterns. Furthermore, CEC payments to facility managers have allowed them to make a difference in their company's financial situation and a positive contribution to their work environment.

Motors and Drives

British Columbia Hydro's (BHC) Power Smart High-Efficiency Motors Program

Every year, BCH's 22,000 industrial customers purchase over 300,000 horsepower (hp) of 3-phase motors (both efficient and standard motors) and consume approximately 15,300 GWh of utility-generated electricity. BCH launched its Power Smart High-Efficiency Program in 1989 to transform the industrial motor market in British Columbia and increase sales of high-efficiency motors in the province.

The program is designed to influence three distribution channels in the province:

- *Direct sales.* Often, purchases of motors for large companies are awarded to motor manufacturers in the form of multi-year supply contracts. Although the manufacturers are not eligible for rebates under this program, their customers receive rebates to purchase high-efficiency motors. In 1990, 22% of the overall rebates paid by BCH was captured by participants who purchased their motors through direct sales.

- *Original Equipment Manufacturers (OEMs).* OEMs are manufacturers who install motors in their packaged products, which are then sold on the market. Since OEM production in British Columbia is aimed at the local market, BCH would benefit from the installation of high-efficiency motors in the packaged equipment assembled by the local OEMs. Like the direct sales channel, OEMs themselves do not qualify for rebates.

- *Local Distribution Channels.* The local distribution channel refers to vendors who stock the motors in their shops. This channel has been particularly important to BCH because the top-ten vendors in the province sell 80% of the motors distributed through this channel.

BCH's goals for Phase 1 (October 1, 1988 through September 30, 1990) of the program were to induce large industrial customers to change their motor-buying patterns and obtain energy savings of 13 GWh in 1989/90, 26 GWh in 1990/91, and 370 GWh by the year 2009. In Phase 2 (the period starting October 1, 1990), BCH intended to reach a target of 80% of the high-efficiency motor sales mix for 1 to 200 hp motors, and to achieve energy savings of 100 GWh by 1993, 400 GWh by 2000, and 1,000 GWh by 2010.

The Power Smart High-Efficiency Program has been marketed through several channels. Potential participants learn about the program requirements through BCH staff and motor vendors. The database of energy-efficient motors and their rebate levels, which is distributed to vendors and manufacturers biannually, has also been a source of information and education.

BCH's motors program has three primary components:

- *The Educational Component.* Through seminars on motors and adjustable speed drives, plant energy audits, a motors database, and other demonstration projects such as the Energy Bus running on efficient motors, BCH trains its customers on the advantages of high-efficiency motors.

- *The Participant Rebate.* This component is considered to be the main driver of the program. Initially, customers were offered $334/kW for the purchase of high-efficiency motors. However, in 1992 the rebate level was reduced to $293/kW. For a typical 20 hp motor, this translated into an approximate rebate of $200.

- *The Vendor Incentive.* Introduced in July 1990, an incentive of $59/kW is available to distributors based in the British Columbia area. This incentive has been very successful in moving the market in this area and encouraging local vendors to stock and recommend high-efficiency motors.

A buy-back component was also introduced in October 1990 to stimulate the early retirement and replacement of conventional motors with high-efficiency motors. However, this component was phased out in January 1993 for two main reasons. First, the purchase of standard operable motors would adversely affect the local rewind shops and drive up the price of rewound and used motors. Second, in the case of burnt-out motors, the inoperable motor is often immediately replaced with a working motor in the inventory. Therefore, buying back burnt-out motors does not necessarily result in the utilization of high-efficiency motors.

The total cost of the program from the fourth quarter of 1988 through the end of 1991 was $4,080,800 and included the administration, overhead, and research that was not related to customer incentives. Incentive costs of $2,101,300 constituted 51% of this cost, while administrative costs (i.e., labor, materials, incentives, travel expenses, consulting costs, etc.) constituted the remaining 49% ($1,979,500). The total cost of the program in 1991 was $1,817,700. Of this, $866,800 was spent on incentives and the remaining $950,900 was spent on administrative costs.

Since its inception 737 customers (equivalent to 3.35% of the approximately 22,000 industrial customer base of BCH) have joined the Power Smart High-Efficiency Motors Program and received 3,153 rebates for 535,339 horsepower. This includes 511,085 hp through customer rebates and 24,254 hp through the buy-back option. The main beneficiaries of the motor rebates were the wood and pulp and paper industries, which accounted for 39% and 33.1%, respectively, of the 105,500 hp rebated in 1991.

BCH has learned that successful implementation of the motors program requires a "clear and consistent" dialogue with trade allies (i.e., vendors and OEMs). This not only allows the trade allies to contribute significantly to the design and implementation of the program but also gains their support, which in turn assists with penetrating the market for motors. BCH has also learned that as the awareness of efficient motors increases among its customers, it can review, reduce, and reallocate the rebate amounts to obtain a better investment for the program funds.

Niagara Mohawk Power Corporation's (NMPC) High-Efficiency Motors and Adjustable Speed Drives Program

NMPC's High-Efficiency Motors and Adjustable Speed Drives Program is designed to overcome market barriers that hamper the installation of high-efficiency motors and drives in the utility's service territory. In NMPC's experience, these barriers include customers' aversion to downtime, which motivated them to replace their failed standard motors with other readily available standard replacements rather than switching to high-efficiency ones. Furthermore, the relatively large costs of high-efficiency motors, facility managers' limited access to capital, and a lack of knowledge about the benefits of high-efficiency motors had seriously hampered their installation in NMPC's service territory.

NMPC's motor program offers rebates to commercial and industrial customers to stimulate the installation of high-efficiency motors and drives in the near term and to enhance customers' awareness about the benefits of the more efficient equipment, thus transforming the market toward more efficient motors and drives. While all of NMPC's non-residential customers are eligible for program participation, the program is mainly targeted at the 300 large hospitals and 2,100 industrial facilities in the utility's service territory. The program began in 1991 after the implementation of several pilot programs during 1990. Rebates are offered to commercial and industrial customers who install high-efficiency motors and adjustable speed drives in their manufacturing, processing and HVAC equipment. Although customers in the commercial sector qualify for program participation, the program has been mainly targeted at large industrial customers, who are the primary users of motors and drives.

The program is marketed along with other NMPC DSM programs and through the program brochure *Reducing Plan for Business*, which includes a booklet that describes all the DSM programs for which customers may qualify. NMPC's marketing strategy also relies on customer and trade ally awareness, which is usually enhanced through trade shows, direct mailings and media advertisements.

To identify potential opportunities for motor and drive replacements, an initial visit is scheduled to a potential participant's facility. This visit is conducted through NMPC's Energy Audit program and is initiated by the customer's representative(s). If the audit results in the identification of any opportunities, the NMPC representatives help the customer to identify the financial requirements for the project, locate trade allies who can supply the necessary equipment, and develop a sales proposal to obtain in-house approval for program participation.

To be eligible for utilization under the program, the proposed high-efficiency motors must be operated at least 3,000 hours per year, be three-phase National Electrical Manufacturers Association design B or C, meet the specified minimum nominal efficiencies, and be tested in accordance with the IEEE standard 112 test method B or an acceptable alternative method for foreign motors. High-efficiency motors from 1 to 200 hp required by the New York State energy code in new construction and major retrofits are not eligible because their installation is required by law. Only AC adjustable speed drives (ASDs) used in throttled fan and pump applications are eligible under the program. Furthermore, to qualify for a rebate, ASDs must be installed in applications that do not require their utilization under standard modes of operation.

Eligible motors with a horsepower rating of less than 5 hp qualify for a rebate of $35, while those of 5 hp or larger qualify for $5/hp. The minimum nominal efficiencies for motors range from 84% for 1 hp motors to 95.8% for 400 hp ones. The rebates for ASDs are not as uniformly structured as those for motors. Generally, the smaller ASDs qualify for larger rebates in terms of dollars per horsepower. For example, a 5 hp ASD qualifies for a rebate of $550 (i.e., $110 per hp), while a 400 hp ASD qualifies for a rebate of $18,000 ($45 per hp).

NMPC's expenditures on its motors and drives program totalled $5.34 million during 1991 and 1992. Customer rebates constituted 79% of the overall program expenditure ($4.23 million), while the remaining 21% ($1.11 million) was spent on administrative costs and expenses. The high program expenditure of $4.48 million during 1992 (more than five times the 1991 expenditures) was attributed to the increased levels of participation and rebates.

For the 1991 and 1992 implementation years, the program achieved a total saving of 76 GWh. During the same period, the total summer and winter peak demand reductions were 1.4 MW and 1.5 MW, respectively. The cost of saved energy in 1991 ranged from $0.0085/kWh (for a discount rate of 3%) to $0.0126/kWh (for a discount rate of 9%). For 1992 the cost of saved energy ranged from $0.0056/kWh (for a discount rate of 3%) to $0.0082/kWh (for a discount rate of 9%).

In 1991 the program's 115 participants had installed 161 motors for a total of 4,975 hp and 214 ASDs for a total of 5,345 hp. In that year, 19% of the rebated high-efficiency motors and 10% of the rebated ASDs exceeded 50 hp. As a result of increases in rebate amounts, the total rebates increased to 736 in 1992. From the beginning of 1992 through February 1993, NMPC rebated 5,260 motors for a total of 191,472 hp and 1,469 ASDs for a total of 58,472 hp. In 1992, 23% of the rebated high-efficiency motors and 23% of the rebated ASDs exceeded 50 hp.

One of the primary lessons learned from NMPC's motors and drives program is that rebate levels can significantly influence program participation rates. NMPC's rebate increases during 1992 quadrupled program participation. The challenge remains to provide rebate levels that optimize program participation and the utilization of the program's financial resources.

The program's simple rebate list, which does not specify exact models and manufacturer brands, is another feature of the program that increases its flexibility and adaptability.

C.1.2 Commercial Programs

Lighting Programs

San Diego Gas & Electric's (SDG&E) Commercial Lighting Retrofit Program

SDG&E's Commercial Lighting Retrofit Program (CLRP) is primarily designed to offer the utility's commercial sector customers cash incentives for 2, 4, and 8 foot fluorescent fixtures (lamps, ballasts, and optical reflectors). However, the program has also convinced many commercial customers to retrofit their entire interior lighting systems with more efficient systems and receive incentives for doing so. Incentives for other lighting systems are offered based on the customer savings as computed by the standard total resource cost test. Specific measures must be approved by a senior SDG&E engineer with extensive background and expertise in lighting.

To recruit customers for program participation, SDG&E account executives usually generate the initial customer leads. Account executives are permanent, salaried employees who work with individual customers and visit their facilities regularly. Subsequent solicitation for program participation is made by lighting representatives. These representatives are the program's sales force and are lighting specialists who have been hired temporarily to "push" the CLRP.

The use of temporarily-hired lighting representatives rather than full-time employees is one of CLRP's unique features. To ensure program success, these representatives receive commissions based on energy savings attained through their sales efforts. Each representative is initially given an energy saving goal based on SDG&E's annual energy conservation plan. In addition to their base salaries, lighting representatives receive 1 mill (i.e., $0.001) per kWh for energy savings up to their pre-set goals. Lighting representatives surpassing their goals are compensated 2 mills per kWh for energy savings beyond their goals. Furthermore, an additional 1 mill per kWh is applied retroactively over all of the kWh savings the representative has accomplished during the year. In case of unsatisfactory performance (e.g., lower lighting levels resulting from retrofits or unhappy customers), the lighting representative must pay back his/her commissions at a 2 to 1 ratio.

Facility audits are performed by a SDG&E lighting representative for customers who are interested in program participation. A number of lighting retrofit options are usually identified during the audit stage. The lighting representative then selects an installation contractor (through a competitive bid process) who will install the recommended lighting measures. In 1990, SDG&E selected six contractors on a competitive basis to form a qualified pool of contractors. The number of qualified contractors in the pool was expanded to ten in 1992. Customers have the option to select their own contractors or use the in-house expertise of their employees. In this case, the installed measures are inspected and approved by a SDG&E lighting representative.

CLRP's energy savings from its inception through 1992 totalled 118 GWh, which is equivalent to a life cycle energy saving of 1,770 GWh. Program savings of 18, 48, and 52 GWh were attained during 1990, 1991, and 1992, respectively. The low energy savings of 1990 were due to the late start of the program in September. CLRP's non-coincident peak demand savings totalled 28.9 MW for the same period (3.9 MW in 1990, 12 MW in 1991, and 13 MW in 1992).

The number of participants in the program has steadily risen since 1990. There were 140, 600, and 789 program participants in 1990, 1991, and 1992, respectively.

Incentive payments constitute the bulk (87%) of the total program expenditures. SDG&E's incentive payments during the three-year period 1990 through 1992 were $2,401,100 in 1990, $7,526,400 in 1991, and $9,383,700 in 1992. Administration costs for the same period were $361,200 in 1990, $700,500 in 1991, and $1,486,500 in 1992.

SDG&E has realized that in order to maintain high levels of customer satisfaction, the program must be kept open to all contractors because many customers prefer to use their own lighting contractors. SDG&E has also learned that in order to avoid bidding wars and wasted efforts, program participants must be required to decide very early on whether they would like to use their own contractors.

An important aspect of SDG&E's CLRP that may be transferable to other utility-sponsored programs is the compensation mechanism for the lighting representatives. The two-tiered commission system directly ties representatives' earnings to kWh saved per customer/job along with the targeted annual energy savings.

Sacramento Municipal Utility District's (SMUD) Commercial Lamp Installation Program

SMUD's Commercial Lamp Installation Program (CLIP) was designed to reduce the utility's afternoon peak demand and help the small commercial customers in its service territory improve their lighting efficiency.

SMUD began a pilot of the CLIP program in 1986. The pilot's primary goals were to:

- implement the energy-saving fluorescent lamp recommendations identified by the small commercial audit program
- develop cost/benefit information
- determine customer acceptance
- determine if direct lamp installation increased the implementation of recommendations in the small commercial audits
- determine vendor and lighting maintenance contractor acceptance
- determine the feasibility of extending the program beyond the 1986 pilot test program.

During the pilot phase of the program 1,278 customers received 54,362 lamps. The resulting energy savings convinced the SMUD program designers to move to the full-scale implementation phase.

CLIP's full-scale program was primarily aimed at small businesses with a demand for electricity of 30 kW or less and annual energy consumption of 48,000 kWh or less. Based on these characteristics, an original target list of 18,500 customers was developed. In 1988, this list was appended with approximately 1,500 more customers whose demand for electricity ranged between 30 kW and 50 kW.

The full-scale program was primarily aimed at replacing standard 4 foot F-40 and 8 foot F-96 lamps with 34 W and 60 W energy-efficient lamps, respectively. In order to distribute lamps to all eligible customers, SMUD set a limit on the number of lamps that each customer could receive: up to 100 four-foot lamps *or* up to 50 eight-foot lamps, including installation. For customers needing a combination of both 4 and 8 foot lamps, SMUD used a point system where each customer was eligible to receive up to 100 points worth of lamps. Under this system, each 4 foot F40 lamp was valued at one point, and each P96 (8 foot) lamp was valued at two points.

Although the program originally allowed for the replacement of incandescent with compact fluorescent lamps (CFLs), 4 and 8 foot lamps represented about 99% of the lamp replacements, and the program's CFL component was eventually cancelled. Under the point system, compact fluorescent lamps were valued at 8 to 25 points and tungsten-halogen lamps were valued 3 to 5 points depending on their wattage. In order to qualify for program participation, businesses were required to meet the following:

- the account must be classified as small commercial (less than 50 kW demand)
- the facility must be owned or rented by one of the SMUD's small commercial customers
- lights must normally operate during SMUD's summer peak period (between 1:00 p.m. and 9:00 p.m.)
- the facility must not already have energy-saving fluorescent lamps
- lamps must be in conditioned space, 12 feet or less from the floor and readily accessible
- ballasts must be compatible with energy saving lamps
- previously delamped fixtures are not eligible
- lamps must be installed during program operation hours (to simplify scheduling and avoid overtime)
- inoperable fixtures, fixtures with ballasts in the process of failing, obvious mechanical problems, or F40 single pin lamps are not eligible
- customers with existing lighting maintenance contracts are not eligible
- customers must allow SMUD to disable their old, standard fluorescent lamps
- SMUD is not responsible for fixing pre-existing defective conditions (e.g., wiring, sockets, or fixtures)
- the customers agree to hold SMUD harmless of all loss or damage arising from, or in any way connected with, pre-existing conditions
- SMUD is not responsible for lamp and ballast failures occurring more than 30 days after installation.

To market the CLIP, SMUD initially tried a direct mail approach where introductory letters and "group relamping" brochures were mailed to the potential program participants. Later, SMUD auditors approached customers on a zip code basis and without prior notification. A spot lighting audit was also performed in case a customer met the eligibility requirements and agreed to participate in the program.

The goal of the program was to recruit as many as possible from the list of 20,000 customers identified through the initial target list. Of the 2,350 customers contacted during the pilot phase, 1,278 accepted installation. In 1987 and 1988, 6,061 more customers were recruited for program participation. This indicates a participation rate of approximately 37% of the identified 20,000 customers. However, SMUD determined that approximately 3,838 of the 20,000 customers actually did not qualify for program participation. This determination reduced the pool of qualified applicants to 16,196 and increased the participation rate to approximately 45%.

Program savings for 1986 (July through December), 1987, and 1988 were estimated at 1.32 GWh, 2.91 GWh, and 2.65 GWh, respectively. Summer capacity savings for the same period were 0.48 MW, 0.98 MW, and 0.86 MW. SMUD estimated that it would save 34.4 GWh of electricity over the life of the measures installed from 1986 through 1988. Furthermore, SMUD expected an additional lifecycle saving of 39.1 GWh to come about from the persistence of 25% of the original installed measures.

Program expenditures from 1986 through 1988 totalled $1,242,300. Program costs consisted of labor costs ($138,100 in 1986, $306,000 in 1987, and $305,400 in 1988), lamp costs ($86,600 in 1986, $195,200 in 1987, and $168,200 in 1988), and other costs ($9,700 in 1986, $21,500 in 1987, and $11,600 in 1988). As depicted by these figures, labor costs constituted 60.4% of the overall costs, lamp costs constituted 36.2% of the overall costs, and other costs constituted the remaining 3.4%.

One of the lessons learned during this project was that lamp acquisition in the open market is much faster and more reliable than acquisitions through the state bidding system. SMUD also believes that it would be simpler and cheaper if the utility hired the auditors and installers because it would reduce time and effort spent on contract approval.

Inclusion of the persistence of energy savings in CLIP's cost/benefit calculations significantly contributed to the attractive outcome of this analysis. Therefore, it would be desirable to build elements into the program that would ensure the persistence of savings. An option is to install 4 foot T-8 lamps (32 W) with special ballasts that would require the customer to continue using energy-efficient lamps after the original lamp is burnt out.

Heating, Ventilation, and Air Conditioning Programs

Southern California Edison's (SCE) Energy Management Hardware Rebate Program

Since 1978, SCE's Energy Management Hardware Rebate Program (EMHRP) has been providing the utility's commercial, industrial and agricultural customers with incentives for energy efficiency improvements. Incentives are paid for lighting, space conditioning, building envelope enhancements and motor upgrades.

EMHRP is available to all of the utility's non-residential customers. The rebate process is quite simple and is managed by one of SCE's energy services representatives. A representative first conducts an energy survey of the customer's facility, recommends applicable energy-efficient measures, and issues a coupon authorizing the customer to install the selected measures. After the installation is completed, the representative performs an inspection, receives copies of the invoices, and validates the coupon. The customer can then redeem the coupon within four to five weeks after the coupon is received by SCE.

SCE's marketing of EMHRP primarily relies on personal contacts. Eligible customers are contacted at least once every other year by marketing representatives who inform them of the latest developments in the utility's incentive programs and also provide them with several customer functions. EMHRP is also marketed through television, print advertisements, trade applications, trade show displays and seminars.

The initial contact with most program participants occurs through the Commercial, Industrial, and Agricultural Audits program during which customers undergo surveys to identify energy conservation opportunities in their facilities/buildings. The energy saving options identified during the survey are then reviewed in order to identify the ones that qualify for rebates. A preliminary rebate amount is calculated for each of the qualifying measures and is provided to customers. Subsequently, the customer can choose measures to implement based on these calculated values. The final rebate amounts are calculated based on engineering estimates of savings that will result from the actual installation.

Rebates for the air conditioners and heat pumps covered under the program are based on the rated electrical cooling output and the seasonal energy efficiency ratio (SEER) or energy efficiency ratio (EER) of the installation. The qualifying measures under these two categories include:

- room air conditioners and heat pumps, air-cooled split system and air-cooled single-package air conditioners and heat pumps, evaporative or water cooled air conditioners, water source heat pumps, and air source conditioners and heat pumps (rebates for these measures range from $9/ton to $20/ton)

- replacement of electric air conditioning systems with evaporative coolers ($70/ton)

- high-efficiency chillers that meet or exceed specified efficiency levels ($15/ton to $18/ton).

The building envelope measures covered under the program are usually rebated on a $/ft^2 basis and include:

- permanent installation of window tints or screens with shading coefficients of 0.50 or less ($0.8/ft^2)

- roof insulations equal to or greater than R-19 and wall insulation equal to greater than R-11 installed in electrically cooled or heated facilities ($0.16/ft^2).

EMHRP's energy savings between 1987 and 1991 totalled 596.3 GWh (207.3 GWh in 1987, 55.5 GWh in 1988, 61.6 GWh in 1989, 79.6 GWh in 1990, and 192.3 GWh in 1991). Lifecycle savings will total 8,312 GWh. Capacity savings during the same period totalled 147.5 MW (72.6 MW in 1987, 11.8 MW in 1988, 11.8 MW in 1989, 15.5 MW in 1990, and 35.8 MW in 1991). Most of the 1991 savings were realized in the commercial sector (123.8 GWh). Industrial projects realized 55.3 GWh, and agricultural customers saved 13 GWh during the same period.

Program participation totalled 28,508 customers from 1987 through 1991 (3,933 in 1987, 1,385 in 1988, 1,545 in 1989, 2,596 in 1990, and 19,049 in 1991). In 1991, commercial customers installed 16,863 measures, industrial customers installed 1,718 measures, and agricultural customers installed 468 measures.

From 1987 through 1991 EMHRP's expenditures totalled $39,472,000. Program costs primarily consist of administration (13% of the total) and incentive expenses (87% of total). The program's administrative costs during 1987, 1988, 1989, 1990, and 1991 were $500,500, $2,316,200, $341,900, $7,400, and $3,264,600, respectively. Incentives paid during 1987, 1988, 1989, 1990, and 1991 were $4,858,700, $377,700, $1,807,900, $5,497,600, and $20,499,500, respectively.

The high program participation levels in 1991 depleted the program's annual budget by April of that year and forced the program managers to reappropriate the budget in order to meet program needs without requesting additional funds.

Through the implementation of EMHRP, SCE has gained invaluable insights into setting appropriate rebate levels for the measures covered under the program. SCE plans to base rebate amounts on the relative value of the energy saved by each measure category. By reviewing different customer use patterns for each piece of equipment, SCE can adjust the equipment and applications saving estimates in a manner that is most valuable to the utility.

Northeast Utilities' (NU) Energy Conscious Construction Program

NU's Energy Conscious Construction (ECC) Program provides building owners and designers with the educational, technical assistance, and direct financial incentives to incorporate energy-efficient design principles and technologies into major renovation and new construction programs.

Until 1988, the ECC program was mainly an informational program that offered builders, designers and building owners educational information about energy-efficient measures. On September 31, 1988, the redesigned ECC, which included incentives equal to the full incremental cost of design and construction costs, went into effect.

NU utilizes a direct one-on-one marketing approach for its ECC program. Inclusion of the same utility staff in all stages of program (i.e., marketing through delivery) is one of strengths of ECC's marketing strategy. The marketing literature includes a straight-forward information pamphlet aimed at informing building owners and facility managers, an aesthetically and philosophically sophisticated pamphlet directed toward engineers and architects, and a guidebook titled *Energy and Economics, Strategies for Office Building Design*, which contains information on the energy and cost impacts of various efficiency measures on a hypothetical 50,000 ft^2 office building. In addition to these marketing materials, NU has placed advertisements for ECC in trade publications and its staff speak at large design conferences several times a year.

The ECC program has two major components: The Prescriptive Area and The Comprehensive Area. The Prescriptive Area is aimed at small projects (facilities with areas of less than 50,000 ft^2), regardless of their stage of construction or design. Under this area, the utility provides the program participants with general and technical support in the design and installation of approved energy measures. Prior to installing any measures, a contract listing the approved measures and their corresponding incentives is signed by the building owner and the utility. NU only pays incentives for measures that are included on this list. The HVAC equipment covered under this area include air conditioners, heat pumps, and fan cooling units. Incentives vary with cooling capacity, Seasonal Energy Efficiency Ratio (SEER), Energy Efficiency Ratio (EER), Heating Seasonal Performance Factor (HSPF), or Coefficient of Performance (COP).

The Comprehensive Area takes advantage of every step of design and attempts to incorporate as many energy-efficiency measures and concepts as possible during the early stages of building/facility design. Within this area, utility personnel and their representatives assist building owners/designers with considering a wide range of energy-efficient measures. The

Comprehensive Area provides the building owner/design team with access to the technical assistance and resources of NU without jeopardizing its complete control of the project.

The Comprehensive Area utilizes a team approach in which NU personnel work directly with the building owner's design team throughout the design process of a new construction or major renovation project. In the first stage, the utility and design team sign an agreement to initiate the comprehensive process. Shortly thereafter, an initial brainstorming session is arranged during which the design team and the utility representatives identify a baseline building design and several alternative energy-efficient designs.

During the next phase, several parametric computer simulations are performed to calculate the effect of each efficiency measure on the energy requirements of the baseline building design. While the simulations are being performed, the design team prepares estimates of incremental costs (i.e., the difference between the cost of the baseline building and the energy-efficient option) to design, obtain and install the efficiency measures included in the alternative designs under consideration.

Upon receipt of the prepared cost estimates, a cost-effectiveness test known as the "screening cap" is conducted. During this test, the estimated incremental cost of a measure is compared to its effect on the energy requirements of the building under consideration (i.e., in the baseline design). Based on NU's requirements, the estimated incremental cost of a measure divided by the product of its useful life and the annual electric energy savings that it produces must not exceed $0.036/kWh. Measures that pass this test are included in an interactive computer simulation that determines the combined effect of the selected measures on the building under consideration.

Prior to measure installations, the building owner is required to sign a contract with the utility stating agreement to proceed with the selected alternative design that includes the measures selected through the interactive simulation process. Incentives are paid-for measures that are properly installed and functioning. In addition to the incentive, the design team receives a $1,000 honorarium for its participation in the brainstorming sessions and is eligible to receive a performance-based incentive award that is the larger of $500 or 30% of the estimated design incentive if the energy-efficient design results in 20% less annual electric energy consumption than the baseline design.

ECC's energy savings during 1989 and 1990 totalled 13.987 GWh (2.876 GWh in 1989 and 11.111 GWh in 1990) and deferred the need for 3.23 MW (0.56 MW in 1989 and 2.67 MW in 1990) of additional summer peak load. It also deferred the need for 2.25 MW (0.46 MW in 1989 and 1.79 MW in 1990) of additional winter peak load.

Program participation is estimated at between 20% and 25% of all new, non-residential construction projects in NU's service territory.

The total program cost consists of the expense cost and the payroll cost. Payroll costs were $379,768 in 1989 and $360,262 in 1990. Expense costs were $1,226,683 in 1989 and $3,465,428 in 1990.

NU has learned that ECC is most effective in influencing the efficiency of a building/facility when it is employed early in the design process. Furthermore, NU has realized that the description of efficiency measures to be included in a project must be clear and carefully drafted in order to avoid any misunderstandings regarding the utility's and customers' obligations under the contract.

C.1.3 Residential Programs

Lighting

Southern California Edison's (SCE) Low-Income Relamping Program

SCE's Low Income Relamping program (LIR) is one of the nine programs in the utility's Customer Assistance Program (CAP) that provides energy-efficiency services to low-income customers and customers with special needs (i.e., senior citizens, the physically handicapped, and those who speak little or no English).

LIR is specifically designed to reduce low-income customers' electric bills, stimulate their conservation awareness, develop a positive image of SCE, and encourage better bill paying behaviors. The program is promoted through community-based-organizations (CBOs) that conduct most of the promotion and the entire delivery of the program. In addition to program delivery, CBOs associated with the program advise and educate the utility's low-income customers about programs available to them through SCE, the California Department of Economic Opportunity, city and municipalities, and CBOs themselves.

To qualify for LIR, a customer's household income must not exceed 150% of the poverty level specified by the federal government's Health and Human Services Department (200% for handicapped persons and senior citizens). CBOs' activities on behalf of SCE include:

- The installation of up to six compact fluorescent lamps in both indoor and outdoor fixtures. The CBO representative installing the measures also records the power consumption of the replaced incandescent lamp and the estimated average usage of the retrofitted fixtures. The CBO representative also encourages customers to replace those fixtures that have the longest duty cycles and contain the highest wattage lamps.

- The CBO completes a simple energy audit as required by CAP. The information collected during this audit includes the type and area of the

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residence participating in LIR, and the characteristics of the building's electric systems (HVAC, lighting, and appliances).

- The CBO representative also conducts a brief energy education session with the customer during which he/she covers the basic principles of energy and water conservation. Furthermore, the operational and safety considerations of the CFLs along with their financial and social benefits are discussed with the customers.

CBOs are compensated by SCE for their services. They have the choice to be compensated either on a flat rate basis of $25 per house or a performance-based rate of $10 for the initial visit and the first CFL and $5 for each additional installed CFL (up to five more).

The measures installed under the program include up to five electromagnetically ballasted and one electronically ballasted integral CFL. The electromagnetic units require 15 watts to produce the equivalent lumens of a 60 W incandescent lamp; the electronic units require 18 watts and produce lumens equivalent to a 75 W incandescent lamp.

Table C-1 depicts LIR's energy and demand savings from 1985 through 1991.

Table C-1
LIR's Energy (GWh) and Demand Savings (MW)
(1985 through 1991)

Year	Energy Savings (GWh)	Demand Savings (MW)
1985	9.6	1.09
1986	13.8	1.46
1987	18.4	1.99
1988	13.3	1.61
1989	16.9	2.11
1990	22.6	2.58
1991	27.2	3.01
Total	121.8	13.85

Approximately 750,000 customers in SCE's service territory qualify for LIR as well as other CAP programs. By the end of 1991, customer participation in LIR had reached 361,527 or 48% of the qualifying customers.

From 1985 through 1991, the LIR program cost SCE $23,547,117. LIR costs primarily consist of CBO expenses, administrative expenses and lamp costs. Table C-2 summarizes the LIR program costs from 1985 through 1991.

Table C-2
LIR's Program Costs (1985 through 1991)

Year	CBO Costs ($)	Admin. Costs ($)	Lamp Costs ($)	Total ($)
1985	1,137,164	134,526	996,812	2,268,502
1986	1,440,316	173,146	1,306,282	2,919,744
1987	1,540,775	205,344	1,716,585	3,462,704
1988	1,262,038	163,406	1,330,066	2,755,510
1989	1,928,162	226,691	1,667,824	3,822,677
1990	1,683,071	243,270	2,175,908	4,102,249
1991	1,595,755	250,000	2,369,976	4,215,731
Total ($)	10,587,281	1,396,383	11,563,453	23,547,117

Through the implementation of LIR, SCE has learned that identifying eligible customers and gaining their trust are two of the program's main challenges. By utilizing CBOs, SCE has enhanced its opportunities to gain the trust of its low-income customers. Furthermore, by interacting with CBOs, the utility's customers are exposed to and can benefit from many other social services that are offered through these organizations.

SCE has also learned that the performance-based CBO pay structure is much more efficient than the flat rate structure. Since this new pay structure was implemented in 1991, the number of lamps installed per home has increased 35%. Finally, in response to requests from many program participants, SCE is considering offering lamps with higher lumen outputs in order to avoid creating low-lit spaces.

Refrigerators

Pacific Gas and Electric's (PG&E) Refrigerator Rebate Programs

The main objective of PG&E's refrigerator rebate programs is to reduce household energy consumption by increasing the penetration of energy-efficient refrigerators within its service territory. In 1991, PG&E incorporated the following three refrigerator rebate programs into its Appliance Efficiency Program:

- ***Efficient Refrigerator Rebate Program.*** This program offered rebates directly to customers. During 1991, a $50 rebate was offered for refrigerators that exceeded the 1990 FAES by 10% (+10%), a $75 rebate was offered for refrigerators that exceeded the 1990 FAES by 15% (+15%), and a $150 rebate was offered for refrigerators that exceeded the 1990 FAES by 20% (+20%).

- ***Refrigerator Salesperson/Dealer Incentive Program (also known as Dealer Spiff Program).*** This program provided incentives to both the refrigerator salesperson and the dealer, and was implemented during the months that the Efficient Refrigerator Rebate Program was not available. In 1991, for each +10% refrigerator sold under the program, the salesperson and the dealer received $10, and $3, respectively; for each +15% refrigerator, $15 and $5, respectively; and for each +20% refrigerator, $20 and $10, respectively.

- ***Contract Refrigerator Rebate Program.*** This program provided incentives to landlords, building managers, and developers who planned to install large numbers of refrigerators in new or existing buildings. In 1991, rebate amounts for this program were identical to those offered under the Efficient Refrigerator Rebate Program.

All three rebate programs are still being offered by PG&E; however, only the 1991 performance data were available at the time of this writing.

In 1991, the Efficient Refrigerator Rebate Program was offered for four months during summer (June 1, 1991 through September 30, 1991). The Refrigerator Salesperson/Dealer Incentive Program was offered from January through May 1991 and October through December 1991, and the Contract Refrigerator Rebate Program was offered for the entire year.

A dealer survey indicated that PG&E's refrigerator rebate programs had significant impacts on refrigerator stocking practices and the layout of their showroom floor. Approximately 80% of the dealers surveyed indicated that during the months the customer rebates were offered, they stocked more high-efficiency units than they would have normally. Almost 90% of the survey respondents indicated that they sold a greater percentage of high-efficiency refrigerators to residential customers than they would have in the absence of the program.

PG&E's 1991 expenditures for the Appliance Efficiency Program totalled $25.6 million, which exceeded the budget of $15.5 million by $10.1 million. The expenditures exceeded the budget partly due to the major success of, and high participation in, the three refrigerator rebate programs.

The net annual impacts of the three refrigerator programs were estimated at 6.9 MW and 12.5 GWh for 1991. The sales of +10% refrigerators totalled 57,259 in 1991, while those of +15% and +20% totalled 38,651 and 48,546, respectively.

PG&E's refrigerator rebate programs were extremely successful during 1991 and drew large responses from customers, dealers and manufacturers. Although the 1991 sales of all refrigerators were down about 1% as compared to 1990 in the PG&E service territory, the 1991 efficient refrigerator sales exceeded those of 1990 by 95%.

Manufacturers also responded to the refrigerator rebate programs by providing a greater number of higher efficiency models. For instance, when the Efficient Refrigerator Rebate Program began, only 31 models exceeding FAES by 20% were available. By the end of 1991, over 180 models exceeding the FAES by 20% were available and sales of +20% refrigerators represented approximately 56% of the total refrigerators qualifying for rebates.

PG&E is concentrating its efforts on developing closer relations with the refrigerator manufacturers. It is also collaborating with other West Coast utilities to promote high-efficiency refrigerators in their collective service territories, thus shifting the market and increasing the penetration of high-efficiency refrigerators.

C.2 DSM INITIATIVES IN THE ASEAN COUNTRIES

C.2.1 Indonesia

The power subsector has expanded rapidly in Indonesia over the past decade. The installed capacity of the Indonesian national utility, Perusahaan Umum Listrik Negara (PLN), grew from 2,555 MW in 1980/81 to 9,189 MW in 1991/92.[1] Sales increased at a rate of 15.4% per year over the same period, from 6,532 GWh to 31,481 GWh. This rapid growth in electricity demand is expected to continue during the 1990s as a result of Indonesia's continuing economic expansion. PLN projections indicate that annual energy sales will increase from 27,741 GWh in 1990/91 to 92,387 GWh in 2000/01, or an average of 12.8% annually.

To meet its power supply obligations under these circumstances, PLN has adopted a comprehensive strategy that mobilizes a wide range of power sector resources. PLN plans to increase its own capacity to 20,983 MW by 2000/01. To complement this, 5,120 MW of capacity have also been earmarked for private sector development over the same period. In addition to supply-side development, PLN is developing demand-side resources through a phased program of demand-side management.

[1] 1980/81 represents fiscal year 1980/81. Indonesia's fiscal year runs from April 1 to March 31.

The inclusion of DSM in PLN's power sector development strategy is a natural extension of the Government of Indonesia (GOI)'s increasing emphasis on energy efficiency. In 1987, the GOI established PT. KONEBA, a government-owned consulting firm, to carry out industrial energy audits and train government and non-government staff in energy conservation. In 1990, a national committee for energy conservation was formed. The work of the committee resulted in a presidential decree for energy conservation issued in September 1991, followed by sectoral action plans at the ministerial level. In PLN, an Energy Conservation Committee, chaired by the Director of Planning, was recently created. This committee encompasses a Supply Efficiency Subcommittee as well as a DSM Subcommittee. PLN's corporate plan for 1992/93-1996/97 identified DSM as an integral part of PLN's strategy. The plan targets annual DSM energy savings of 144 GWh by 1996/97.

Electric energy efficiency and preliminary DSM activities have been supported by a wide range of external sources. KONEBA was created under a World Bank loan. A study of household energy use completed by the joint UNDP/World Bank Energy Sector Management Assistance Program (ESMAP) in 1990 identified substantial electricity savings potential in that sector.[2]. In 1992, the United States Agency for International Development completed an extensive study of energy use in buildings throughout the ASEAN region, emphasizing the potential for improvements in the efficiency of electricity use.[3]

Despite PLN's interest in and understanding of the potential for DSM, there was no plan that laid out the practical steps necessary to achieve the benefits of DSM implementation. At the request of PLN, USAID provided financing for the preparation of a DSM Action Plan that would provide the necessary roadmap for further development of DSM resources. The action plan included:

- a discussion of the motivation for DSM and key DSM issues in Indonesia
- a realistic analysis of the potential impacts of a cost-effective DSM program in the near term
- the description of a coordinated and phased series of comprehensive DSM development activities, including the scope, timetable, and budget for each activity.

The action plan identified a three-phase, eight-year $170 million DSM program consisting of the preparation of a master plan, the implementation of pilot projects, and subsequent full-

[2] Joint UNDP/World Bank Energy Sector Management Assistance Program (ESMAP). *Indonesia: Urban Household Energy Strategy Study*. Report No. 107A&B/90, 1990.

[3] Lawrence Berkeley Laboratory. *ASEAN-USAID Buildings Energy Conservation Project, vols. I-III.* Report No. LBL-32380. Berkeley, California, 1992.

scale implementation. The action plan estimated that such a program could reduce peak capacity requirements by 4.6% and total generation by 1.4% by the year 2000, the last year of the program. The plan was completed in late 1992.

The action plan was developed over a relatively short period (about 3 months) and relied on a wide range of existing data sources and analytical techniques to identify load shape objectives and the potential for different measures and programs to achieve these objectives.

For example, the rapid growth in both peak demand and total sales indicated the need for peak clipping and conservation load shape objectives. Next, to quickly estimate sectoral and end-use load shapes, system load data were adjusted for losses and disaggregated according to sales data by tariff class. This was supplemented by informal discussions with consumers and utility personal regarding periods of peak demand for various sectors. The results were checked by comparisons with data available from other countries, and summing the end-use load shapes to ensure they added up to the total system load shape. Although this approach cannot substitute for load research, it provided a view of potential DSM contributions by sector and measure towards load-shape objectives in a level of detail adequate for action plan preparation. The economic analysis of these measures and the estimates of their impacts suggested that industrial tariff measures, residential lighting, and new building construction efficiency programs would yield the greatest benefits. Finally, timetables and budgets were prepared for each phase of DSM development (i.e. Master Plan preparation, pilot programs, and full-scale implementation) taking into account the program development needs in Indonesia and experience in other countries.

The action plan quickly stimulated support by multilateral financing agencies for each of the action plan elements. PLN, the Asian Development Bank (ADB), and the World Bank decided that ADB would finance an $8 million pilot program under ADB's Power XXIII loan. This project is expected to begin in the middle of 1994. The World Bank, on the other hand, will finance the preparation of a DSM Master Plan as part of the Bank's Outer Islands Project loan. This Master Plan will aim to develop in further detail the programs and institutional mechanisms necessary for full-scale DSM implementation. The Outer Islands Project is expected to go the Bank's Board for approval in the middle of 1994.

C.2.2 Thailand

Recently, a DSM assessment was conducted for the residential sector in Thailand. This assessment encompassed comprehensive analyses of the major residential electricity end-uses including space cooling, refrigeration, lighting, cooking, water heating, and the powering of other appliances.

The study outlined 23 economically viable DSM measures that could be implemented through the use of existing technologies. If fully implemented, the program is expected to reduce annual electricity use by up to 500 GWh and coincident peak electrical demand by 160 MWe during the first year of its implementation.

Energy-efficient refrigerators were identified as the measures with the highest potential for energy savings. It is estimated that improvements to the insulation and compression of Thai refrigerators will reduce their average electrical use from 400 kWh per unit per year to below 200 kWh per unit per year. The potential nation-wide energy savings resulting from the introduction of energy-efficient refrigerators are estimated at 170 GWh. Negotiations are currently underway with a large Thai refrigerator manufacturer to produce a high-efficiency prototype unit for testing and evaluation.

To estimate the resulting energy savings in the residential sector, the study assumed that retired equipment and appliances will be replaced with high-efficiency ones and that energy-efficiency measures will be instituted in new construction projects. The full implementation of this strategy over a ten-year period could result in cumulative savings of more than 6,000 GWh and a peak reduction of more than 2,000 MW by 2005. The overall electrical consumption of the residential sector in 1989 totalled 7,025 GWh, while Thai households were responsible for approximately 20% of the peak utility load of 7,095 MW.

Other Thai DSM initiatives under consideration include:

- a potential $149 million project to delamp conventional lighting and install low-loss ballasts and other lighting retrofits in city halls
- direct load control of air-conditioning units in commercial buildings
- instituting an energy conservation promotion act that would include building and equipment standards.

C.2.3 Malaysia

The rapid growth of the Malaysian economy during the past decade will most likely continue into the next century. This economic growth is expected to result in a better distribution of wealth and lead to higher consumption levels of consumer goods such as electrical appliances, thus creating more demand for electricity. As a result, demand for electricity in the Malaysian Peninsula is expected to grow at a rate of 12% from 1991 through 1995, and to exceed 6,000 MW in 1996 and reach 9,500 MW in 2000.

In view of the anticipated changes in the nation's economic structure and lifestyles, Tenaga Nasional Berhad (TNB) is seeking to lead the efforts for energy efficiency improvements in Malaysia. Recognizing that economic energy pricing is a prerequisite for effective energy

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conservation, TNB started offering time-of-use and interruptible tariffs to its customers in April 1993.

To further enhance the efficient use of electricity in Malaysia, TNB is interested in obtaining the Malaysian Government's assistance in devising:

- a blueprint for a national energy efficiency program that would culminate in a comprehensive action plan to pursue and implement energy efficiency as part of the Malaysian way of life

- energy efficiency regulations under the Electricity Supply Act of 1990 in order to reinforce the DSM programs to be instituted by power utilities

- appliance labelling and field testing protocols of end-use technologies to verify the quality, reliability and performance of these technologies

- standards for new buildings that would take into account the country's hot and humid climate, and the need for optimizing air-conditioning and daylighting in offices, factories, and commercial buildings

- a double tax deduction strategy for investment in DSM.

Although no specific DSM programs have been implemented yet, the following outline of DSM activities has been developed for the TNB's Center for Energy Management and Development:

- Commercial and Industrial Market Focus:

  - *Shared Savings Scheme.* Under this program TNB, through commercial banks, will finance energy efficiency projects in the commercial and industrial sectors. Customers will repay the cost of the program through their monthly electric bills.

  The targeted technologies include electric ballasts, tri-phosphor lamps, optical reflectors, occupancy sensors, energy-efficient chillers, high-efficiency motors, and variable speed drives.

- Residential Market Focus:

  - *Franchise Stores.* TNB will franchise the rights to run individual stores that only sell energy-efficient appliances. Each store will benefit from TNB's mass marketing and educational campaign.

- *Smart Savers Corners.* In each TNB district office a Smart Savers Corner will display information on energy saving equipment for homes.

- *Voluntary Appliance Labelling.* TNB will encourage appliance manufacturers to put efficiency labels on their equipment.

The targeted technologies include high-efficiency air-conditioners, low-loss magnetic ballasts, high-efficiency refrigerators, compact fluorescent lamps, and turbo ventilators.

▸ Load Management Market Focus:

- *Shared Savings Scheme.* This option is identical to the commercial and industrial sectors' shared saving option.

- *Direct Load Control.* TNB plans to offer a monthly discount on electric bills to customers who allow direct load control of their air-conditioner(s). During the peak times of the day, air-conditioners will be turned off from 10 to 15 minutes for every 30-minute period.

- *Alternative Rates.* TNB already offers three schemes to reduce peak demand in the commercial and industrial sectors. These include time-of-day rates, interruptible demand agreements, and standby diesel generator agreements. Typically, these schemes account for a great deal of peak demand reduction but negligible energy savings.

▸ Support Activities:

- *Community Outreach.* TNB plans to conduct several energy awareness campaigns with a focus on encouraging customers to use electricity wisely.

- *Professional Outreach.* TNB plans to work with building design professionals and educate them on efficient design concepts.

- *Technical Training.* TNB plans to offer a series of courses at its training center. These courses will focus on providing engineers, architects, and energy managers with a background on how to manage energy use and operate and/or design efficient factories and facilities/buildings.

- *Technology Database.* TNB plans to create a database of efficient technologies and practices. This database will be available through modem connection in the form of an electronic bulletin board.

- *Lease of Testing Equipment.* TNB plans to lease auditing testing and measurement equipment. This equipment will be used by customers in the commercial and industrial sectors.

- *Ambassadors for Energy Efficiency.* TNB plans to establish a program for children who wish to carry the message of energy efficiency to their parents and friends.

In the area of technology and planning, TNB plans to set up an energy demonstration center that will act as a learning center as well as a showcase of efficient technologies. A laboratory will also be set up to test the performance of various residential appliances and lighting equipment.

ANNEX D
PROCEEDINGS OF THE ROUNDTABLE DISCUSSION FORUM ON DSM/IRP ACTION PLAN OPTIONS FOR THE PHILIPPINES

A Roundtable Discussion Forum on demand-side management (DSM) and integrated resource planning (IRP) was organized by RCG/Hagler Bailly and the United States Agency for International Development (USAID) and hosted by the Philippine Department of Energy. It was held on April 13, 1994 at the Shangri-La EDSA Plaza Hotel in Metro Manila.

The Roundtable was attended by representatives of the Government of the Philippines, Philippine utilities, and donor organizations concerned with DSM and IRP. David Wolcott of Hagler Bailly served as the Roundtable's moderator. He presented DSM/IRP issues and facilitated discussions among the group on the advantages and disadvantages of several DSM options from the points of view of their respective organizations.

Attachment 1 to this annex presents the Roundtable agenda. A list of the participants is given in Attachment 2. The remainder of this annex highlights the main presentations and findings of the Roundtable.

D.1 OBJECTIVE

The objective of the Roundtable was to arrive at a general understanding and agreement on how all organizations concerned can best coordinate their activities to implement DSM/IRP in the Philippines.

D.2 BACKGROUND

To provide background to the discussions, DSM/IRP activities in the Philippines and three neighboring countries were briefly reviewed.

D.2.1 DSM/IRP Activities in the Philippines

Current DSM/IRP activities in the Philippines are funded by five major agencies: USAID, the World Bank, the Asian Development Bank, the Australian International Development Assistance Bureau, and the Trade and Development Agency of the U.S. Department of Commerce. These activities are listed below:

U.S. Agency for International Development

- The Energy Efficiency Program sponsored the project resulting in this *DSM Action Plan.*
- The Energy Training Program conducted a workshop in February 1994 and plans another one in October 1994.
- A $4.5 million technical assistance program has been proposed with Global Environmental Facility (GEF) money.

The World Bank

- The Power Systems Planning Training Program produced a workshop on DSM in December 1993.
- ASTAE produced a regulatory DSM training workshop in October 1993 and a utility DSM training workshop in June 1994.
- The CFL Lighting Efficiency and Market Research Study is testing specific energy-efficient lighting technologies and conducting market research on customer reactions.

The Asian Development Bank

- The Long-Term Power Systems Planning Study is providing technical assistance to NAPOCOR to start to develop an integrated resource planning capability.
- A DSM soft loan program of an undetermined amount has been proposed.

Australian International Development Assistance Bureau (AIDAB)

- An Energy-Efficiency Pre-Feasibility Study was conducted to examine establishing a technology training center in the Philippines focused on DSM.

Trade and Development Agency (TDA)

- An assessment of DSM potential in the industrial sector will be conducted with the CEPALCO distribution company hosting the project.

D.2.2 DSM/IRP Activities in Other ASEAN Countries

Other neighboring countries are also implementing DSM/IRP:

Thailand

Thailand's $189 million, five-year DSM program is being funded as follows: EGAT ($149 million), Japan ($25 million), Global Environmental Facility ($9 million) and AIDAB ($6 million). EGAT (the utility) is expected to recover most of its contribution from electric rates.

- The program's goal is to reduce demand by 225 MW and energy by 1,000 GWh/year before the end of the century.
- The program's activities are modest to date, including a delamping program working with manufacturers of fluorescent lamps and ballasts, and lighting retrofits in city halls throughout the country.
- Future program activities may include the direct load control of air conditioning in commercial buildings through radio frequency signals.
- In addition to EGAT's activities, Thailand is noted for its Energy Conservation Promotion Act, which has two basic components: 1) a requirement for large enterprises to employ full-time energy managers and 2) the development of building codes and equipment standards.

Malaysia

TNB (the utility company) has established an ambitious goal of reducing demand by 450 MW.

- TNB's targets are specific appliances that contribute to residential peak demand: rice cookers and ceiling fans. The utility has also developed its own capability to manufacture CFLs, which it is marketing at a discount to overcome the public's lack of awareness of the product.
- TNB is also engaged in retrofitting air conditioners in commercial buildings including training contractors.
- Industrial audits in Malaysia are being sponsored by the ADB.
- A major trade initiative is being sponsored by the California Energy Commission, specifically to promote energy service companies (ESCOs).

Indonesia

Indonesia's *DSM Action Plan* is a model for the one being developed for the Philippines.

- ***History***

  1981-1991. A phenomenal rate of growth of 15.4%/year in energy demand was recorded over this ten-year period.

  1987. KONEBA, a government consulting firm, was established to conduct industrial energy audits.

  1990. A National Energy Conservation Committee was established, similar to the DSM Working Group created by Energy Undersecretary Salazar of the Philippines.

  1991. A Presidential Decree was issued ordering that DSM be undertaken. PLN (the utility) established supply-side and DSM working groups in response to the decree.

  1992. RCG/Hagler Bailly prepared the *DSM Action Plan* with USAID funding.

  1994. The government is now preparing building codes and equipment standards.

- ***DSM Action Plan***. The Indonesia plan contains:

  - an overview of DSM issues and objectives (i.e., country policy, load shape objectives of the utility, customer requirements)

  - a realistic analysis of potential DSM impacts (not looking at the total resource potential, but taking a hard-nosed look at practical near-term potential)

  - details of the three-phase, 8-year, $170 million DSM Program, which will result in savings of 4.6% in demand and 1.4% in energy. This is a fairly modest, but a very realistic and near-term contribution.

- ***DSM Action Plan Results: Two Very Well-Coordinated Multilateral-Funded Programs***

  The ADB Power XXIII Loan is now being developed to provide $8 million for DSM pilot projects, specifically:

- residential and commercial CFLs
- assistance in developing the ESCO market
- introducing industrial communications and metering technology to industrial customers.

A World Bank Outer Islands Loan will provide for the development of a DSM Master Plan and focus on developing the institutional framework.

D.3 MAJOR ISSUES IN IMPLEMENTING DSM/IRP IN THE PHILIPPINES

D.3.1 Current Laws and Legislative Proposals

Issues

- The question is: Does the legal and regulatory authority exist to mandate DSM/IRP in the Philippines or must it be created? There are two schools of thought. Some believe that RA 7638, the Act Creating the Department of Energy, gives adequate authority. Others believe that this authority does not exist and that HB 5734, an Act to Institutionalize Energy Conservation and Enhance Efficient Use of Energy, is necessary.

- If authority does exist, what policies are necessary to implement DSM/IRP? Possible policy mechanisms include:

  DOE:

  - Philippines Energy Plan update
  - Draft Department Order on DSM/IRP

  ERB:

  - Orders, e.g., in response to the NAPOCOR petition for tariff restructuring (LRMC, demand charges)

  NAPOCOR:

  - Power Development Program (PDP)
  - Contract minimum levels (take or pay)

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- The following provisions for encouraging DSM/IRP were suggested, regardless of the legal, regulatory, or policy mechanism:
  - Establish IRP as the basis for power sector planning.
  - Provide authority for NAPOCOR and the distribution companies to develop and implement an integrated resource plan.
  - Provide authority for the distribution companies to invest in DSM.
  - Provide authority for NAPOCOR and the distribution companies to recover the costs of DSM expenditures through electric rates.
  - Provide financial incentives for NAPOCOR and the distribution companies to implement DSM.
  - Provide authority for ERB to impose rate surcharges on distribution companies that fail to implement DSM.
  - Make a provision for public involvement.

Reactions

- Consensus was reached that RA 7638 provides sufficient basis for DOE to exercise its authority to encourage energy efficiency, including conservation and DSM. It was noted that HB 5734 had been pending in Congress before the creation of DOE one and a half years ago.
- DOE is already working on a Department Order that would mandate ERB to develop a regulatory framework allowing the recovery of utility investments in DSM, and specify what utility companies and NAPOCOR can do related to DSM. The most important specific authorities contained in the draft Order are:
  - ERB is to establish a regulatory framework for DSM.
  - Utility companies are to be given authority to invest in energy conservation and DSM projects, giving appropriate consideration to income losses from reduced sales due to investments and expenditures for promoting conservation and efficiency.
  - Rates charged by electric utilities shall encourage them to make efficient investments throughout entire power system.

- IRP is to be employed by NAPOCOR.

- There was consensus that the distribution companies and cooperatives should be included in the system planning for IRP, in the light of recent moves toward power system restructuring and privatization.

  An emerging idea is that utilities are headed for decentralization. However, the DOE believes that there should still be an overall IRP-based Master Plan to ensure that macro objectives are met, such as having the ideal fuel mix and providing low-cost electricity. A process is being fleshed out in an on-going project whereby the distribution companies will be responsible for meeting their own loads, but the government would still continue to pursue its national objectives.

- There was some apprehension as to how to reconcile the move towards the restructuring and decentralization of the power sector with a centralized IRP-based Master Plan. It was noted that the objective of the study is to formulate a strategy for restructuring the energy sector, including the privatization of NAPOCOR.

- An important issue noted was the reinstitution, after eight years, of the contract minimum level NAPOCOR charges its customers, based on historical consumption experience. This was considered to be a disincentive to DSM because it would create a "take or pay" contract.

  It was explained that such a contract was developed because MERALCO wanted to make the minimum level the basis for penalizing NAPOCOR should it be unable to deliver the contract level. It was not really meant to be the basis for "take or pay." However, it was mentioned that if that is the real motivation for the tariff, it could be accomplished in another way, without creating disincentives for DSM.

  The suggested way out of this disincentive to DSM was to give customers an exemption on the contract minimum if they participate in a DSM program.

Proposals

- It was suggested that in the pending amendment to EO 215 and its implementing rules and regulations, the procedure should be rationalized for private distribution utility companies to go into power generation themselves or contract directly with independent power producers. This should level the playing field in power generation.

- There was a suggestion to add to the draft Department Order some provision that could encourage utility companies, with support from ERB, to introduce rate designs that would complement DSM programs. These may be time-of-day, seasonal pricing, and interruptible rates.

D.3.2 Conducting Market Research for DSM

Issues

- The first and most important issue is the identification of DSM capabilities in the Philippines. What are the available DSM technologies and services? Specifically:
  - Equipment manufacturers and distributors (e.g., CFLs, efficient motors, controls, air conditioners).
  - Energy service companies (ESCOs). These are general contractors that bundle together services for DSM. ESCOs typically come from engineering consulting firms and equipment vendors. Many are also subsidiaries of industrial firms and utility companies.
  - Joint-venture prospects with international companies as possible sources of capital and expertise. The DSM program could include assistance in brokering such types of ventures.
- The second issue is understanding the needs of utility customers, DSM equipment manufacturers, and ESCOs.
  - Focus groups, interviews, and surveys of customer opinions and attitudes must be undertaken. Without the participation of customers, there can be no savings in DSM.
  - In the "Golden Carrot" approach, the utility company works with manufacturing companies to market and distribute products in support of DSM efforts.
  - Business development training should encourage engineering companies to go beyond engineering services to become ESCOs.
  - The collaborative process is very important. A program involving ERB has been proposed to the World Bank for technical assistance in the amount of $275,000.

- The third issue is that gathering and using end-use load research data are important for designing DSM programs and understanding their impacts.
  - The NAPOCOR project to acquire modern metering equipment with World Bank and Japanese support is an important development in acquiring customer load profiles. However, it is necessary to understand the data at the end-use level.
  - MERALCO has proposed a project to acquire end-use load data. This project could build a comprehensive library of end-use load shapes by sector. This will also be important to support end-use load forecasting techniques.

Reactions

- At the institutional level, it was pointed out that DOE has developed some energy efficiency programs and they can share the results with the utility companies. The DOE programs include:
  - engineers conducted energy audits for industrial and commercial firms
  - training programs were offered for energy managers employed by large commercial firms
  - an appliance testing and labeling program has developed a standard for window-type air conditioning units and is now developing one for refrigerators and freezers
  - the Fuel and Appliance Testing Laboratory (FATL) was established, one of the only two in Asia
  - a building efficiency standard was adopted by the Department of Public Works and made part of the building code
  - assistance was provided to private companies to invest in energy-efficient technologies through USAID's Technology Transfer for Energy Management (TTEM) project. Appropriations for this program are 60 million pesos, to be used over the next three years.
- DOE announced that it has a list of ESCOs, but no data base on manufacturers and relevant companies in DSM.

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- It was remarked that DOE should extend its efforts on equipment standards and buildings codes. DOE agreed that while these have been incorporated as parts of the building and other codes, there is a need for more information dissemination. Standards for some appliances are already mandatory, with compliance being enforced by the Bureau of Standards under the Department of Trade and Industry.

- It was noted that a good reason for developing a collaborative process in the Philippines is that DSM is a very new concept here. An emphasis of the program should thus be on educating people about DSM. In this connection, it was pointed out that the DSM Working Group under Undersecretary Salazar is has already started a partial collaborative group.

- It was remarked that the process before ERB can be confrontational. The electricity and oil industries are very political. A collaborative process is therefore a practical venue that can be explored before the utilities file a petition with ERB. This process can avoid an expensive and time-consuming evidentiary proceeding at the ERB.

- Regarding load research data, the following points were made:

    - Financing is being sought for the acquisition of end-use data.

    - Local capabilities exist to generate load data for typical residential, commercial and industrial establishments. Although it seems that there has been no need to do this on a regular basis, with DSM, the need may be present.

    - ADB is interested in load forecasting and in setting up a data bank to support forecasting as a component of the transmission line project with NAPOCOR. ADB can include a $1 million component for this. Technical assistance on load forecasting techniques can be provided to a government agency like NAPOCOR.

- It was pointed out that it is difficult for ADB to provide loans to MERALCO because it is a private corporation. In order to do this, funding would have to be channelled through the Development Bank of the Philippines (DBP).

- Initiatives on end-use data were discussed by DOE:

    - A new Energy Household Consumption Survey being undertaken by DOE should have a report out by the middle of next year.

- A similar survey undertaken in 1989 with World Bank assistance is currently available.

- Data on energy consumption in major industries are also available. The 1979 Industrial Energy Profile is being updated and may be available by the end of this year.

Proposal

The second phase of the World Bank project may include technical assistance for DSM program development through a collaborative process. It was suggested that ERB prepare a proposal to tap this potential.

D.3.3 The DSM Assessment Process

Issues

- The first part of the process is to examine DSM technologies. The result is a DSM supply curve based on estimates of costs and savings. While national assessments are fine, when MDB power sector loans are to be appraised, there is also a need to look at the distribution level, such as for MERALCO.

- One criterion in a DSM assessment is to determine the most cost-effective measures to be considered in pilot programs.

- DSM is generally recognized as a "benign" technology in terms of generating pollution. But the question is: Who is going to determine the environmental costs of power sector resources in the Philippines?

- Benefit/cost analyses of DSM programs go from a review of the technologies to an assessment of programs that can form the basis for multilateral loan program activities. DSM pilot programs must 1) limit their objectives, 2) demonstrate early success, 3) have high visibility for the public, media and the donor, and 4) generate political benefits for consumer groups. Such programs must also closely track administrative costs.

- The U.S experience has found that residential DSM programs cost more and save less than originally projected. Thus, it was suggested that MERALCO's initial focus be on DSM programs for the commercial and industrial sectors.

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Reactions

- *Environmental Considerations*

  - DOE has a project using an environment software program to analyze the impacts of energy development programs. It is believed that this can be a useful tool for estimating the environmental costs of the power sector.

  - The IRP-based plan to be generated by the ADB study is supposed to consider environmental costs. It was urged, however, that decisions be guided by standards and not by technologies. For example, if it is decided that coal should be part of the resource mix, it should not be excluded from consideration. Technologies should be considered in light of the total analysis, including environmental costs. (A clarification was made that environmental costs refer to the damages to the environment even after pollution control measures are in place.)

  - It is believed that environmental impact statements should be developed for DSM projects, just as they are for power generation projects.

- *Focusing on the Industrial Sector*

  There was a general negative reaction to initially focusing DSM efforts on the industrial sector.

  - It was noted that except for industrial power audits, pilot projects for the industrial sector are rare because of the large capital expenditures required.

  - Focusing on the industrial sector will require knowledge of industrial processes, which can take a long time to acquire. On the other hand, residential projects meet most of the key criteria for pilot programs previously described. Furthermore, from an equity point of view, since the cost of DSM is to be charged to all customers, it was feared that household customers may complain if the initial focus of DSM efforts is on the industrial sector.

  - Because the choice of specific DSM pilot programs must depend on the overall load shape objectives for the country, these objectives should be determined first. It was remarked that what is good for MERALCO may not necessarily be good for the whole country.

- On the other hand, there is no need for the utility to learn all about industrial processes in order to implement DSM in the industrial sector. There are experts who can be hired to do this. It is also not necessary to pass on the costs of DSM to all customers. Industrial DSM costs could be passed on only to industrial customers.

Proposal

It was proposed by MERALCO to initially consider large commercial projects for DSM.

D.3.4 DSM Pilot Programs

Issues

- Practical issues in designing DSM pilot programs were discussed.
  - Marketing, providing incentives, and developing practical delivery mechanisms are important. Installing DSM technologies is not necessarily an activity that should be done by the utility companies themselves, as they could hire people to conduct these activities.
  - Information tracking and management systems are necessary for effective project management.
  - DSM tariff programs are not just the creation of demand rates. What is important is creating the ability of customers to respond to these rates. For example, DSM tariff programs involve not only explaining what a demand charge is to the customers but also helping them to acquire capital equipment or pooling them together in cooperatives in order to help them respond to the tariff.
  - Since significant funding for DSM pilot programs will likely be coming from multilateral development agencies, it is important to consider developing bankable projects. An economic study will not be sufficient. Financial analyses of proposed projects must also be prepared to support the development of an investment program.
- Some forward-looking issues on the implementation, evaluation and scale-up of DSM pilot projects were also discussed.

- It was pointed out that most issues in implementation concern organizational development within the utility company. These are mainly in the areas of:

  - -- creating customer service and marketing capabilities
  - -- developing impact evaluation capabilities
  - -- contracting with implementation agents.

- In scaling up the pilot project, the usual question is whether the expansion should be vertical or horizontal. For example, in the case of an industrial pilot program, the decision should be made on whether the project should be scaled up to other industrial customers (horizontal) or to both the industrial and commercial sectors (vertical).

Reactions

- If an ADB loan is to be given to a utility distribution company, the only way to obtain concessional rates is to process a line of credit through DOE or DBP. The program can then be funded from this credit line, but projects will be evaluated by the implementing agency.

- It was pointed out that before any decision on funding DSM programs can be made by the ADB, an appropriate rate structure must be in place.

- Regarding the implementation of DSM programs, there is a newly developing industry to set up ESCOs that can provide the delivery mechanism for DSM projects. This has been the experience in the United States, where an entirely new industry has emerged to help develop these programs.

Proposals

The following proposals were addressed to the donor agencies:

- There is a need to identify DSM technologies that may be available from within the country and from other Asian countries as well.

- Establishing environmental costs is an important issue. There is a need for institutions (perhaps not the government), such as an independent institute, that can develop the necessary database for establishing environmental costs.

D.3.5 Integrated Resource Planning

Issues

IRP provides the strategic framework through which the benefits of DSM can flow throughout the entire power system, making DSM workable as a sustainable process. There are two issues in IRP: utility planning and integrated resource acquisition.

- ***Utility Planning:*** This is an analytical process that includes load forecasting, supply planning, transmission and distribution planning, DSM assessment, and analyses of tariff impacts. These analytical results all flow into the integrated resource plan.

  A question is whether the ADB Long-Term Power System Study can provide IRP modeling capabilities. NAPOCOR uses macroeconomic load forecasting models and WASP, a least-cost supply expansion planning model. These must be expanded to include end-use load forecasting and IRP models.

  There are two ways to do IRP analyses. One is to make a comparative benefit/cost analysis (including environmental costs) and select the least-cost resources. The second way is by optimization, similar to the WASP model, except that IRP models provide inherent capabilities to analyze DSM and supply-side options.

  Some IRP models developed by the Electric Power Research Institute (EPRI) were cited: EPRI's IRP-Manager model and the EGEAS model.

- ***Integrated Resource Acquisition:*** There are four different scenarios in the NAPOCOR privatization study:

  - Scenario 1 is the British model where there is complete disaggregation of the generation, transmission and distribution functions.

  - Scenario 2 calls on the distribution companies to take the lead in power sector planning and to contract for the purchase and sale of electric resources with generators and NAPOCOR.

  - Scenario 3 concentrates responsibility on NAPOCOR for system planning and creating a competitive marketplace.

  - Scenario 4 is the U.S. model of vertically integrated utilities.

Under the recommended scenario (scenario 2), things would look different from what they are today. While under the present situation, NAPOCOR has primary utility planning responsibilities, under the recommended option, distribution companies would have a greater load forecasting and planning role. Distribution companies like CEPALCO will need computer models to develop the capability to do forecasting. They will need training in modeling. Technical assistance should be applied to the small distribution companies, perhaps through PEPOA.

Reactions

- With regard to the ADB TA study:

  - The comment that the ADB study may not be providing for the development of IRP modeling capabilities at NAPOCOR was noted by the ADB representative. It is believed that the terms of reference for the study contain provisions for some specific IRP model. This matter will be looked into.

  - It was explained that the macro-economic model currently used for load forecasting is a product of a directive from the President requiring studies for which inputs were provided by different government agencies. Previously, NAPOCOR adopted an econometric model on a disaggregated level. This was a product of a foreign-assisted project under a U.K. consultant, undertaken in 1986 and updated in 1989. The product of the study was reviewed by ADB consultants; their general impression was that there were mis-specifications of the models. These are the areas to be looked at by the ADB consultants, and an informal workshop is being organized to come up with a demand objective by a cross-section of distributors, NEDA, and other major players in the industry.

  - It was explained that a review of the load forecast in the ADB study will include refining the macroeconomic load forecast and training on end-use load forecasting. The objective is to move in the direction of end-use forecasting. The study will also formulate recommendations for IRP and provide IRP training.

  - There was a note of caution that the study will be focusing mainly on scenarios defined by polic, options.

  - It was noted that there are many overlaps between the ADB and USAID efforts. This matter will be discussed with the consultants.

- On the relationship of DSM and IRP:

  On the question as to which should precede the other, it was suggested that proceeding in parallel is a good idea. The two do not constitute a sequential process.

- On implementation issues:

  The following observations were put forward.

  - Under the present scenario, the distribution companies do not need to perform any planning functions. EO 215 stipulates that strategic planning rests with NAPOCOR. Thus, there is centralized planning under NAPOCOR and DOE.

  - When EO 215 was formulated, the concept of BOT had not yet been developed. Should the BOT law now recognize the structure of the energy industry wherein NAPOCOR is still the central point for power planning?

  - EO 215 has not opened up the private sector for power generation planning. Any distribution company wanting to sell to independent power producers needs to obtain DOE approval.

  - Under the recommended privatization scenario, system planning would no longer lie with NAPOCOR. It would contract with the distribution companies, creating a power pool relationship. The ADB TA study should take into consideration the possible direction of system planning.

  - Under the recommended scenario, the distribution companies will be conducting the IRP analysis and developing DSM. ERB will be regulating the process.

Proposals

- If NAPOCOR privatization scenario 2 is adopted, EO 215 needs to be amended to take into consideration the issues discussed above.

- Likewise, distribution companies need to be provided with an IRP model and training for common use in resource planning.

D.4 CONCLUSIONS AND GENERAL RECOMMENDATIONS

- Much DSM training has been conducted in the Philippines. However, what is needed now is more operational and less theoretical training.
- Political will is needed to develop the policy instruments for DOE and ERB.
- It is time to get a pilot program underway. What is needed is empirical evidence from the field.
- The World Bank should have a larger role. So far, its contributions to DSM efforts have mostly been training activities. DSM should be considered in a power sector loan.
- The time has come for pledging commitments to DSM, not only from lenders but also from participating Philippine organizations.
- It is time to implement DSM, focusing on solutions and not on barriers.
- The cooperation of donors is needed to gain a common focus on DSM and IRP.

Undersecretary Salazar closed the meeting, thanking everyone for their participation. It was hoped that the understandings and agreements reached in the Roundtable would form the basis for moving ahead with the design and implementation of DSM programs in the Philippines.

ATTACHMENT 1
ROUNDTABLE AGENDA

DSM/IRP ACTION PLAN OPTIONS FOR THE PHILIPPINES
A Roundtable Discussion Forum

Wednesday, April 13, 1994
Shangri-La EDSA Plaza Hotel (Batanes Room)
Mandaluyong, Metro Manila, Philippines

Moderated By: David R. Wolcott
RCG/Hagler Bailly with USAID

MEETING PURPOSE

This is a meeting of representatives of Philippine government and utility organizations and donor organizations concerned with Demand-Side Management and Integrated Resource Planning (DSM/IRP). The meeting is not intended to be a seminar, in the sense of being a presentation on "What is DSM/IRP". Rather, the meeting is a Roundtable Discussion Forum regarding "How can DSM/IRP be most effectively implemented in the Philippines".

The role of the moderator is to present various options on each topic. The role of the participants is to discuss the pros and cons of each option, reflecting the mission and opinions of their respective organizations. The ideal result of this meeting will be a general understanding and agreement regarding how all organizations can best coordinate their activities to implement DSM/IRP in the Philippines.

AGENDA

8:30 - 9:00 A.M.	Registration
9:00 - 9:30	Welcome, Introductions, and Meeting Purpose Undersecretary Mariano S. Salazar Department of Energy
9:30 - 10:00	Status of DSM Activities in the Philippines
10:00 - 10:30	DSM/IRP in the ASEAN Region - How are Other Countries Implementing DSM/IRP? - Focus on Indonesia DSM Action Plan
10:30 - 10:45	Coffee Break
10:45 - 11:45	Current Laws and Legislative Proposals - Does Legal/Regulatory Authority Exist to Mandate DSM/IRP in the Philippines or Must It Be Created? - If Authority Does Exist, What Policies are Necessary to Implement DSM/IRP?

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11:45 - 12:30	Conducting Market Research for DSM
	- Identifying DSM Capabilities in the Philippines: Available DSM Technologies and Services
	- Understanding the Needs of Utility Customers, DSM Equipment Manufacturers, Energy Service Companies (ESCOs)
	- Gathering and Using End-Use Load Research Data
12:30 - 1:30	Lunch (Batanes II)
1:30 - 2:15 P.M.	The DSM Assessment Process
	- DSM Supply Curves: Which Technologies are Appropriate for the Philippines?
	- Benefit/Cost Analyses of DSM Programs: Which Sectors and Measures Should Pilot Projects Focus on in the Philippines?
2:15 - 3:00	DSM Pilot Projects
	- Designing DSM Pilot Projects: Practical Steps
	- Implementation, Evaluation, and Scale-up
3:00 - 3:15	Coffee Break
3:15 - 4:00	Integrated Resource Planning
	- Modeling and Analytical Requirements: Are Existing Computer Models Adequate for IRP or Are New Ones Needed?
	- Organizational Issues: DSM/IRP Under Different NAPOCOR Privatization Scenarios
4:00 - 4:30	Discussion and Conclusion
	Undersecretary Mariano S. Salazar Department of Energy

ATTACHMENT 2
ROUNDTABLE PARTICIPANTS

COMPANY	PARTICIPANTS
Asian Development Bank ADB Ave., Ortigas Center Pasig, Metro Manila Tel. No.: 6326485 Fax No.: 7417961; 6326816	Geoffrey Wilson Senior Financial Analyst Anthony Joseph Jude Energy Specialist Energy Industry Department Perminda N. Fernando Senior Energy Specialist Energy Industry Department
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The Office of Energy, Environment, and Technology

The Agency for International Development's Office of Energy, Environment, and Technology 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 air pollution.

To address these problems, the Office of Energy, Environment, and Technology 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, adaptation, 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 USAID 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 USAID staff in areas of energy that can help to 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 countries as they pursue policy and regulatory changes to provide market incentives for environmentally beneficial technologies.

To pursue these activities, the Office of Energy, Environment, and Technology 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, Environment, and Technology 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 USAID's field offices in assisted countries.

Further information regarding the Office of Energy, Environment, and Technology's projects and activities is available in our Program Plan, which can be requested by contacting:

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