Demand-Side Management in Ukraine
DSM Demonstration Program Design

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ENI

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Executive Summary

S.1 Project Background and Objectives

This report presents the results of work sponsored by the United States Agency for International Development (USAID), Bureau for Europe and the New Independent States, Energy and Infrastructure Division. Through a bilateral program, USAID has been providing assistance to the Government of Ukraine (GOU). One of the DSM (demand-side management) Demonstration's tasks included the design of DSM pilot projects for two electricity distribution companies in Ukraine, which is the topic of this second part of a two-part report.

Over the past year, the GOU has begun to introduce sweeping legal and regulatory reforms to accelerate the transition to a market-oriented economy. The Power Sector Restructuring and Regulatory Reform Program of the GOU, authorized by Executive Decree on April 21, 1994, is expected to revitalize the energy sector, enhance its long-term viability, and encourage economically optimal investment and consumption decisions. The new Ukraine power structure will rely on market forces rather then regulation to select the least-cost energy options.

Part 1 of this report presents a definition and description of DSM and the results of a national assessment of the potential for DSM in Ukraine. A number of electric end-use efficiency measures were screened for cost-effectiveness and then combined into candidate DSM programs. These programs were defined to realistically develop the achievable DSM resource at the national level in Ukraine over the short term (six years). This assessment was done to be consistent with the appraisal of multilateral development bank credits that may become available to Ukraine in that time frame for power sector investments.

Two roles were identified for DSM in the vertically disaggregated, restructured Ukrainian power sector. First is the role that DSM can play in minimizing rates for suppliers (distribution companies) through competition of supply-side and demand-side resources in the Energomarket pool. Second is the role of DSM as a tool through which utilities (local electric companies, or LECs) can provide customer service to ensure loyalty and retention of key large customers in the new competitive supply market. This helps ensure the viability and competitiveness of these key large customers. At the same time, DSM results in the acquisition of cost-effective energy resources.

While the identification of demand-side resources and the implementation of a regulatory framework form a necessary foundation for the subsequent development of DSM, further information on customer response to DSM, training of Ukrainian utility staff, and technical proof of concept are all required if widespread implementation is to take place. Pilot DSM projects can address these issues while providing opportunities to demonstrate whether proposed programs work as expected. Further information can also be gained to reduce uncertainties regarding program impacts and improve program delivery.

One purpose of the DSM assessment in Part 1 was to identify sectors and end uses where pilot projects would be most appropriate in Ukraine. The industrial sector and some of the industrial-like segments of the communal service sector (such as municipal water pumping, hereafter included in the definition of the industrial sector) were identified in Part 1 as offering both the greatest achievable savings potential as well as the most cost-effective programs. The industrial sector was also identified as the sector most likely to be able to shift large dispatchable loads off the utility system peak period. Therefore, these sectors were determined to be the primary candidates for DSM pilot projects.

This Part 2 of the report presents the design of two pilot industrial DSM projects suitable for financial support from multilateral development banks. The DSM pilot project design task was undertaken in work with Dneproenergo and Vinnitsaenergo, two of the original electric distribution companies in Ukraine. Dneproenergo served a heavily industrialized area of central-western Ukraine. Vinnitsaenergo served a more agricultural-based region of central Ukraine. As a result of the power sector restructuring, these two energos no longer exist. Rather, newly formed LECs serve the loads in these regions. Four of these LECs will participate in the final design and implementation of the pilot projects described in this report.

The primary objective of this task was to design pilot industrial DSM programs that would demonstrate how DSM can successfully and cost-effectively be implemented in a deregulated, fully competitive, market-based Ukrainian electric sector. Both an LEC operated energy efficiency pilot program and a non-utility (ESCO) based load management bidding pilot program were designed. The energy efficiency pilot program was designed to demonstrate the value of DSM as a customer service tool to aid the LECs in customer retention and acquisition of cost-effective energy savings. The load management bidding program was designed to demonstrate how DSM (dispatchable load) can compete with generation resources in the newly formed Energomarket power pool.

The programs include incentives to ensure participation by utility customers, a marketing approach to solicit such participation, and an evaluation plan. The pilot programs were designed to address customer attitudes, values, and needs and their responses to the effectiveness of alternative delivery mechanisms, which were explored through focus groups. The focus groups were held with utility and Ministry of Energy and Power (Minenergo) staff, utility customers, and vendors of DSM products and services in the spring of 1995.

A secondary objective was to help develop capabilities within the government, the utilities and the private sector to design, implement, and evaluate DSM programs on a continuing basis. An end-use load research element was designed as part of the DSM Demonstration Project to help achieve this objective. Through end-use load research, utilities can more accurately gauge the DSM potential at specific customer sites. End-use load research data also allow utilities to more effectively assess the impacts of their DSM efforts. To support the design of the load research element, monitoring (generally for a week) of the energo's customer facilities was conducted during the project using end-use power monitors. Finally, a training component of the Demonstration Project, also designed to achieve this objective, will be undertaken during the implementation of the pilot project.

S.2 Scope of the DSM Pilot Project Design

Chapter 2 of this part of the report begins by presenting some North American experience with industrial DSM programs. A description is provided of seven of the most successful traditional DSM programs in the United States and Canada along with a description of several successful utility financed, shared savings programs and load management programs. Common traits that contributed to program success are identified along with steps that may be appropriate for the implementation of the pilot industrial DSM projects in Ukraine. The chapter concludes with a discussion of the current utility trends in the United States in response to deregulation and retail wheeling, and the fate of DSM in the new, competitive environment.

Chapter 3 presents the concept of a pilot project. The general objectives that a pilot seeks to accomplish are described. The rationales for the specific pilot projects recommended for implementation by the LECs and ESCOs are then presented. These rationales are responsive to the barriers, risks, and uncertainties that currently confront the Ukrainian economy and utility sector.

Chapter 4 summarizes the results of the DSM assessment of Part 1 of this report, focusing exclusively on the industrial sector. The characteristics of electricity consumption in Ukraine's industrial sector are presented. The costs and savings of candidate DSM measures are presented, as are the results of the screening of those measures for cost-effectiveness, resulting in a DSM supply curve for the industrial sector. The measures are then aggregated into generic industrial DSM programs that serve as the basis for the industrial DSM pilot projects presented here.

Chapter 5 presents the end-use load research element of the DSM demonstration, starting with a discussion of the purpose and goal of utility load research. The short-term monitoring conducted for this demonstration is described, including a presentation of some of the pertinent results from the end-use monitoring of 10 sites during the demonstration. The methodology, sampling plan, equipment configuration, and data collection and analysis protocols for the end-use load research element of the demonstration are defined.

Chapter 6 presents specifications for the DSM pilot projects. This includes a discussion of each of the two pilot projects' content and features, financing and contractual structures, marketing strategy, program design, field delivery and implementation issues, verification strategies, process and impact evaluation, and cost recovery. The demonstration project training component is also described.

Chapter 7 concludes with a summary of the practical issues associated with the implementation of the DSM pilot projects and associated training, including project organization, identification of key project participants and stakeholders, the makeup of the advisory committee, project data tracking system configuration, and the target project goals. A schedule for implementation of the pilot projects is also provided.

Included in the appendices A through E are definitions of common terms; survey instruments, interview guides and site data request forms; data on the cost of conserved energy and capacity for measures screened during the assessment (Part 1 of this report); data and reference information on the end-use load research task; and site reports and data gathered from each of the participating industries.

The proposed projects are pilot projects, as much experimental tools as a serious effort to acquire DSM resources. They are experimental in that they will test methods for marketing, interacting with customers, providing financial incentives, organizing personnel, managing information flows and record keeping, and acquiring cost-effective electric resources at the LECs. They will also test an innovative concept of allowing demand-side resources to be compete with supply-side (generation) resources in a national power market pool.

The information gathered during DSM pilot project implementation will be extremely valuable in the design of the full-scale DSM program implementation. It will also be valuable in demonstrating both the mechanics and value of DSM in a competitive utility market.

S.3 North American Experience with Industrial DSM Programs

The American Council for an Energy-Efficient Economy recently analyzed North American experience to date with industrial DSM. The Council conducted a survey of utilities and prepared a database of industrial DSM programs. More than 80 utilities and third-party organizations were interviewed. The study focused on incentive-based industrial DSM programs, and excluded load management-only and information-only programs (including technical assistance programs). The primary measures of program success adopted for the study were high participation rates and/or high electricity savings as a percentage of 1989 industrial electricity sales, at levelized costs below the avoided costs of most utilities.

A total of 12 successful programs were identified in the database. The average annual savings as a percent of 1989 industrial sales for these programs are 1.1 percent, the average annual participation rate is 9 percent of eligible customers, and the levelized utility cost is $0.014/kWh saved. The successful programs have therefore achieved roughly six times the savings and two times the participation of the average program in the database, at lower cost. Seven of these successful programs are described in the report to provide some models as to how an industrial DSM pilot project could be implemented in Ukraine.

These programs differ from the proposed pilot projects in that through these programs, each of the utilities offered grants to their customers as an incentive for their participation. However, there are several traits (outlined below) that appear among these relatively successful programs (programs with above-average participation and savings) that apply as well to the type of industrial programs proposed for Ukraine.

- **Addressing Customer Concerns.** Addressing customer concerns is particularly important when it comes to industrial firms. To date, industries have been skeptical about the quality and intent of utility DSM programs. Issues of concern for industries include power quality and reliability, environmental regulations and competitiveness. Industries also often perceive there to be a high technical and financial risk associated with DSM measures that affect their processes.

  Finally, because industrial customers are busy and focused on production, programs must be

"user-friendly" and well-administered to minimize the paperwork, bureaucracy and customer time requirements.

- **Marketing Techniques.** The marketing techniques employed by the utility can make the crucial difference between an industrial program's success and failure. The utility needs to make continual personal contact with the customer and target the marketing efforts to the customers appropriate decision makers.
- **Program Flexibility.** Generally, the more program flexibility the utility offers to the industrial customer, the more successful the utility has been in recruiting participants.
- **Financial Incentives.** Customer financial incentives are offered by all the programs in the database. A few programs offer the option of low-to-no-interest loans instead of, or in addition to, a cash rebate. Generally, the programs offering larger financial incentives have above-average participation and savings.
- **Program Analysis and Evaluation.** Two-thirds of the utilities offering the successful programs in the database have performed extensive market research of their industrial customer base and/or have performed impact and process evaluations. These activities provide utilities with a wealth of information on how to improve the design of their programs and thereby increase participation and savings.

Examples of successful load management bidding programs and an energy service charge program are also described in the report. These programs demonstrate approaches to DSM that are similar to those presented in this report. The successful traits described above also are found in these programs. One of the important lessons learned from the load management energy cooperatives is that a third party broker can effectively motivate commercial and industrial customer to continually refine their energy management and capture greater and greater efficiency over time. Load management cooperatives can provide an effective, low-cost means for major energy users to profit from load management and energy efficiency.

Currently in the United States the electric utility industry is being deregulated and thrust rapidly into a competitive environment similar to the one that will exist in the Ukraine. For many utilities, this is requiring a shift in the way that they do business. The fate of DSM in this new environment is uncertain. Many utilities are using DSM as a means of providing a value-added service to their industrial customers, in some cases only for "at-risk" customers — customers that may choose to purchase power elsewhere. Other utilities are choosing to abandon DSM. Yet others are providing "energy services," which may include a wide variety of services designed to benefit their customers such as productivity improvement audits, financing for energy efficiency improvements, and assisting the customer to link with other resources that may benefit them (environmental services, for example). Utilities are making stronger efforts to become good business partners with their customers and to understand their needs and operations.

Clearly, the purpose and need for DSM in the current more competitive supply market have changed. The need to reduce rates and provide customer service to ensure loyalty and retain key large customers is the primary driver for DSM in a deregulated environment, whether it be in Ukraine or in the United States.

S.4 Overview of the Pilot Projects

A pilot project provides the opportunity to test a new concept on a small scale. This approach controls for much of the technical and economic risk and uncertainty usually associated with undertaking any new enterprise. DSM as a utility program activity and as a resource that can compete with generation resources is certainly a new concept in Ukraine and should therefore be amenable to the test of proof of concept that pilot projects provide.

The two pilot projects for this Demonstration have been designed to demonstrate the value of DSM resources in the restructured Ukrainian power sector. In the Load Management Bidding Pilot project, ESCOs will be solicited to provide turnkey energy and load management services to prescreened industrial sites in Ukraine.

The ESCOs will identify, design, install, and start up DSM measures in selected sites. They will be responsible for arranging financing, procuring equipment, and assisting with bidding of demand-side resources (dispatchable load) to the Energomarket. This pilot project is designed to demonstrate how DSM can be a profitable venture for the private sector.

LEC cooperation is essential to the success of private sector efforts. The LECs can provide a "value-added" service to their customers participating in the load management pilot project by processing and submitting load management bids to the Energomarket pool and providing information on customer energy consumption and wholesale and retail pricing. At the same time, DSM resources can result in a reduction in the LEC's costs. During the electric system's peak period, when revenues from the sales of power do not cover the LEC's cost to purchase power from the pool, it can be cost effective for the LEC to reduce their load. This can be done through load management bidding.

The Energy Efficiency Pilot project will be implemented through the participating LECs. The LECs will provide energy efficiency services to select "at risk" industrial customers as a customer retention strategy. These services will include identification of cost-effective DSM resources and financing of energy efficiency improvements. The financing, in the form of a loan to industrial customers, will be paid back through shared savings on the energy bills. Technical, economic, and marketing training will be provided for trade allies, utilities, and other necessary parties.

S.4.1 Objectives of the DSM Demonstration

The pilot projects serve three primary functions: to demonstrate the value of offering energy efficiency financing as a customer service and retention technique in the new competitive environment; to demonstrate the value of DSM as a resource which can effectively compete with generation resources in an Energomarket pool; and to demonstrate methods of acquiring cost effective DSM resources in a market driven electricity market.

In addition, the Demonstration will serve several other objectives:

- Provide a better understanding of electricity end-use in the industrial sector and produce (through audits and energy analyses) equipment inventories, process flow characterizations, and a base of market research information. These activities will have continuing value well beyond the life of the pilot project and will serve as the foundation for an ongoing program of systematic industrial load and market research.
- Help define and test the current capabilities of manufacturers, distributors, vendors, equipment specifiers, and architect-engineer specialists to support DSM on an expanded scale. Further, the Demonstration will provide technical support and funding to expand existing capability, develop new expertise, and build bridges to U.S. and other foreign purveyors of DSM technology by establishing formal affiliate relationships with Ukrainian enterprises.
- Demonstrate the capability of Ukrainian utilities to deliver and manage a DSM program, including program marketing, project management, information flows and records keeping, project evaluation, and program evaluation.
- Test numerous program design features and encourage experimentation to help guide the design of a full-scale program. The design features to be tested include marketing approaches, financial incentive arrangements, savings verification procedures, technologies and technology packages selected for assistance, and program procedures.
- Give new insights into how Ukrainian industrial decision-makers evaluate investments in energy efficiency in terms of alterative uses of capital, and the influence of size, market position, growth prospects, private versus public ownership, and other factors on investment criteria, expectations and the quantification of risks and rewards.

- Allow the LEC's to work with their industrial and communal service customers and other prominent institutions and organizations to catalyze a public-private partnership for implementing electric efficiency throughout Ukraine and help instill the notion of DSM as a valuable, stable resource for Ukraine's energy future.

S.4.2 Barriers, Risks, and Uncertainties

There are many barriers, risks, and uncertainties associated with launching DSM programs and innovative non-utility based programs in Ukraine. When the first DSM efforts were started in North America, U.S. utilities had to completely change the way they related and marketed to their customers; Ukrainian utilities will have to do the same.

Successfully marketing and implementation of DSM in Ukraine will require the development of new skills, new organizational structures, new laws and regulations, new businesses, and whole new industries. The size of this task alone is a large barrier to DSM. But the interest and willingness to overcome such a large barrier appear to be present in Ukraine. Some of the specific barriers, risks, and uncertainties that have been identified warrant discussion here.

Much of the information on barriers presented below was gathered from a series of six focus groups held May through June 1995 and from site visits to major enterprises in Ukraine during May 1995. These focus groups were run by the Socis — GALLUP International, a Ukrainian market research firm. Two focus groups were made up of industrial customers; one of residential customers; one of equipment vendors, manufacturers, and service providers; one of commercial customers; and one of staff from the Ministry and Kievenergo. Site visits were conducted by the international DSM consultant, end-use load experts and energo technical staff. A brief summary of each of the site visits is included in Appendix E of the report.

Severe Shortage of Capital to Make Energy Efficiency and Load Management Improvements. Most of Ukraine's industry faces severe capital shortages, so severe that many operate only periodically due to lack of capital to purchase raw materials. In addition, the investment needs in aged, out-of-date industrial facilities are enormous, as are the pressures just to stay viable. The focus groups pointed out that, for many industries, investments are made only in critical items. Participant after participant in the focus groups identified lack of capital as the primary barrier to installing DSM measures. Clearly, upfront financial assistance will have to be a central component in any DSM program initiated in Ukraine.

Comfort and Trust of the Energos. The recent severe economic downturn in Ukraine has claimed many casualties, including many relations between debtors and creditors. Many companies found themselves unable to pay their electric bills. In addition, mandatory curtailments have created bad feelings between the energos and some of their customers. Much of the mistrust and bad feelings that exist might be overcome once the LECs show they are interested in providing customer service in addition to selling electricity and once there is a better understanding of the benefits of DSM

Price of Energy-Efficient Equipment. A number of focus group participants identified the high prices for energy-efficient equipment as a significant barrier to DSM investments. They explained that equipment buyers are extremely sensitive to first price: they choose the lowest-priced piece of equipment even when they know that the more efficient, but more expensive, piece will be much cheaper to operate and in general will be of higher quality. One solution to this problem is for the utility to defray part of the cost of DSM measures by providing financial incentives or financing for its customers. Another solution is for the private sector (ESCOs) to offer financing that is paid back through shared savings in the customers' utility bills.

Availability of Energy-Efficient Equipment. While some energy efficient equipment is available in the market, virtually no Ukrainian manufacturers produce energy efficient equipment. It is strongly suggested that trade allies be invited to provide input to program design and implementation. It is also strongly suggested that the LECs develop partnerships with key trade allies to reduce the barriers of equipment availability.

Companies May Go Out of Business after DSM Investments are Made. In the difficult economic environment of Ukraine, many industrial and commercial facilities are being closed, and many of them permanently. This situation creates a difficult challenge to the successful implementation of DSM programs and services. Special precautions will probably have to be taken to avoid a high rate of loss or nonperformance of DSM investments. For the pilot projects, the LECs and ESCOs may want to focus on those industries that have a significant export market or on those industries and communal services that have a stable source of revenue and have been operating on a regular schedule.

Baseline Energy Use and Load Data May be Difficult to Obtain. In the type of DSM projects proposed, it is important to obtain reliable data on energy use and load profiles before DSM measures are installed. These data help DSM program managers and ESCOs estimate potential savings, which is necessary for negotiating customer financial assistance and evaluating the program. If reliable information on a customer's baseline energy use is not available, there is a risk that financial assistance could be offered for phantom or less than cost-effective energy savings.

Utility Cost Recovery and Lost Revenues. Concerns regarding cost recovery and lost revenue are also a barrier. Strategies to minimize costs that are not fully recovered in utility rates and revenues lost as a result of lower electric sales have been incorporated into the pilot project designs. The costs for measure identification and implementation as well as the LEC administrative costs to implement the Energy Efficiency Pilot project can be recovered through a fee (in the form of interest) on the financing offered to customers. Financing for the Load Management Bidding Pilot will be provided through non-utility capital. Even this financing will be recovered through shared savings contracts between the participating industries and ESCOs. Only the revenue lost due to lower sales of electricity (as a result of DSM) will have to be absorbed. This loss will be subsidized by shareholder dividends. This loss can be considered an expense of doing business (since financing of DSM measures in the Energy Efficiency Pilot is done for customer service and customer retention purposes).

Current Utility Rate Structure and Government Profit Formula are Disincentives to Conservation. Currently, each industry or business is allotted a fixed amount of electricity demand. If that amount is exceeded or not reached, penalties are imposed. In addition, if the limit is not reached, the allotment is reduced the next year. It is essential that the LECs eliminate this "allotment" and penalty mechanism to eliminate this DSM disincentive.

For many state-owned industries, profit is tied to expenses. A profit of a set percentage of operating costs is allowed. If energy costs are reduced, operating costs are reduced, thus reducing profit. Again, industries operating under this sort of government control face a strong disincentive to implement conservation. As more industries become privatized, this problem will disappear.

Document Management/Lack of Computerization. Implementing a DSM program presents significant challenges for managing a large volume of documents. Because of the very low level of computerization within the LECs, much financial and energy use data are still recorded and compiled by hand. If this practice is employed for implementing DSM, the program will be made unnecessarily difficult to administer.

Lack of Marketing Experience. A successful DSM program, even a targeted program requires good marketing. Even North American utilities that have had many years of marketing experience often have trouble marketing their programs and services. Marketing is a new concept for Ukrainian utilities. Given the small amount of experience the LECs have had with marketing, it is expected that they will require assistance in developing and implementing a marketing plan for this pilot program.

Customer Service Focus. In the new competitive environment, utilities must develop a strategy and objectives for customer retention and growth. Besides price, what distinguishes one utility from another is often customer service. Offering DSM and DSM financing as a customer service is one strategy for retaining customers in a competitive environment - particularly in Ukraine where most industries are capital constrained. LECs will have to learn a new way of doing business, similar to what utilities in the United States are currently having to do to remain viable.

LEC Knowledge, Skills, and Technical Capabilities. In order for LECs to provide good customer service, it will be necessary for them to develop a better understanding of their customers' needs, their processes, opportunities for DSM, and economic viability. They will need to organize in such a way as to facilitate this, for example, establishing customer service representatives and customer tracking records. Staff will need training in industrial energy efficiency, customer service concepts, contract management and negotiation, etc. Some of this training will be provided through this DSM demonstration.

S.5 Overview of the Industrial Sector

The industrial sector is the largest energy consuming sector in Ukraine. In 1994, this sector accounted for electricity sales of 88.6 TWh. "Industrial-like" commercial/institutional loads accounted for 17.2 TWh. Together these sectors account for 65% of the total net domestic sales. Although the composition of industrial demand may change, reflecting broader economic trends and changes that are likely to occur in the countries industrial base, Ukraine's industrial sector will likely maintain its predominance in terms of electricity consumption.

The key characteristics of Ukraine's industrial consumers include the following:

- An estimated 90% of electricity consumption in the industrial sector is consumed by electric motor systems. Industrial motor usage is relatively constant throughout the day and night with little seasonal variation.
- Over half of industrial lighting is incandescent. Mercury vapor lighting is also common. Both lighting types are good candidates for efficiency improvements.
- The most significant types of electricity consuming processes reported are furnaces and welding.
- In the industrial survey sample, 46 percent reported that electricity costs were a major concern and 42 percent were interested in price incentives for energy efficient equipment
- Cost effective industrial DSM programs and load shifting are estimated to be able to save over 6,400 GWh/year and 3,880 MW of cumulative capacity additions by 2001.

In Part 1 of this report, the DSM assessment for Ukraine, a number of industrial DSM measures were identified as likely candidates for implementation in Ukraine. Although all of the measures are technically feasible, programs should be built only around measures shown to be cost-effective. Because of the diversity of process loads, the lack of detailed information about these loads in Ukraine, and the difficulty of replicating, process measures were not considered in the assessment. Instead, the analysis focused on lighting and motors, although some of the measures selected address overall industrial electricity use.

Part 1 of this report describes how the cost of saved energy and the cost of saved demand can be derived and compared to avoided energy and capacity costs to determine whether a particular measure would be a good candidate around which to develop a program. The results of this screening analysis are presented in Chapter 4 of this volume along with the physical energy and demand savings that would be expected from those measures if they were applied to all existing installations.

Using DSManager, cost effectiveness tests (the TRC and Participant tests which are described in the report) were conducted for programs. The assessment of all programs took into account direct program costs, fixed overheads for each program, and the national program overheads that pertain to all programs. The benefit-cost results for each energy-efficiency program outlined in Chapter 4 (including the national DSM aggregate) for the TRC, RIM and participant tests are shown for programs that were determined to be cost effective. Also shown is the net benefit from each of the three perspectives, and the energy and demand savings attributable to each program and for all programs. Programs around the following measures were determined to be cost effective:

- commercial/institutional motors, motor drives and motor downsizing
- industrial motors, motor dives and motor downsizing
- industrial facilities maintenance

- industrial lighting
- street lighting.

From a total resource perspective, the net present value benefit of all the programs is US$88 million. This signifies that Ukraine's energy requirements can be met at a substantial cost savings through DSM.

S.6 End-Use Load Research Element

The DSM Demonstration contains an end-use load research element as an integral component of the pilot project designs. End-use load research is important to DSM activities being considered. By understanding how its customers use electricity in their facilities, utilities can more accurately gauge their DSM resource potential. Load research also plays an important role in impact evaluation, through which the actual costs and savings of efficiency measures are accurately determined. Finally, a load research staff or department at a utility can increase the level of customer service because utility staff interact with their customers and learn more about their needs for energy services. This last point is especially relevant in Ukraine, where utilities are realizing the need to change their market outlook from a strong tradition as commodity vendors to one of energy service providers.

In this Demonstration, a pilot end-use load research task was undertaken as a means of introducing the concept of load research to the DSM pilot project design process. Load research is a separate pilot project activity because it involves different people at the utility whose tasks are performed independently and at different times than the DSM project implementation staff.

Load research data are also necessary to evaluate the cost-effectiveness of DSM and load management programs and their impact on utility operations. Load shapes can be produced and analyzed along with process data (if available) to determine specific energy consumption. Then these data are available for determining the program impacts associated with any energy efficiency improvements made as a result of a DSM program.

Although load research will be conducted at industrial, commercial, and residential facilities, the focus of the Demonstration project in Ukraine is the industrial sector, which accounts for the major portion of the country's electricity demand. The program's primary sources of data are:

- whole-premise data (kW and kWh)
- survey data collected from a wide range of customers
- end-use data measured by monitoring instruments.

The objectives of the load research task were:

- to help the utility gain a better understanding of how consumers use electricity as a basis for enhancing customer service
- to help identify specific DSM measures and estimate their impacts
- to the extent possible, to use the data to more accurately characterize the end-use load shapes developed in the National Assessment portion of this demonstration.

As a result of this task, load shapes were developed for selected end-uses. The load shape data provides a basis from which to determine the energy and demand savings potential. It also provides a baseline from which savings can be verified. Finally, the protocols developed and training provided will enable LEC staff to better provide customer service and implement DSM programs.

S.7 Pilot Project Design Specifications

The preliminary specifications for the industrial DSM pilot projects are presented in Chapter 6. While every effort has been taken to provide as much detail as possible, a more complete project design should be undertaken before project implementation. These specifications can be used as a guideline but the current status of utility regulation and the economy in Ukraine should be considered at the actual start of the project. Details of the two pilot projects designs, verification and evaluation requirements and sources of project financing are provided below.

S.7.1 Load Management Bidding Pilot Project

Content and Features

The Load Management Bidding Pilot Project is designed to provide a mechanism through which dispatchable load can be bid to the hourly spot market pool in competition with supply side resources. All accepted bids will receive a payment from the pool, much as will supply-side (generation) resources. This resource payment, as explained in Part 1 of this report, will be equal to the highest accepted $/kWh bid (demand or supply side resource bid). Demand side resource bids will only be accepted when the bid price and quantity result in a decrease in the overall marginal pool price.

In this pilot, two or more ESCOs will be solicited to provide turnkey services to six prescreened industries. The selected ESCOs will identify retrofits and dispatchable load shifting opportunities; work with the industries to arrange financing; design, specify, and procure equipment; and install and start up selected projects under a shared savings contract. The ESCOs will act as an agent to the industries and as an intermediary between the industries and their LEC to bid dispatchable load to the Energomarket. The ESCOs will be responsible for providing the monitoring and verification and in some cases the operation and maintenance of projects.

During Phase 1 of this project, candidate industries were selected by the former Dneproenergo and Vinnitsaenergo for participation in this pilot project. Subsequently, site visits were conducted for the 10 sites selected — 7 industrial sites, a hospital, a school, and a water pumping facility to market the project and to assess their economic viability, willingness to participate in the pilot project, and DSM potential. A summary site report for each of these sites is included in Appendix B.

Sites were selected based on their energy load size, energy savings potential, level of interest in the project, the response of their respective energo management, relative financial stability of the site operation, and ability to make payments in hard currency. Detailed information gathered on energy cost, consumption, tariffs, and load profiles as well as the background and financial information on the sites will be appended to the ESCO RFQ. Six of the 10 sites will be selected for participation in this program.

Each prescreened industrial site is served by one of the newly organized LECs. The four LECs participating in this ESCO pilot program will have an integral role its development and implementation.

A Request for Qualifications (RFQ) solicitation and subsequent procurement process will be administered by an international DSM consultant on behalf of the Minenergo. The purpose of this procurement is to arrange turnkey energy service contracts and investments between U.S.-based ESCOs and the prescreened industrial firms in Ukraine. All participating U.S. ESCOs will be expected to undertake projects with Ukrainian companies that have expertise in engineering, mechanical and electrical contracting, project management, equipment sales, or other allied fields.

The pilot program is also designed to serve additional goals: to promote development of the energy efficiency industry in Ukraine, to develop the mechanics and demonstrate methods for the sale of DSM resources to the new Ukraine central power pool (the Energomarket), and to design and test innovative contract and financing mechanisms that can be replicated.

The RFQ will contain background information needed by ESCOs to make informed proposals. U.S. businesses face daunting challenges doing business in Ukraine. A major goal of the procurement design is to reduce the ESCOs' barriers to entry. For ESCOs interested in developing ground-floor business opportunities in Ukraine, this procurement program will organize and offer the following:

- identification and introduction to qualified, decision-ready, major industrial end users and LECs
- assistance with project development and arrangement of financing
- USAID capital grants for equipment in each participating industry
- introductions to Ukrainian energy efficiency businesses who can serve as local partners
- other measures to mitigate ESCO development risk.

The ESCOs will arrange a package of financing from one or more sources for identified DSM measures. The financing will be paid back through an energy services contract between the industry and the ESCO. The ESCOs will specify, procure, install, and start up the DSM equipment and measures at each site. ESCOs are also responsible for verifying savings resulting from the measures. In some cases, the ESCOs may be contracted to maintain the savings.

The Energomarket pool, using preestablished verification protocols, will verify that the load bid to the pool was in fact dispatchable. Resource payments for accepted bids will be paid by the pool to the LEC and will be equal to the highest accepted pool price bid (generation or DSM) at each hour. The LEC in turn may charge the industry processing fee for their time, then submit the resource payment to the industry. The minimum pool bid is 2 MW.

Contract Structures

The parties involved in the ultimate transactions anticipated by this pilot program include the ESCOs (and their equipment suppliers, subcontractors, and Ukrainian partners), the end user companies, the LECs, and the Energomarket. Several possible contract structures are described below.

1. ESCO/End User Energy Services Agreement. This primary agreement will address all ESCO services, including equipment installation and commissioning, equipment performance standards, operations and maintenance, measurement and verification of savings, and performance guarantees. End-user payments to the ESCO and the disposition of the equipment, including ownership, insurance, termination, and other provisions, will also be addressed. Financing for projects will be provided via the ESCO or arranged by the ESCO to be provided directly to the end user. The ESCO and the end user may create a separate project-specific joint venture.
2. LEC Contract. The LEC will have a contract with either the end user or the ESCO (or both) concerning the program and the sale of DSM resources (dispatchable load) to the LEC. LEC payments for sale of DSM resources will be made to the end user or through the ESCO to the end user. These payments will be accounted for in the ESCO/end user agreement and be incorporated into the ESCO's compensation.
3. LEC/Energomarket DSM License Provision. This provision will include forms and protocols for bidding and payment for spot sales of DSM resources to the Energomarket. The bid will include the following components: quantity of load reduction, time and duration of load shedding, price, and measurement and verification methods.

Field Implementation

To understand the motivation for dispatchable load bidding and its effect on the market, it is useful to examine the bidding process from each of three perspectives: the LEC, the Energomarket, and the end-user. On any given day that a participating industry has dispatchable load available, it may submit an hourly bid to the Energomarket pool through its LEC according to established protocols. The bid will specify the MW load it can dispatch, the hours during which it can supply the load curtailment, its bid price, and how the bid will be verified. It must be submitted 24 hours before the load is proposed to be dispatched.

First, since the bid must be submitted through a LEC, the bid must be approved initially by that LEC. Other than for special customer relation purposes, the LEC generally will only approve a bid if it is for a peak load period in which the LEC is purchasing power for a wholesale price higher then their retail price, i.e., only if they project that they will be losing money on power sales during those hours. In this situation, the bid will reduce the LEC's costs. If the LEC approves the bid, it will aggregate all acceptable bids, add a processing fee, and submit them to the Energomarket pool.

If the DSM bid reduces the pool price for example from 4.0 cents/kWh to 3.9 cents/kWh (a 2.5% reduction) and reduces system demand from 30.0 GW to 29.5 GW (a 1.7% reduction), then the pool will make payments of (29.5 + 0.5) million x 3.9 cents/kWh = $1.7 million for one hour of electricity resources. To recover these costs, it must charge $1.7 million/ 29.5 million kWh = $0.0397/kWh, so wholesale rates have been reduced. However, if the pool were to accept twice that amount of DSM (1.0 GW) at the same bid price, then demand would be reduced by 3.3% and wholesale rates would have to rise to $1.17 million/ 29 million kWh = $0.0403/kWh. In this case, because the DSM increased the pool price, the pool would not accept the bid.

Industrial customers must be sufficiently motivated to be willing to reduce their load during peak periods. Based on simulated pool prices, the following example demonstrates the total resource payments an industry could receive if a 10 MW dispatchable load curtailment was made available (and bid) to the pool during peak periods. The pricing used in this example are likely prices based on simulated pool prices over one year. The actual accepted bid prices are subject to conditions at the time of submittal. (To simulate pool prices, the year was divided into winter, shoulder, and summer weekday and weekend periods.)

If the industry was willing to shift or curtail load for 4 cents/kWh, they would be able to receive a resource payment at that rate for 280 hours per year. This would result in a total resource payment of $159,200. The LEC will most likely take an administrative fee out of that payment in order to process the bid. In addition to the resource payment, shifting load off-peak or curtailing load may also reduce a customer's energy bills and affect production rates, labor costs, or other factors. All of these factors must be taken into account when determining the net benefit to the customer of load management bidding. Clearly, load management bidding can provide benefits to all three parties.

Verification

Verification of dispatchable load will be essential for payments by the pool. Successful verification of a load management program requires a tractable definition of what would have been used in the absence of the bid. One approach used in interruptible/curtailable load programs is to define a "firm service," a level to which usage must be reduced to comply with service agreements. One of the functions of the pilot program will be to develop verification protocols for DSM bidding. These protocols will then be tested during the pilot projects. Development of these protocols will require understanding issues relevant to verification protocols. This will include understanding the types of loads likely to be bid and ways of rigorously identifying baseline usage for those types of loads.

S.7.2 Energy Efficiency Pilot Project

Content and Features

The Energy Efficiency Pilot Project is an investment-based energy service charge program in which the LEC will provide customers with upfront capital to finance the incremental cost of efficiency measures. In return, the participant (customer) pays a monthly energy service charge directly to the LEC to repay the investment with interest. The intent is that the savings from the installed energy efficiency measures after payment of the energy service charge will create an immediate positive cash flow for the industry from day one. This program is offered both as a "customer service" to retain customers and as a means of acquiring cost-effective energy savings. In a competitive market, providing value-added services to customers is often key to retaining customers as well as to acquiring new customers.

As a criterion for obtaining an energy efficiency loan from the LEC, customers should be required to sign a long-term contract to purchase power from the LEC. In this way, the LEC is providing a value-added service and as a result is ensuring that the customer will stay in their system.

The loans should be offered to customers the LEC considers to be at risk of leaving their system. The interest rate on the loans should be set such that the LEC recovers all costs, including administrative costs. Lost revenue resulting from implementation of energy saving measures will be subsidized by shareholder dividends. To maximize project flexibility and to allow project managers to maximize the use of local and customer-specific knowledge, the project will operate under a broad set of principles and policies rather than a set of prescribed procedures.

Contractors will be involved at each stage of the pilot project to conduct energy reviews, quality control inspections, and verification. The LEC will approve contractors as qualified to undertake the work or will accept comparable certification by a nationally recognized organization.

The LEC will contract with energy engineering firms and energy service companies to conduct an energy audit/review of the participant's process and facilities or of the particular efficiency measure of interest. The LEC will pay for the technical assistance up front. The industry will agree that if it does not participate in the program (i.e., implement measures identified through the study that meet an agreed upon rate of return or simple payback), it will pay a fee that will cover a portion of the cost of the study.

Proposed DSM projects may include, but will not necessarily be limited to, the following technologies and operational improvements, which were identified as cost-effective in Chapter 4: high-efficiency motors, motor downsizing, motor-driven systems improvements (such as fan and pump motor controls), process maintenance, process optimization or modernization that results in efficiency improvements, and high-efficiency lighting. Any other technology or measure that passes the TRC test and the Participant test should be also eligible.

Customers will be offered 100% upfront financing for approved DSM projects based on energy and demand savings and project cost. The financing will be offered through the energy services contract. Interest rates on the financing will be competitive with market rates. Rates should be set at the marginal cost of capital plus a spread sufficient to cover the cost of the program. The industry will pay a monthly energy service charge directly to the LEC through its electricity bill.

A performance verification of the completed financed projects will be conducted six months after installation and startup to assure proper operation and training of system operators. If the verification indicates a need for system or equipment adjustment or an operation and maintenance procedure modification, the customer is responsible for making necessary adjustments or for contacting a contractor to fix the problem. If actual savings fall short of projected savings by more then 20% because of inaccurate savings estimates, the LEC will make a one-time adjustment to the energy service charge, lowering it for the life of the contract.

Customers need to understand that by implementing DSM, the LEC is acquiring a resource on their behalf that is less expensive than conventional supply-side resources. Moreover, it is one that can have both end-use productivity and environmental benefits. However, customers are expected to (and do) pay for all resources — supply and demand side — that utilities acquire for their benefit.

Field Implementation

Written program policies and guidelines must be established and provided to all program staff, including standard program application guidelines and financing forms and guidelines. A program marketing brochure will need to be designed and printed. All affected and participating employees should be provided training to ensure that they understand the goals of the program and the program procedures. Verification methodologies and guidelines must be developed.

The program and customer tracking database should be designed along with the evaluation workplan. It is very difficult and expensive to collect data needed for program evaluation retroactively. Rather, the fields for data identified as essential for the process and impact evaluations can be included in the program and customer tracking databases at the project start.

Engineering staff in each LEC will need to be trained on the technical aspects of energy efficiency so that they can review and approve energy efficiency cost and savings estimates and measure verification plans. The LECs can use contract engineers until they acquire the expertise in-house.

Finally, an RFQ will be written and issued to solicit qualified engineering firms and ESCOs. These firms can be put on a retainer and called upon to conduct energy reviews, design, quality control inspection services, or performance verification services for the LECs and their customers.

Energy Reviews

A project energy review fund should be established which equals 15% of the total project operating budget. If an energy review results in a completed project, the cost of the energy audit should be added to the cost of the project before determining the financing offer. In this way the energy review fund will be replenished. If an energy review does not result in a completed project, the energy review fund will be depleted. This procedure encourages limiting energy reviews to those facilities that are genuinely interested and motivated to implement recommendations as well as to encourage follow-through with customers after energy reviews.

Installation can take place in one of two ways. The LEC can make the arrangements on behalf of their customers, or the customer can make arrangements directly with a contractor to handle the installation themselves.

S.7.3 Verification and Evaluation

The load management bidding and energy efficiency projects will be feasible only if economic benefits outweigh costs. It is crucial to provide stringent guidelines for evaluating savings attributable to measure installation and as discussed earlier, dispatchable load. Additional information on the verification and evaluation process to be followed for the load management bidding and DSM energy efficiency projects is contained in Chapter 6. A detailed evaluation workplan and verification protocols will be developed concurrently with program implementation as actual sites are selected.

A verification protocol is simply an action plan outlining, step by step, how the reference baseline is to be established, what impacts are to be quantified from that baseline, and what time periods will be used. It describes the role of metering, engineering, and statistical methods in producing these impact estimates. It also specifies the environment within which verification takes place and what other activity flows need to be metered (e.g., production rates, temperatures, fluid flows). This will produce not only a “snapshot” estimate of current savings but also insight into longer-term issues of savings persistence. A few brief definitions will help clarify the role of each process.

Verification is the confirmation that a particular measure was installed and that the differences in energy consumption and demand before and after the measure(s) installation, or with and without load management, are confirmed at the site.

Impact evaluation is the estimation across an entire DSM program of the impacts of program implementation in terms of energy and demand savings.

Process evaluation is the systematic study of a program’s implementation to assess the efficiency and effectiveness of the program delivery process.

Verifying the savings that result from the pilot project is essential to:

- show participating customers, LECs, and ESCOs that measurable energy and demand savings or load curtailment have occurred
- provide a basis for payments related to these savings.

Estimating the total impact of the pilot program is important to:

- prove the feasibility and cost-effectiveness of an industrial DSM project
- provide input into the design of a subsequent full-scale program.

Apart from the savings impacts, the evaluation team must be concerned with how effectively the pilot project was implemented. DSM programs are seldom implemented as designed, and during a program's operation, unanticipated problems generally arise. Process evaluations document in-field modifications to the program sometimes referred to as "lessons learned." Program goals and targets may change during program implementation as well. Process evaluations also provide timely feedback for program management and for reporting. The process evaluation will address such issues as the efficiency of field delivery and customer perceptions of satisfaction and enhanced service quality.

Finally, a benefit-cost analysis to gain insight into how cost-effective a full-scale project is conducted. Of course, a pilot project cannot be expected to be as cost-effective as a full-scale project because of one-time startup costs, project learning and training costs, and economies of scale, but this type of analysis could still be very useful in helping to estimate the cost-effectiveness of a full-scale project. The outcome of this analysis will be important in securing support and funding for full-scale expansion. It will also be instrumental in examining what project features, measures, or delivery procedures are necessary to eliminate or modify for the full-scale version of the project.

S.7.4 Training and Development

Training, education, technical assistance, and partnerships with trade allies are critical to the success of DSM programs. This is particularly true in Ukraine, where the concept of DSM is new. Customers, contractors, and LEC staff must understand DSM technologies and concepts. They must know how to install and maintain DSM projects to ensure persistence of savings. Trade allies services can be leveraged to supplement utility marketing efforts at little cost. Several training and information components of these DSM pilot programs will enhance the success of DSM efforts.

Substantial education and training activities to communicate a wide range of technical and institutional information will be provided to people who might be involved in the DSM program implementation. In some cases, the training will be oriented to the executive and management level and in other cases it will be oriented to the technical and operational level. The venue and format for training will reflect a broad diversity of approaches, from intensive workshops to more general seminars and a conference.

Training and business development assistance will be provided to support local Ukrainian ESCOs and energy engineers' participation in the Demonstration and the pilot projects and to strengthen local engineering capabilities in general. The USAID-sponsored training program will involve the curriculum and testing materials of the Association of Energy Engineers (AEE). Training workshops on different energy engineering topics such as energy efficient motors and industrial process efficiency will be offered by AEE. The participants will be encouraged to take the Certified Energy Manager (CEM) examination, which will be administered in Ukraine after the CEM preparatory training takes place. AEE will also establish local chapters in Ukraine for those who have received the training. Engineering and maintenance staff from participating industries will also be encouraged to attend the technical training.

Business development assistance will be provided which will focus on efforts to broker joint ventures between U.S. and Ukrainian ESCOs. Potential Ukrainian firm participants will be provided additional training and business advice on topics such as corporate planning, financial planning, contracting, and business development.

S.7.5 Sources of Project Financing

A variety of sources of project funding and financing will be explored, including:

- **International Finance Corporation.** A member of the Work Bank group that makes loans to private companies.
- **World Bank.** Currently leading the power sector restructuring process in Ukraine and developing a package of power sector loans.
- **European Bank for Reconstruction and Development (EBRD).** Currently developing an energy efficiency financing facility for Ukraine.
- **Concessional Sources of Bank Funds.** Typically concessional sources provide funds in a variety of ways that tend to be more flexible then other sources. Funds are provided through grants or at below market rates.
- **Commercial Finance Sources.** European and Ukrainian commercial banks.
- **European Union Programs.** The THERMIE program (an energy engineering assistance program) and the TACIS program (the European Union foreign aid program to the republics of the former Soviet Union) may provide technical and financial support to European vendors.
- **Energy Service Companies.** Most ESCOs provide project financing as part of the package of services they offer to clients.
- **Industrial Customers.** As defined under the design of this DSM pilot project, the participating industrial customers would be required to finance a significant portion of capital improvements at their facilities.
- **Other Sources.** These could include the GOU and donor agencies (e.g., USAID).

S.8 Project Administration and Schedule

S.8.1 Organization

Each pilot project will be organized and managed differently. However, a variety of organizations will be involved in some way in both projects. Key participants will be the LECs; the implementation contractors and consultants (perhaps a half dozen or more individuals, firms, and ESCOs specializing in audits, engineering analysis, end-use metering, and installation); a coordinating committee; and other interested agencies and parties such as equipment vendors, engineering firms, business and professional associations, university faculty, nonprofit groups and international DSM consultant to support the LECs.

The coordinating committee established for the original Ukraine Demand-Side Management Project, the Coordinating Committee on Development of a Draft for a System for Demand-Side Management for the Ukraine, will continue to serve in an advisory capacity for the final pilot project designs and implementation. The original members will continue to serve on the committee along with several proposed new committee members, including industry, LEC and National Energy Regulatory Commission representatives. An international DSM consultant, funded directly by a donor agency (e.g., USAID), will provide project design, coordination, and implementation support.

The roles and responsibilities of four key parties are described below.

LECs. Each LEC will establish a project lead who will be responsible for the DSM Demonstration. The LECs will be the central management and administrative leads in the development and implementation of the Energy Efficiency Pilot Project. They will also provide support to ESCOs participating in the Load Management Bidding Pilot Project. Finally, they will be the conduit through which the ESCOs obtain and sell dispatchable load to the Energomarket. As such, the LEC serves a primary role for implementation of both pilot projects.

ESCOs. The ESCOs work for the customer (end user). They will provide turnkey services for the load management bidding pilot project, which includes identification of DSM projects (both load management and energy efficiency); energy and economic analysis of cost and savings; design, equipment specification, and procurement; installation and startup service; monitoring and verification; and arrangement of financing. The ESCO has responsibility for the system performance. During the pilot project, the ESCOs will work under a project development agreement with the international DSM consultant and the industry.

Association of Energy Engineers (AEE). AEE will organize training for local energy engineering and ESCO consultants and firms. The preparatory course CEM exam will be offered and the exam will be administered in Ukraine. Finally, AEE will establish a Ukrainian chapter for those who received the training.

International DSM Consultant. The international DSM consultant will augment LEC staff by providing day-to-day pilot project management and supervision of the various implementation contractors and consultants for the energy efficiency pilot project. They would also facilitate coordination between the LECs, the Energomarket, the advisory committee, and trade allies. For the load management bidding pilot project, the DSM consultant will serve a major role in the design and implementation. The DSM consultant will also be responsible for coordinating the project training efforts.

In addition, the consultant will be responsible for the development, installation, and maintenance of the performance tracking system; the technical savings impact verifications; and the process and impact evaluations of the DSM demonstration. The consultant will also serve as a conduit of technical information and experience to the implementation contractors and consultants.

A 15-month schedule of activities is planned for this Demonstration. This timetable is ambitious but achievable if the LECs, ESCOs, and the international DSM consultants coordinate closely from the beginning of the program. A detailed schedule is included in Chapter 7 of the report.

S.8.2 Demonstration Energy Savings Goals

The goal of this DSM Demonstration is to implement DSM at six industrial sites. Based on data from the audits, and assuming a 75% implementation rate of identified projects, pilot program first year savings (after field installation and commissioning) should exceed 39 million kWh and achieve a monthly demand reduction of 46.9 MW. Projected savings will be refined after further discussions with the candidate sites and the engineering design and implementation of measures. Achieved savings will be based on the verification and impact evaluation.

S.8.3 Performance Tracking, Financial Management, and Records Control

It is recommended that the LECs implement a PC-based tracking system to facilitate financial management and records control as well to effect near real-time monitoring of field activities and project management. Load management bidding will require near real-time instrumentation and monitoring capability. Tracking systems also provide necessary data with which to segment customers into “risk” categories, in other words, to identify and monitor those customers assumed to be at risk of leaving the system.

In addition, the information contained in the system will be useful for estimating savings impacts and for performing a variance analysis of expected versus actual performance. This feature will serve as an “early warning” indicator that corrective action may be necessary to prevent the pilot project from straying off course as problems surface. The performance tracking system combines passive documentation and records management features with active resource allocation, scheduling, and transactions processing functions.

Chapter 1 - 1Introduction

This report presents the results of work sponsored by the United States Agency for International Development (USAID), Bureau for Europe and the New Independent States, Energy and Infrastructure Division. Through a bilateral program, USAID has been providing assistance to the Government of Ukraine (GOU). One of the DSM (demand-side management) demonstration project's tasks included the design of DSM pilot projects for two electricity distribution companies in Ukraine, which is the topic of this second part of a two part report.

Part 1 of this report presents an overview of the sweeping legal and regulatory power sector reforms currently under way in Ukraine as a result of the Power Sector Restructuring and Regulatory Reform Program of the GOU, authorized by Executive Decree on April 21, 1994. The new Ukraine power structure will rely on market forces rather then regulation to select the least-cost power supply options.

Part 1 then presents a definition and description of DSM and the results of a national assessment of the potential for DSM in Ukraine. A number of electric end-use efficiency measures were screened for cost-effectiveness and then combined into candidate DSM programs. These programs were defined to realistically develop the achievable DSM resource at the national level in Ukraine over the short term (six years). This assessment was done to be consistent with the appraisal of multilateral development bank credits that may become available to Ukraine in that time frame for power sector investments.

Two roles were identified for DSM in the vertically disaggregated restructured Ukrainian power sector. First is the role that DSM can play in minimizing rates for suppliers (distribution companies) through competition of supply-side and demand-side resources in the Energomarket pool. Second is the role of DSM as a tool through which utilities (local electric companies, or LECs) can provide customer service to ensure loyalty and retention of key large customers in the new competitive supply market. This helps ensure the viability and competitiveness of these key large customers. At the same time, DSM results in the acquisition of cost-effective energy resources.

While the identification of demand-side resources and the implementation of a regulatory framework form a necessary foundation for the subsequent development of DSM, further information on customer response to DSM, training of Ukrainian utility staff, and technical proof of concept are all required if widespread implementation is to take place. The impacts of DSM programs are difficult to assess prior to implementation because of the many factors that influence program effectiveness. A pilot DSM project can accomplish these objectives while providing opportunities to demonstrate whether proposed programs work as expected. Further information can also be gained to reduce uncertainties regarding program impacts and improve program delivery.

One purpose of the DSM assessment in Part 1 was to identify sectors and end uses where pilot projects would be most appropriate in Ukraine. The industrial sector and some of the industrial-like segments of the communal service sector (such as municipal water pumping, hereafter included in the definition of the industrial sector) were identified in Part 1 as offering both the greatest achievable savings potential as well as the most cost-effective programs. The industrial sector was also identified as the sector most likely to be able to shift large dispatchable loads off the utility system peak period. Therefore, these sectors were determined to be the primary candidates for DSM pilot projects.

This Part 2 of the report presents the design of two pilot industrial DSM projects suitable for financial support from multilateral development banks. The DSM pilot project design task was undertaken in work with Dneproenergo and Vinnitsaenergo, two of the original electric distribution companies in Ukraine. Dneproenergo served a heavily industrialized area of central-western Ukraine. Vinnitsaenergo served a more agricultural based region of central Ukraine.

As a result of the power sector restructuring, these two Energos no longer exist. Rather, newly formed LECs serve the loads in these regions. Four of these LECs will participate in the final design and implementation of the pilot projects described in this report.

The primary objective of this task was to design pilot industrial DSM programs that would demonstrate how DSM can successfully and cost-effectively be implemented in a deregulated, fully competitive, market-based Ukrainian electric sector. Both an LEC operated energy efficiency pilot program and a nonutility (ESCO) based load management bidding pilot program were designed. The energy efficiency pilot program was designed to demonstrate the value of DSM as a customer service tool to aid the LECs in customer retention and acquisition of cost-effective energy savings. The load management bidding program was designed to demonstrate how DSM (dispatchable load) can compete with generation resources in the newly formed Energomarket power pool.

The programs include incentives to ensure participation by utility customers, a marketing approach to solicit such participation, and an evaluation plan. The pilot programs were designed to address customer attitudes, values, and needs and their responses to the effectiveness of alternative delivery mechanisms, which were explored through focus groups. The focus groups were held with utility and Ministry of Energy and Power (Minenergo) staff, utility customers, and vendors of DSM products and services in the spring of 1995.

A secondary objective was to help develop capabilities at Dneproenergo and Vinnitsaenergo (now at the LECs) to understand both their customers' energy related investment and decision making criteria and how they use electricity. Understanding these issues is critical to the effective design and implementation of DSM programs. An end-use load research element was designed as part of the DSM pilot project to include an analytical framework and load monitoring plan. To support the design of the load research element, short-term monitoring of Dneproenergo and Vinnitsaenergo's customers' facilities was conducted during the project using end-use power monitors.

Chapter 2 of this part of the report begins by presenting some North American experience with industrial DSM programs. A description is provided of seven of the most successful traditional DSM programs in the United States and Canada along with a description of several successful utility financed, shared savings programs and load management programs. Common traits that contributed to program success are identified along with steps that may be appropriate for the implementation of the pilot industrial DSM projects in Ukraine, drawing on the lessons learned from North America. The chapter concludes with a discussion of the current utility trends in the United States in response to deregulation and retail wheeling, and the fate of DSM in the new competitive environment.

Chapter 3 presents the concept of a pilot project. The general objectives that a pilot seeks to accomplish are described. The rationales for the specific pilot projects recommended for implementation by the LECs and ESCO are then presented. These rationales are responsive to the barriers, risks, and uncertainties that currently confront the Ukrainian economy and utility sector.

Chapter 4 summarizes the results of the DSM assessment of Part 1 of this report, focusing exclusively on the industrial sector. The characteristics of electricity consumption in Ukraine's industrial sector are presented. The costs and savings of candidate DSM measures are presented as are the results of the screening of those measures for cost-effectiveness, resulting in a DSM supply curve for the industrial sector. The measures are then aggregated into generic industrial DSM programs that serve as the basis for the industrial DSM pilot projects presented here.

Chapter 5 presents the end-use load research element of the DSM demonstration, starting with a discussion of the purpose and goal of utility load research. The short-term monitoring work conducted for this demonstration is described, including a presentation of some of the interesting results from the end-use monitoring of 10 sites during the demonstration. The methodology, sampling plan, equipment configuration, and data collection and analysis protocols for the end-use load research element of the demonstration are defined.

Chapter 6 presents specifications for the DSM pilot projects. This includes a discussion of each of the two pilot projects' content and features, financing and contractual structures, marketing strategy, concurrent market research activities, program design, field delivery and implementation issues, verification strategies, process and impact evaluation, and cost recovery. The demonstration project training component is also described.

Chapter 7 concludes with a summary of the practical issues associated with the implementation of the DSM pilot projects and associated training, including project organization, identification of key project participants and stakeholders, the makeup of the advisory committee, project data tracking system configuration, and the target project goals. A schedule for implementation of the pilot projects is also provided.

The proposed projects are pilot projects, as much experimental tools as a serious effort to acquire DSM resources. They are experimental in that they will test methods for marketing, interacting with customers, providing financial incentives, organizing personnel, managing information flows and record keeping, and acquiring cost-effective electric resources at the LECs. They will also test an innovative concept of allowing demand-side resources to be compete with supply-side (generation) resources in a national power market pool.

The information gathered during DSM pilot project implementation will be extremely valuable in the design of the full-scale DSM program implementation. It will also be valuable in demonstrating both the mechanics and value of DSM in a competitive utility market.

Chapter 2 - 2North American Experience with DSM Programs

The American Council for an Energy-Efficient Economy recently analyzed North American experience to date with industrial DSM. The council conducted a survey of utilities and prepared a database of industrial DSM programs. More than 80 utilities and third-party organizations were interviewed. The study focused on incentive-based industrial DSM programs such as those being proposed in this pilot program, and excluded load management-only and information-only programs (including technical assistance programs).

The primary measures of program success adopted for the study were high participation rates and/or high electricity savings as a percent of 1989 industrial electricity sales, at levelized costs below the avoided costs of most utilities.

There are a number of important caveats associated with the data. Perhaps most important, there is much variation in the quality of the industrial program data and the methods different utilities use to track data. Additionally, for about one-third of the programs analyzed, the energy savings results are highly approximate because, for many of the joint commercial and industrial (C&I) programs, a formal delineation of industrial versus commercial savings has not been performed. Other key issues include the fact that the number of participants, free riders, indirect costs, and customer costs are frequently not tracked.

The study resulted in the compilation of a database on 31 incentive-based, energy-saving industrial DSM programs offered by 17 utilities. The average industrial program for which quantitative results were available (based on average database values and excluding remote outliers) has been offered for four years, has annually saved 0.2 percent of a utility's industrial 1989 electricity sales, has a 4 percent participation rate, and has a levelized utility cost of US$0.019/kWh saved.

A total of 12 "successful" programs were identified in the database. These programs met one or more of the following four criteria and cost the utility no more than $0.045/kWh saved: (1) annual participation rate of at least 8 percent, (2) annual savings as a percent of 1989 industrial sales of at least 0.5 percent, (3) cumulative participation rate of at least 12 percent, and (4) cumulative savings as a percent of industrial sales of at least 0.7 percent. The average annual savings as a percent of 1989 industrial sales for these successful programs are 1.1 percent, the average annual participation rate is 9 percent, and the levelized utility cost is $0.014/kWh saved. The successful programs have therefore achieved roughly six times the savings and two times the participation of the average program in the database, at lower cost.

Examples of successful energy efficiency programs are provided in Section 2.1. Traits common to these successful programs are described in Section 2.2, followed by recommendations for steps that would advance DSM efforts. The last two sections of this chapter discuss some examples of load management programs and the effect deregulation is having on utility DSM efforts in the United States.

2.1 Examples of Successful Programs

Bonneville Power Administration's Aluminum Smelter Conservation/ Modernization Program

Bonneville Power Administration (BPA), a federal wholesaler of electricity in the northwestern United States, has been administering its Aluminum Smelter Conservation/ Modernization (Con/Mod) Program since 1987. The original purpose of this program was to retain load through improving the energy efficiency of the aluminum smelters in the region. The 10 primary smelters in BPA's service territory purchase approximately one-third of BPA's power, or roughly 15 percent of the total electricity used in the region (sold by BPA and other utilities).

The program was introduced at a time when BPA had an electricity surplus and when the aluminum industry was just emerging from one of the longest economic slumps in recent history. Two plants had closed in the region, and there was the threat of more closures in the near future. The most vulnerable plants were of World War II vintage. Aluminum production is highly electricity-intensive; electricity purchases are responsible for approximately 25 percent of this industry's production costs.

The short-term objective of the Con/Mod Program was to encourage the region's 10 primary aluminum smelters to make additional investments in plant modernization so that they could become economically viable in the highly competitive world aluminum market. The long-term objective of the program from BPA's perspective was to purchase low-cost power from the smelters through efficiency improvements.

All 10 primary aluminum smelters participated in planning and designing the program. Initial measurements of the baseline efficiency of the smelters, in kWh per pound of aluminum produced, were made in 1987. Since then, the smelters have reported their electricity use per pound to BPA on a quarterly basis. The incentive payment to the smelters is linked to improvements in this baseline efficiency and equals $0.005/kWh (1987$) saved over a 10-year period, or roughly one-third of the costs of efficiency improvements. Although the deadline for completing the modernization projects was mid-1991, BPA will continue making incentive payments to the smelters over the life of the measures. The customers are under no obligation to explain to the utility how they reduce their electricity consumption because of proprietary concerns. According to utility staff, as a result of this stipulation and the fact that many of the smelters need to make some of the improvements in order to survive, the financial incentive offered to the customer is fairly small.

Since the start of the program, Con/Mod has achieved electricity savings of 4.1 percent of total industrial sales1 and a 100 percent participation rate. Although BPA has not estimated the free ridership of this program, its staff notes that some of the measures would have been installed regardless of the program because of the smelters' need to remain competitive and electricity's high contribution to total aluminum production costs. The levelized cost to the utility has been $0.006/kWh saved. According to the utility, the low cost of the program is partly due to the minimal administrative requirements of the program, since the smelters do not allow utility staff to enter their facilities. The smelters keep all the recorded data and report results to BPA.

BPA suspects that some smelters have made "real" energy savings as a result of the program, and others have made less genuine savings, meaning that the methods for reducing the kWh usage per unit of aluminum produced were not necessarily due to pure energy-efficiency improvements, but rather to other changes in the process and production operations. For example, the amount of savings achieved in the smelter projects depended on the assumed baseline efficiency, which was negotiated jointly by BPA and the smelters.

Since the program was initiated during an economic slump in the U.S. aluminum industry, the efficiency of many of the smelters was lower than normal when baseline efficiencies were calculated, according to utility staff. Soon after the program began, the industry began to recover as aluminum prices escalated. Smelters resumed their "normal" operations, the efficiencies of the plants improved, and BPA has reason to believe that the resulting reductions in kWh per pound of aluminum were claimed as savings under the Con/Mod Program. Although BPA notes that this suspicion cannot been proven, the utility has seen only 50 percent of the savings "paid for" through this program, and increases in aluminum production do not fully account for the discrepancy. "Real" energy savings generally came from installing process control measures and measures controlling the magnetic field of the pot within which aluminum is produced.

The program has been deemed successful by the utility, although there has been some concern about free riders and the fact that in late 1990 one of the 10 smelters shut down. No official impact evaluation of the program has been performed because the aluminum smelters will not allow BPA into their facilities.

BPA's Energy Savings Plan

BPA's Energy Savings Plan (ESP) was initiated in early 1988 as a custom pilot program to promote energy efficiency in industries. According to utility staff, for the first 18 months of the program, participation was disappointing.

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[1] _ Industrial electricity sales included in these calculations are both sales directly from BPA to the smelters and sales made by BPA's utility customers to their respective industrial customers.

As a result, when BPA redesigned the program to a full-scale version in mid-1990, it decentralized the program and altered the marketing techniques. Whereas the earlier version of ESP was designed and administered only by BPA, the revised program gives administering control to the utilities who distribute BPA's power in order to reduce the paperwork and increase the flexibility of the program. The new version brings together vendors, contractors, utility customers, industrial customers, and others to help plan, design, and participate in the ongoing evaluation of the new program structure. As part of this evaluation, these parties contribute to the annual modification of a list of flexible "program principles" that the administering utilities use as the basis for designing their own version of ESP. BPA staff noted that flexible program principles were chosen over program rules in order to give the individual utilities the ability to design the program around the needs of their particular industrial customers. The ongoing revision of the principles allows BPA to incorporate lessons learned and changing conditions into the program design in a timely manner.

The utilities administering the program generally negotiate incentives with industrial participants based on an individual customer's needs; other benefits such as changes in labor requirements or nonelectric savings are taken into account. On average, however, the customer receives — upon completion of a project — $0.15/kWh saved in the first year or 80 percent of the project costs, whichever is smaller. It was noted that as long as a project's payback can be reduced to less than three years, most industrial firms are interested in participating. Because, as with most industrial DSM programs, the customer receives a financial incentive *after* installing a project, the largest barrier to participation is the difficulty industrial firms face when trying to locate the capital for initially financing a project.

Increased emphasis has been placed on equipment vendors since the redesign of ESP in mid-1990. Utility marketing staff attend trade shows and offer vendor seminars to educate vendors on how ESP works and on effective methods for marketing their products by marketing ESP. Vendors have since played a central role in "selling" the program to industrial customers, and BPA staff cite this as largely

The past 1½ years of the program have seen a fourfold increase in the number of participants compared to the first 1½ years. If industrial electricity sales to primary aluminum smelters are excluded (since they are not eligible for the program and account for 95 percent of BPA electricity sales to industrial customers), the 1991 savings as a percent of industrial sales were 2.2 percent. The 1991 participation rate was 4 percent. Cumulative savings as a percent of sales are 5.5 percent and the cumulative participation rate is 12 percent. ESP's low levelized utility cost of $0.005/kWh saved indicates its cost-effectiveness.

Boston Edison's Energy Efficiency Partnership Program

The Energy Efficiency Partnership Program, offered by Boston Edison since 1990, provides commercial and industrial customers incentives to install energy-efficient measures in new and existing facilities. Incentives for customers constructing new facilities, or extensively renovating existing facilities, cover the incremental cost of efficient equipment. Incentives for retrofit measures generally buy down the payback period to one year, with the typical incentive covering approximately 80 percent of an industrial project's total costs. The retrofit incentives are received by the participant in quarterly payments over a two-year period, contingent upon the verification of savings through end-use metering of a sample of installations within a facility.

If a participant wishes to receive an energy audit, two choices are available: either a free "mini" audit, which covers lighting and motor systems, or a more comprehensive audit, which the customer pays for up front. The participant will be reimbursed a portion or all of the comprehensive audit costs, depending on the percentage of recommendations that are adopted.

According to the utility, few new construction projects have been completed. Little direct marketing of the program has been done; the program is marketed via word of mouth. The utility generally tells industrial customers interested in the retrofit portion of the program that by participating in the program, their electricity bill can be reduced by 20 percent on average.

The program has seen an annual participation rate of 7 percent and cumulative savings as a percent of sales of 0.7 percent (cumulative participation and annual savings were not available). The estimated levelized program cost is $0.035/kWh. One industry expert who has followed the Energy Efficiency Partnership noted that the program has been successful in acquiring process-related savings. Participation has been somewhat hindered by the fact that customers must finance the retrofits themselves; payments from the utility are received slowly over time and are given only if certain levels of savings are achieved. In an attempt to address these concerns, the utility is currently redesigning the way incentives are paid.

British Columbia Hydro's Power Smart: Efficient Compressed Air Systems Program

British Columbia Hydro (B.C. Hydro) has estimated that up to 50 percent of the energy used in an industrial compressed air system can be lost through leaks. These losses are particularly great in pulp and paper mills, whose facilities often occupy acres of land and have an extensive network of distribution piping. In its Efficient Compressed Air Systems Program, B.C. Hydro performs free leak tests on the compressed air systems of its industrial customers, targeting pulp and paper customers. The test identifies the general location of leaks, estimates how much they are costing the customer, and suggests a leak reduction target (generally down to 15 percent leakage of air volume). Either the customer repairs its own leaks (generally at very low cost) and the utility performs a follow-up leakage test three to six months later, or — if the customer agrees to do quarterly leak testing for 2½ years — the customer and the utility split the cost of leak testing equipment. If the leak reduction targets are being met, the utility will refund the customer's payment for the leak testing unit.

The program reached 27 percent of the eligible customers in 1991 alone and 60 percent since the program's inception 2½ years ago. Electricity savings as a percent of industrial sales were 0.07 percent in 1991 and 0.15 percent cumulatively. The levelized utility cost is $0.005/kWh saved. Some of the reasons for the program's success in recruiting participants were noted by the program manager: (1) the utility set an internal mandate to achieve 100 percent participation over a three-year time span; (2) an extensive marketing effort was made, including seminars and computer software packages; and (3) little time and effort are required by the customer to participate in the program.

Central Maine Power's Power Partners Program

Central Maine Power's (CMP's) Power Partners Program is an all-source bidding program in which C&I customers or energy service companies (ESCOs) submit energy management project bids in response to RFPs issued by the utility for specific blocks of power. The applicants propose a payment level for a projected amount of electricity savings. Although bids have not been solicited for almost three years because of adequate power availability, savings from existing projects are still coming in, including savings from industrial projects. Measures often installed in the industrial projects include process-related improvements and lighting retrofits. Incentive payments are made over the lifetime of the measures, with the sum of the payments made over the years generally covering more than 100 percent of the initial project costs. To date, ESCOs have generally managed the industrial projects in the program.

As of early 1992, the industrial projects within this bidding program have saved the equivalent of 1.2 percent of CMP's industrial electricity sales. Approximately 7 percent of CMP's industrial customers are involved in the Power Partners Program. The levelized utility cost is $0.030/kWh saved. This cost takes into account all savings and costs accrued through 1991, and does not include future savings and costs since these were not available from the utility (projects typically receive payments for 15 years). Thus, the program is a cost-effective resource for CMP, even though the utility payment may be large compared to the initial cost of the efficiency projects. The utility monitors all projects within this program to determine if the savings are persisting over time. CMP staff noted the program's flexibility as a key component contributing to its success. No estimates of the free ridership for this program have been made.

Puget Power's Industrial Conservation Incentive Program

Puget Power, located in Washington State, has administered its Industrial Conservation Incentive Program since 1981. Utility staff work with program participants and consultants to perform analyses of entire industrial systems, identify where the electricity savings and greatest overall customer benefits lie, oversee project bidding, assist in project design, and perform savings verification tests. Seminars on commonly applied measures such as adjustable-speed drives (ASDs) or compressed air-related measures are available to customers. Energy audits are performed by utility staff as well as consultants chosen by either the utility or the customer. Three- to five-year plans are developed with participants to coordinate which measures will be installed and when. Initially, although the program was open to all industrial customers, Puget targeted its marketing toward the 100 largest industrial customers. In the last few years they have begun to market to small- and medium-sized customers as well. The customer incentive usually covers approximately 75 percent of materials and installation costs of a project. Puget staff noted that because of the intensive labor requirements of this program, the availability of staff to broadly market the program is limited. The program is marketed simply by word-of-mouth.

The utility divides the measures performed into three categories: process, HVAC, and lighting. According to the program manager, 80 percent of the measures performed are in the process category, which includes pumping, motor/ASD, compressed air, and refrigeration-related measures as well as other site-specific measures. Of these, pumping, motor/ASD, and compressed air-related measures are the most commonly installed process measures.

The utility performs savings verification on every project one year after project completion, including metering and monitoring installed equipment. In addition, for some of the projects, the utility will return to the facility in later years to see if the equipment is still on line. Although the utility has not yet formally estimated the number of free riders in the program, a preliminary draft evaluation by a consultant indicates that approximately 10 to 20 percent of the program's participants may be free riders.

The program achieved a participation rate of 1 percent in 1991 and 5 percent cumulatively. According to the utility, low electric rates reduced the participation in the earlier years. The electricity savings as a percent of industrial sales were 0.7 percent in 1991 and 2.0 percent since the beginning of the program. The savings have increased by a factor of four over the past three years. For 1992 and beyond, the utility has a goal of saving 1 percent of industrial sales annually through this program. The levelized utility cost in 1991 was $0.026/kWh saved.

The utility attributes the program's success to a number of factors, including the following: (1) the program is part of a package of energy services, and is marketed as such (industrial customers generally do not want to be part of a *program*, according to the utility, but would rather receive *energy services*); (2) contractors involved in the projects generally have extensive technical expertise in the participating industries; and (3) the audits and recommendations target process-related improvements.

Wisconsin Electric's Smart Money for Business Program

Wisconsin Electric's (WEPCo's) C&I Smart Money for Business Program is a combination custom and prescriptive program offering commercial and industrial customers zero-to-low interest loans or cash rebates for installing qualifying energy-efficient measures. Special incentives are also provided to encourage energy-efficient design and new construction. Prescriptive rebates are available for lighting, HVAC, energy management controls, and refrigeration measures. Custom incentives are available for motor and process-related improvements and are negotiated with the customer on a case-by-case basis (even prescriptive rebates are sometimes negotiated). According to the program manager, this keeps program costs down since the lowest required incentive is generally offered. Between 20-50 percent of a custom project's total costs are typically covered by the incentive. If a project requires a feasibility study, WEPCo will pay up to 50 percent of the costs of a comprehensive audit.

After administering the program for over three years and studying the managerial structure of its industrial customers, WEPCo refined its marketing approach to reflect what had been learned. A two-pronged strategy is now taken: utility engineers communicate with and market the program to process-level plant personnel such as plant engineers and maintenance operators.

Simultaneously, utility account executives interact with and market the program to industrial vice presidents. Generally, smaller projects can be handled by the process-level employees, whereas larger projects must be dealt with at a senior management level.

Over the past five years, almost half of all WEPCo's industrial customers have received rebates or loans through the Smart Money Program. The majority of participants have focused on prescriptive measures, with approximately 70-80 percent of rebates being prescriptive. More than half of the industrial energy savings have been due to lighting measures, while process-oriented measures are responsible for approximately 30 percent of the savings. The program manager noted that it has taken time to gain the trust of the industrial customers with regard to DSM, especially in moving from lighting and HVAC measures to process measures. According to the utility, industrial customers have shown great concern and caution in altering their processes.

The industrial portion of Smart Money for Business experienced a 12 percent participation rate in 1991 and a 49 percent participation rate since the start of the program. Electricity savings as a percent of industrial electricity sales were 0.4 percent for projects installed in 1991, and 2.5 percent for projects implemented since the program began. The levelized utility cost is $0.021/kWh saved. The program manager noted that the program's success in recruiting a large proportion of the eligible industrial customer base and acquiring significant savings as a percent of sales is primarily due to the utility's focus on understanding the customer's perspective, making personal one-on-one customer contact, utilizing effective marketing techniques, simplifying the program while still offering a comprehensive package, and securing the technical expertise necessary to do a good job.

The program manager noted that the utility is experimenting with a new component to the program: the utility will arrange contract agreements between customers and ESCOs with technical expertise in particular industries. The utility will assist in an initial audit, but beyond this, the utility will primarily act as a facilitator. The ESCOs will guarantee the savings to the customer and sell the savings back to the utility.

2.2 Successful Programs: Common Traits

There are several traits that appear among the relatively successful programs (programs with above-average participation and savings). Outlined below are some of the primary features that appear to distinguish more successful programs from less successful programs.

Addressing Customer Concerns

Addressing customer concerns is particularly important when it comes to industrial firms. To date, industries have been skeptical about the quality and intent of utility DSM programs. A survey conducted in 1991 by the Washington State Energy Office concluded that industries do not generally perceive utilities and government as credible sources of information. This is primarily due to insufficient attention on the part of utilities to the perspective and priorities of industrial customers.

Issues of concern for industries include power quality and reliability, waste minimization and disposal, environmental regulations, and competitiveness. In order to operate successful industrial energy-efficiency programs, it is essential for utilities to understand the relationship of these factors with industrial process energy flows and to design and market programs with such links in mind.

In particular, productivity and environmental concerns are more important to industries than are energy costs. Not only must industrial firms remain competitive in order to survive, they must also comply with a growing number of environmental and health regulations. In addition, many industries want to be viewed as "green." Capital budgeting cycles of industrial firms often reflect these concerns; according to one industrial manager, the first capital expenditures for large industrial firms in the United States are generally related to Occupational Safety and Health Administration and environmental regulations, and the second expenditures are usually for new or improved product development. Various utilities with at least five years of industrial DSM experience behind them, such as B.C. Hydro, Puget Power, and Wisconsin Electric, indicated that they have had to "prove their value to the industrial customer" and that it

has been important for them to find ways to increase the productivity and/or reduce the environmental impact of a customer's facility while also reducing energy consumption.

Whereas industrial plant managers may be keen about the idea of improving the efficiency of nonprocess systems (such as lighting and space heating and cooling), they may be unwilling to change their process because of the perceived high technical and financial risk associated with process changes. Putting such a risk in the hands of a utility company is often considered an unwise decision.

As a result, a number of utilities, such as United Illuminating, Wisconsin Electric, and Wisconsin Power and Light, allow the industrial participants the option of performing the energy-efficiency analyses and retrofits themselves, choosing their own vendor or engineering contractor to help design and install energy-efficiency measures, or using engineering contractors chosen by the utility for their expertise in particular industries and processes. Wisconsin Power & Light, after administering its C&I Bright Ideas for Business custom program for three years, recently began hiring consultants with specific industrial process experience to perform the detailed industrial energy analyses. According to the utility, hiring the average DSM consultant to assist in detailed industrial process energy audits has not been effective, from either a technical or a marketing standpoint.

Since "time is money" for an industrial customer, an industrial conservation program must be user-friendly to be widely acceptable to a diverse industrial base; it needs to be well-administered and minimize the paperwork, bureaucracy, and customer time requirements often associated with utility programs. One drawback associated with many custom measure programs, as they are currently administered, is the long wait between initial customer enrollment in the program and actual receipt of an incentive payment.

A few industrial DSM program managers noted that it is worthwhile for utilities to follow large industrial customers' capital budgeting cycles closely. The utility should present the program to the customer well in advance of the start of a new cycle (i.e., offer a free audit and indicate the energy-saving opportunities) to increase the likelihood for implementation. Planning a marketing approach around the customer's capital appropriations can also shorten the length of time between initial customer contact and final measure implementation. Industries have a limited attention span; if the bureaucratic process drags on too long, their attention tends to shift away from the program and its merits and back to more urgent concerns within their facilities.

Marketing Techniques

The marketing techniques employed by the utility can make the crucial difference between an industrial program's success and failure. Industrial programs cannot be run out of an office. Bill stuffers and other direct mail alone will rarely succeed in marketing a conservation program to the appropriate people in a large industrial facility. The utility needs to make continual personal contact with the customer and target the marketing efforts to the customer's appropriate decision makers. One utility program manager indicated that utilities often will market their programs through utility staff who have had no previous contact with the industrial customer, whereas elsewhere in the utility — most likely in the customer relations department — close relationships have developed over years of interaction. It is worthwhile to utilize existing contacts with industrial customers so that utility staff do not waste time competing with equipment vendors and other salespersons for the attention of the industrial firm.

Some utilities, such as BPA, B.C. Hydro, and Niagara Mohawk, have focused on trade allies (e.g., motor and ASD manufacturers) for marketing a program. B.C. Hydro, for example, provides an incentive to equipment vendors equal to 20 percent of the customer rebate. Marketing a program through the use of trade allies not only reduces the administrative costs for the utility, but can also reduce the participant paperwork required. As a program administrator at B.C. Hydro noted, trade allies and manufacturers can indirectly act as utility marketing staff and thus reduce the utility labor required to market a program.

Program Flexibility

Generally, the more program flexibility the utility offers to the industrial customer, the more successful the utility has been in recruiting participants. A custom program is inherently more flexible than a prescriptive

program and is therefore generally attractive to industrial customers. However, even custom programs can be too rigid for industrial customers, as was demonstrated in the earlier version of BPA's Energy Savings Plan. The failure of the program to recruit participants was partly due to the concrete, restrictive deadlines for submitting project proposals, which had no relationship to the capital budgeting cycles of industrial facilities.

Ultimately, both custom and prescriptive programs can play important roles in securing industrial energy-efficiency improvements. If the two types of programs are offered in conjunction with each other, more customers will most likely be reached and greater savings achieved than if only one type of program is offered. By offering prescriptive rebates for particular measures, utilities can achieve high participation rates and get a large number of customers accustomed to working with the utility. Several utilities have found that success with prescriptive rebates (financial incentives provided for specific DSM technologies) increases customer receptivity to custom rebates for process-related measures.

Financial Incentives

Customer financial incentives are offered by all the programs in the database. A few programs offer the option of low-to-no-interest loans instead of or in addition to a cash rebate. Generally, the programs offering larger financial incentives have above-average participation and savings, such as Commonwealth Electric's Custom Rebate Program. In addition, a few utilities offering relatively successful industrial conservation programs have noted that vendor incentives can streamline and improve the effectiveness of program marketing.

However, as the program manager of B.C. Hydro's Bonus Partners Program noted, high incentives do not guarantee program success and neither are they always needed. Tailoring a comprehensive range of energy-related services (including DSM) to the needs of the industrial customer may mean that an incentive equaling, for example, 20-50 percent of a project's total cost may be sufficient, rather than 80 percent of a project's total cost.

Program Analysis and Evaluation

Two-thirds of the utilities offering the successful programs in the database have performed extensive market research of their industrial customer base or have performed impact and process evaluations. For example, Wisconsin Electric altered its industrial marketing strategy for the Smart Money Program after studying the managerial structure of its industrial customers for over three years. BPA, B.C. Hydro, Puget Power, Wisconsin Electric, and Wisconsin Power and Light — all utilities offering successful programs — have performed process or impact evaluations of their programs. These activities provide utilities with a wealth of information on how to improve the design of their programs and thereby increase participation and savings.

2.3 Steps to Advance Industrial DSM

There are a number of important steps that should be taken by North American utilities to improve the field of industrial DSM. These recommendations are also appropriate for new industrial DSM programs in Ukraine. They include the following:

- Utilities should improve industrial DSM program design by addressing customer concerns, improving marketing techniques, focusing on program flexibility, and offering financial incentives.
- Utilities should improve data tracking methods and program evaluation techniques.
- There should be improved information exchange among utilities through industrial DSM workshops and an annual industrial DSM conference.

- Contiguous electric utilities should coordinate industrial DSM efforts to reduce customer and vendor confusion, and electric and gas utilities should coordinate joint industrial energy audits.

- Utilities should establish better links with industries by attending industrial energy conferences and coordinating with industrial trade associations and state industrial efficiency programs.
- Utility industrial DSM staff should receive education and training on industrial process materials and energy flows, the budgeting cycles of different industries, the general perspective of the industrial customer, and the links between improved energy efficiency and increased productivity and reduced environmental emissions.
- The quality and quantity of data on industrial energy use patterns should be improved.
- State-of-the-art, energy-efficient industrial technologies should be demonstrated and monitored more widely.
- Utilities should involve trade allies (manufacturers, distributors, engineering consultants, etc.) in program design, education, marketing, and implementation. This is particularly important for Ukraine. Getting trade ally acceptance and involvement can help ensure that the desired energy efficient products are available in the marketplace. Utilities can also leverage the resources of trade allies for program marketing and in some cases to educate end users.
- Audits should identify all benefits of energy efficiency improvements, including water conservation, other fuel savings, product quality and production rate improvements, and waste minimization.

2.4 Example of a Utility Financed, Shared Savings Approach

Pacific/Utah Power, the electric generation and distribution divisions of PacifiCorp, was a forerunner in implementing an innovative type of efficiency program in which customers repay the costs of their efficiency installations through monthly energy service charges on their electric bills.2 The program provides 100 percent upfront financing for energy efficiency measures. The intent is that the savings from the energy efficiency measures, after payment for the installation, will create an immediate positive cash flow. The time period of the energy service charge varies, and the interest rates are competitive with the market. Typical contract terms are 5 to 10 years. This program is referred to as an “investment-based energy service charge program.” It is offered in seven western U.S. states. PacifiCorp operated both a large commercial program, the Energy FinAnswer, and an industrial program, the Energy FinAnswer Industrial. The commercial program targeted new construction. The industrial program targeted both new construction and the retrofit market. A summary of the industrial program follows.

PacifiCorp Energy Services sales representatives work closely with the targeted customers. Key executives at targeted companies are initially sent a letter and a program brochure through the mail. Followup marketing is done with a telephone call to the customer. Contractors are involved at each stage of the program. PacifiCorp provides the energy analysis to identify cost-effective efficiency improvements, a performance verification of the completed systems to assure their proper operation, and training of system operators. Any new or existing industrial customer who is above a 12-month average threshold energy demand use of 500 kW is eligible.

After an audit is completed by a third-party, professional energy consultant (at no cost to the customer), an engineering team approved by the customer then evaluates the recommendations and designs the new equipment and systems for the facility. If the owner approves, an energy service contract is signed, enabling funding for the project, which is then made available on a construction progress basis.

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2 _ SBW Consulting, Inc., “Commercial and Industrial Energy-Efficiency Profiles of 1992 Northwest Electric Utility Programs,” Northwest Power Planning Council, May 1993.

A performance verification is done after the project is completed and has been operating for an agreed-upon time period. This phase assures that the new energy systems and equipment are performing as designed and verifies that the operators are operating and maintaining the equipment properly. For retrofitted facilities, if the performance verification process shows that actual savings fall short of projections by more than 15 percent, PacifiCorp will make a one-time adjustment to lower the energy service installment payment for the life of the contract.

2.5 Examples of Load Management DSM Approaches

There have also been a number of programs and efforts undertaken in the United States for load management through load cooperatives, load curtailment (or interruptible load) programs, and load management bidding programs. Examples of these programs are described below.

Pacific Gas & Electric Company's Pilot Interruptible Bidding Program

PG&E implemented its PowerBreak Program in 1993. This program was designed to assess the feasibility of obtaining nonfirm resources through a bidding process, and to determine if the resources could be obtained for a price below the nonfirm tariff incentive (which was measured by PG&E's full avoided cost). Eligible customers had to be capable of shedding at least 200 kW of peak period demand for up to six hours. PG&E could request up to 30 load curtailments each year for no more then 100 hours total. Customers whose bids were accepted by PG&E would receive monthly rate discounts from June 1993 through April 1996. The program was designed in a collaborative approach using an advisory group that included such parties as the California Energy Commission, the California Public Utility Commission's Division of Ratepayer Advocate, representatives from large energy users, residential ratepayers, and other utilities.

A total of 13 bids were received through the pilot program auction. All bids were accepted, for a total of 8.3 MW. Bid prices varied, and the weighted average bid price was $73/kW/year, which was below their avoided cost. The number of bidders was limited in part because a number of PG&E customers were already on a nonfirm rate (set at their avoided cost). Potentially many of these customers may have bid if the nonfirm rate were not in existence.

Only one curtailment was called in 1993 and none in 1994. During the one curtailment called, most PowerBreak participants curtailed their loads in excess of the amount required by their contracts with PG&E. Based on this experience, with all else being equal, an auction can lower the cost of nonfirm resources to the utility.

California Energy Coalition's Energy Cooperatives[3]

The California Energy Coalition (CEC) was established as a third party to coordinate the energy use of large commercial and industrial customers and to broker this service to Southern California Edison (SCE) and other utilities. The CEC represents its members in contract negotiations with SCE and manages members' ongoing load management capabilities. By coordinating their efforts, large commercial and industrial energy users can respond collectively to shed loads with a high degree of individual flexibility and reliability. By design, the load cooperative allows one member to compensate for another's inability to meet load reduction targets at any given time when called by the utility. Members are customers who are willing to lower their power demand when called by SCE but who also maintain another level of flexibility by working within the pool of users who can individually reduce their power demand at different times. The CEC also seeks to raise the awareness of its members of the potential of energy efficiency and offers energy efficiency services to their members.

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[3] _ Summarized from the Results Center's Profile #9, IRT Environment, Inc., 1992.

Energy cooperatives are based on computer networks that continuously monitor the individual and collective energy use and reductions of large users. The results are measurable to utility and user alike. The cooperative provides revenues from energy savings while maintaining required energy services. Membership provides additional value in the form of recognition by the community. The cooperative management provides its members with expert assistance in achievement of energy efficiency capabilities.

In 1982, the CEC established a 15-year contract with SCE for load management capabilities. For every kilowatt of peak demand that the CEC can curtail reliably to the firm (or minimum) service level, the CEC is paid an incentive. Of that fee, the CEC retains a portion (15 percent) for management and (5 percent) to enhance its capabilities. The CEC then writes checks to it members based on their prorated share of the overall capacity. Incentives are based on measured data. The first load cooperative was unlimited in size. The second two cooperatives were limited in size by SCE to 10 MW each. Startup costs for members are low. They must invest money for initial consultation with the CEC, to establish curtailment potentials and procedures, and to buy the computer equipment necessary to interface with the CEC. Financing for these initial costs can be arranged through the CEC via shared savings.

In 1992, the CEC provided Southern California Edison with 14 MW of summer peak capacity at a total cost to SCE of $365,000.

One of the most important lessons learned from energy cooperatives is that a third party broker such as the CEC can effectively motivate its members to continually refine their energy management and capture greater and greater efficiency over time. The CEC provided an effective, low-cost means for major energy users to profit from load management and energy efficiency. According to SCE, load cooperatives also offer a potential business opportunity for utilities. If utilities organized and facilitated load cooperatives, they would be able to deal directly with their customers rather then through a third party.

2.6 Current Trends in the United States

Currently in the United States the electric utility industry is being deregulated and thrust rapidly into a competitive environment similar to the one that will exist in the Ukraine. For many utilities, this is requiring a shift in the way that they do business. The fate of DSM in this new environment is uncertain. Many utilities are using DSM as a means of providing a value-added service to their industrial customers, in some cases only for “at-risk” customers — customers that may choose to purchase power elsewhere. Other utilities are choosing to abandon DSM. Yet others are providing “energy services,” which may include a wide variety of services designed to benefit their customers such as productivity improvement audits, financing for energy efficiency improvements, and assisting the customer to link with other resources that may benefit them (environmental services, for example). Utilities are making stronger efforts to become good business partners with their customers and to understand their needs and operations.

The other recent shift in the United States has been to move away from traditional end-user focused DSM programs toward more comprehensive programs focused on all actors in the market. The goal of these efforts is “market transformation.” Market transformation, in the context of DSM programs, is said to occur when a lasting beneficial change in the behavior of some group of actors within a market system is induced. Such changes should lead to increases in the adoption of energy efficient technologies, and or changes in the market for energy services such that new, more efficient products, processes, and practices are widely available and used. By definition, these changes persist long after such programs have been modified or discontinued. While traditional utility DSM programs have focused almost exclusively on achieving impacts by influencing end-user demand, the broader goal of market transformation encourages participation by other actors in the market such as manufacturers, equipment vendors, and other trade allies.

The success of these market transformation efforts is yet to be determined. However, it is clear that there can be a significant impact from leveraging the significant resources of trade allies, and the power of government regulations and standards.

Clearly, the purpose and need for DSM in the current more competitive supply market have changed. The need to reduce rates and provide customer service to ensure loyalty and retain key large customers is the primary driver for DSM in a deregulated environment, whether it be in the Ukraine or in the United States.

Chapter 3 - 3Concept of a Pilot Project

A pilot project provides the opportunity to test a new concept on a small scale. This approach limits much of the technical and economic risk and uncertainty usually associated with undertaking any new enterprise. Demand-side management as a utility service offering and as a cost-effective, competitive resource is a new concept in Ukraine. It is important therefore to conduct proof-of-concept pilot programs before undertaking full-scale DSM efforts. In this chapter, the basic objectives of the proposed pilot projects are described. The rationale for the specific approaches recommended for implementation is presented. This rationale reflects the lessons learned from North American experience with industrial DSM programs adapted to the difficult circumstances and utility sector restructuring that currently confront the Ukrainian economy and utility sector. A discussion of these barriers, risks, and uncertainties in Ukraine follows. The chapter concludes with a description of the vision for future DSM efforts in Ukraine.

3.1 Objectives of Proposed Pilot Projects

Two pilot projects have been designed to demonstrate the value of DSM resources in the restructured Ukrainian power sector. The first is the Load Management Pilot Program through which ESCOs will be solicited to provide turnkey energy and load management services to prescreened industrial sites in Ukraine. The ESCOs will identify, design, install, and start up DSM measures in selected sites. They will be responsible for arranging financing, procuring equipment, and assisting with bidding of demand-side resources (dispatchable load) to the Energomarket. This pilot project is designed to demonstrate how DSM can be a profitable venture for the private sector. LEC cooperation, however, is essential to the success of private sector efforts. The LECs can provide a “value-added” customer service to their customers participating in the ESCO pilot project by processing and submitting load management bids to the Energomarket pool and providing information on customer energy consumption, and wholesale and retail pricing. At the same time, DSM resources can result in a reduction in the LEC’s costs. During the peak period when revenues from the sale of power do not cover the LEC’s costs to purchase power from the pool, it can be cost effective for an LEC to reduce their load. This can be done through load management bidding.

The second, the Energy Efficiency Pilot Program, will be implemented through the participating LECs. The LECs will provide energy efficiency services to select “at risk” industrial customers as a customer retention technique. These services will include identification of cost-effective DSM resources and financing of energy efficiency improvements. The financing, in the form of a loan to industrial customers, will be paid back through shared savings on the energy bills. Technical, economic, and marketing training will be provided for trade allies, utilities, and other necessary parties.

Thus the pilot projects serve three primary functions: to demonstrate the value of offering energy efficiency financing as a customer service and retention technique in the new competitive environment; to demonstrate the competitiveness of dispatchable demand-side load resources with generation resources in the new Ukraine central power pool (the Energomarket); and to demonstrate methods of acquiring cost effective DSM resources in a market driven electric market.

The DSM Demonstration also serves several other objectives, including to:

- Provide a better understanding of electricity end use in the industrial sector and produce (through audits and energy analyses) equipment inventories, process flow characterizations, and a base of market research information. These activities will have continuing value well beyond the life of the pilot projects and will serve as the foundation for an ongoing program of systematic industrial load and market research.
- Promote development of an energy efficiency industry in Ukraine by enhancing and building the current capabilities of manufacturers, distributors, vendors, equipment specifiers, ESCOs, and architect-engineer specialists to support DSM on an expanded scale. Further, the DSM Demonstration will provide technical support, training, and funding to expand existing capability,

develop new expertise, and build bridges to U.S. and foreign purveyors of DSM technology by establishing formal affiliate relationships with Ukrainian enterprises.

- Demonstrate the capability of Ukrainian utilities to deliver and manage a DSM program, including program marketing, project management, information flows and records keeping, project evaluation, and program evaluation.
- Demonstrate the capability of the private sector to deliver DSM resources.
- Demonstrate the feasibility, economic attractiveness, viability, and market opportunity for turnkey ESCO operations in Ukrainian industries.
- Test various program design and delivery mechanisms and encourage experimentation to help guide the design of a full-scale program. The mechanisms to be tested include marketing approaches, financial incentive arrangements, savings verification procedures, technologies and technology packages selected for assistance, resource bidding, and program procedures.
- Give new insights into how Ukrainian industrial decision-makers evaluate investments in energy efficiency vis-a-vis alternative uses of capital, and the influence of size, market position, growth prospects, private versus public ownership, and other factors on investment criteria, expectations, and the quantification of risk-reward.
- Allow the LECs to work with their industrial customers, ESCOs, and other prominent institutions and organizations such as the Ukrainian Ministry of Energy and Power (Minenergo), the National Energy Regulatory Commission (NERC), the Energomarket (National Dispatch Center), Kiev Polytechnic Institute, and the Ukraine Ministry of Economy to catalyze a public-private partnership for implementing electric efficiency throughout Ukraine and help instill the notion of DSM as a valuable, stable resource for Ukraine's energy future.

The Load Management Pilot Program is designed to demonstrate the cost-effectiveness of load management as a resource. In the long run, time-of-use rates may provide the necessary market signals to encourage cost-effective load management by the end user. However, given that the concept is relatively new in Ukraine, it is critical during the pilot project to encourage participation in demand-side bidding. The proposed resource payment for dispatchable load will help create awareness in Ukraine of the value of demand-side resources and will increase the awareness and technical knowledge of the opportunities that are available. Finally, the resource payment helps ensure participation while the mechanisms, procedures, and economics of bidding demand-side resources to the pool are developed and tested.

3.2 Rationale for Proposed Projects

There are numerous reasons why the pilot DSM projects proposed in this volume were selected. The key reasons are identified and briefly discussed below.

- ***The DSM Demonstration reflects program experience in North America.*** It is important to take advantage of the more than 12 years of industrial DSM program experience in North America, and the more recent approaches U.S. utilities are taking because of deregulation. The proposed projects incorporate many features from the most successful North American DSM programs and customer service efforts that are appropriate in a competitive environment.
- ***The DSM Demonstration is designed specifically to provide mechanisms for DSM to work in a deregulated, competitive environment.*** The innovative approaches proposed are designed to demonstrate the availability and cost-effectiveness of DSM resources as a means to reduce system peak.
- ***The DSM Demonstration will increase the technical knowledge and capabilities of trade allies in Ukraine.*** A significant amount of technical, marketing, and economic training will be provided to local engineering firms, utility staff, industries, and other trade allies. In addition, the ESCO pilot project addresses the limited in-country knowledge of DSM and DSM technologies by

bringing outside expertise into Ukraine and transferring that expertise through the establishment of partnerships with local firms.

- ***The pilot projects are highly flexible.*** They are designed to allow a broad array of project types and meet varying customer needs. Customers, ESCOs, and the LECs can negotiate special arrangements for project installation and financing to overcome barriers and minimize problems.
- ***The pilot projects allow customers to design their own projects.*** Customers can use their own staff and select their own contractors to develop projects. This allows customers to avoid problems that a more rigid, utility-controlled project might encounter.
- ***The DSM Demonstration provides the opportunity for the LECs to enhance their customer service image and to gain experience in marketing services to their customers.*** Before the restructuring in Ukraine, Energos only needed to sell electricity — they were not at risk of losing customers. In a competitive environment, customer service can be key to customer retention and growth. The Energy Efficiency Pilot Program provides the opportunity for LECs to develop a closer working relationship with their customers and improve their service quality. Experience in North America has shown that industrial customers respond best when they are marketed through person-to-person contact using existing personal relationships with customers and, when possible, top-level management.
- ***The DSM Demonstration is flexible enough to deal with an industry undergoing tremendous change.*** To say that Ukrainian industry is faced with difficulty in making its transition from state ownership to private ownership is an understatement. It is very difficult to foresee many of the special problems being encountered in this transition. Therefore, a flexible program that allows program managers to avoid these problems when they are encountered is preferable.
- ***The pilot projects are focused on the industrial and industrial-like communal service sectors because that is where most electricity is consumed, where most of the potential electricity savings can be realized, and where the highest energy consuming customers are.*** These are both the customers most likely to consider “shopping around” for power and those that may have the best opportunity for load management. Roughly 65 percent of the total net annual electricity consumed in Ukraine is consumed in the industrial and commercial service sector. Seventy-nine percent of the cost-effective energy savings and one hundred percent of the cost-effective demand savings identified in the DSM assessment are in the industrial sector and municipal water and wastewater systems segment of the communal service sector.
- ***The pilot projects rely on custom designed projects.*** Most Ukrainian industrial companies tend to be relatively large; projects are thus likely to be large, and custom programs are appropriate. Custom programs are best suited to relatively large projects in which the extra staff time required for their implementation can be justified. Custom designed programs can better optimize systems for energy and capacity savings.
- ***Industrial programs will help revitalize Ukrainian industry.*** With Ukrainian industry undergoing such a difficult transition, for the sake of the national economy and the welfare of the Ukrainian people, it is important that Ukrainian industry be given assistance in becoming more efficient and therefore more viable and competitive.
- ***The pilot projects emphasize financial assistance to help overcome the critical shortage of capital for improvement projects.*** The focus groups clearly identified lack of capital as the key barrier to investments that improve energy efficiency. Representatives of many companies said that, in the past, they were constantly investigating opportunities for increasing efficiency at the requirement of the Ministry. Now, there is a strong focus on reducing energy consumption to reduce costs. Some said their capital shortage is so severe that they have no need for investment criteria — they cannot invest in anything unless it is absolutely essential. Only a few of the wealthier enterprises currently have investment criteria. One said their investment criteria was half a year, another said it varied between half a year and three years.

While capital availability is not nearly as large a barrier for North American industrial companies, it nonetheless is a very significant barrier — so significant that a decade of program experience has taught DSM program managers that making substantial financial assistance available or providing financing to DSM program participants is essential to a successful program and may increase customer satisfaction with the LEC. Because of the severe limitations on the amount of capital available for discretionary investments in Ukraine, financing is crucial to the success of DSM efforts.

- ***The pilot projects test means for LECs to attract and retain customers in a competitive environment***, while increasing the efficiency of energy use and increasing the viability of their customers.
- ***The pilot projects operate within a set of guiding principles that are sufficiently broad to allow program managers to use their knowledge of local companies, problems, and situations to steer the program around problems and to focus assistance on those customers most valuable to the LEC.*** If the pilot projects which are being proposed by non-Ukrainian experts, were based on a rigid set of procedures and rules, as is common in North America, they would be highly likely that these procedures and rules would conflict with a number of local customs, capabilities, or situations. The program is therefore designed to take maximum advantage of local knowledge. A set of broad principles is recommended to guide the program. Program managers are encouraged to experiment and find the best ways to implement the program consistent with these principles.

3.3 Barriers, Risks, and Uncertainties

There are many barriers, risks, and uncertainties associated with launching North American-style DSM programs and innovative non-utility based programs in Ukraine. After all, it has taken more than a decade for these programs to evolve in North America, where many mis-steps were taken and well-intentioned but ineffective programs were initiated. When the first DSM efforts were started in North America, U.S. utilities had to completely change the way they related and marketed to their customers; Ukrainian utilities will have to do the same.

Successfully marketing and implementation of DSM in Ukraine will require the development of new skills, new organizational structures, new laws and regulations, new businesses, and whole new industries. The size of this task alone is a large barrier to DSM. But the interest and willingness to overcome such a large barrier appear to be present in Ukraine.

Some of the specific barriers, risks, and uncertainties that have been identified warrant discussion here. Many others exist, but the emphasis here is on those that are particularly relevant to applying DSM in Ukraine.

Much of the information presented below was gathered from a series of six focus groups held May through June 1995 and from site visits to major enterprises in Ukraine during May 1995. These focus groups were organized and run by the Socis-GALLUP International, a Ukrainian market research firm. Two focus groups were made up of industrial customers; one of residential customers; one of equipment vendors, manufacturers, and service providers; one of commercial customers; and one of staff from the Ministry and Kievenergo.

Site visits were conducted by a party of international DSM consultants, end-use load experts, and Energo technical staff. A brief summary of each of the site visits is included in Appendix E.

<u>Severe Shortage of Capital to Make Energy Efficiency and Load Management Improvements</u>

The majority of North American DSM programs are justified largely on the basis that utility customers lack the capital to make conservation and load management improvements. Or, if they do have the capital, competing investment priorities sharply restrict the amount of capital made available for such energy projects.

The situation is more severe in Ukraine. Most of Ukraine's industry faces severe capital shortages, so severe that many operate only periodically due to lack of capital to purchase raw materials. In addition, the investment needs in aged, out-of-date industrial facilities are enormous, as are the pressures just to stay viable. The focus groups identified that for many industries investments are made only in critical items. Participant after participant in the focus groups identified lack of capital as the primary barrier to installing DSM measures. Many of the participants have identified improvements they would like to make, but cannot make them because they lack capital. Clearly, upfront financial assistance will have to be a central component in any DSM program initiated in Ukraine.

Comfort and Trust of the Energos

The recent severe economic downturn in Ukraine has claimed many casualties, including many relations between debtors and creditors. Many companies found themselves unable to pay their electric bills, and consequently ran up large debts with their electric utility. In addition, mandatory curtailments have created bad feelings between the Energos and some of their customers.

Much of the mistrust and bad feelings that exist might be overcome once the LECs show they are interested in providing customer service in addition to selling electricity and once there is a better understanding of the benefits of DSM. Some customers simply do not believe that a company in the business of profiting from the sale of electricity would have a sincere interest in helping them reduce their electricity bill. Once they understand, most participants will be willing to accept assistance from their LEC.

Perhaps the best way around this barrier is for the LECs to quickly build a positive working relationship with their key customers. Once customers see that the LECs are interested in a business partnership, and they have had a chance to learn more about the rationale and benefits of DSM, they may choose to participate.

Price of Energy-Efficient Equipment

A number of focus group participants identified the high prices for energy-efficient equipment as a significant barrier to DSM investments. They explained that equipment buyers are extremely sensitive to first price: they choose the lowest-priced piece of equipment even when they know that the more efficient, but more expensive, piece will be much cheaper to operate and in general will be of higher quality.

This price relationship between efficient and inefficient equipment is due in part to the fact that most energy efficient equipment is foreign-made. The participants said that even though they recognized superior efficiency and technology in the foreign-made equipment, they would buy whatever had the lowest price.

One solution to this problem is for the utility to defray part of the cost of DSM measures by providing financial incentives or financing for its customers. In the United States, rebate incentives are viewed as electric resource costs that the utility incurs and recovers from all customers in electric rates, much as the utility incurs and recovers costs for power purchased from generators or the transmission grid. The costs to provide financing, however, can be fully recovered through shared savings contracts, with the individual customers benefiting from the financing rather then being recovered from all rate payers, and thus avoiding cross subsidies. To encourage the highest level of participation, at least some portion of the incentives will need to be provided up front rather then after installation is verified or in some way reduce the first cost of the energy efficient equipment. Another solution is for the private sector (ESCOs) to offer financing that is paid back through shared savings in the customers' utility bills.

It will also take some education for both the Energo and enterprise management to understand the concept of "payback."

Availability of Energy Efficient Equipment

While some energy efficient equipment is available in the market, virtually no Ukrainian manufacturers produce energy efficient equipment. It is strongly suggested that trade allies be invited to provide input to program design and implementation. It is also strongly suggested that the LECs develop partnerships with key trade allies to reduce the barriers of equipment availability.

Companies May Go Out of Business after DSM Investments Are Made

Except in bidding-based DSM programs, utility-sponsored DSM programs in North America are offered to customers without discriminating on the basis of customer financial health. A financially weak company is offered the same kind of financial incentives in DSM programs as a financially strong company. This approach is made possible because of the relatively stable economic environment in North America, and it is made desirable because it avoids the expense of financial reviews of DSM program participants.

In the difficult economic environment of Ukraine, many industrial and commercial facilities are being closed, and many of them permanently. This situation creates a difficult challenge to the successful implementation of DSM programs and services. Special precautions will probably have to be taken to avoid a high rate of loss or nonperformance of DSM investments.

Simple financial reviews of companies selected to participate in the ESCO or LEC DSM pilot projects probably will not be adequate. Many of these companies will have had very limited exposure to the free market, which makes projections of future financial performance difficult. For the pilot project, the LECs may want to focus on those industries that have a significant export market or on those industries and communal services that have a stable source of revenue and have been operating on a regular schedule. Industries have been prescreened for the ESCO Load Management Pilot Program, but ESCOs will want to conduct their own assessment of the industries' viability.

To protect its investments, the LECs may have to require agreements with program participants that would allow the recovery and removal of equipment financed by the DSM program. The low cost of labor (for equipment retrieval) relative to the high cost of new equipment could make this a practical and cost-effective means of reducing this risk.

Baseline Energy Use and Load Data May Be Difficult to Obtain

In the type of DSM projects proposed, it is important to obtain reliable data on energy use and load profiles before DSM measures are installed. These data help DSM program managers and ESCOs estimate potential savings, which is necessary for negotiating customer financial assistance and evaluating the program. If reliable information on a customer's baseline energy use is not available, there is a risk that financial assistance could be offered for phantom or less then cost-effective energy savings. Lack of reliable baseline information will also make verification of demand resources bid to the pool extremely difficult.

This problem could be acute in Ukraine, where substantial changes in economic activity have greatly affected production levels and patterns. For example, a factory making an energy-intensive product with batch processing, such as steel making, would experience an increase in energy intensity per unit of product as its production level fell. If a DSM program manager were to negotiate financial assistance for measures that reduce this energy intensity, the subsequent reductions in energy intensity may be primarily the result of rising production levels, not the DSM measures, yet the utility might be obligated to pay for the savings. Many measures, however, will produce savings in proportion to production rates. In this case, if the factory weathers the current economic crisis, savings might be higher then projected.

Utility Cost Recovery and Lost Revenues

As with most electric utilities in the world (including most in North America), expenditures on DSM programs in Ukraine may result in costs that are not fully recovered in utility rates, as well as revenues lost as a result of lower electricity sales. Strategies to minimize these costs have been incorporated into this pilot project design. The Energy Efficiency Pilot Program has been designed to minimize costs that cannot be recovered. The costs for measure identification and implementation as well as the LEC administrative costs to implement the pilot project can be recovered through a fee (in the form of interest) on the financing offered to customers. In other words, the LEC will offer financing to select industrial customers that will be paid back with interest through the savings on the customers' utility bills (often called a shared savings contract). The interest charged will cover the cost of money as well as the utilities' administration fees. Lost revenue from the reduction in sales of electricity due to the DSM measures will, however, not be recovered. These costs will be expenses to shareholders and should be viewed as a cost of doing business. They are a cost of providing customer service that the LEC deems necessary to ensure the viability of their key customers and to keep customers from leaving the system and purchasing their power elsewhere.

Current Utility Rate Structure and Government Profit Formula are Disincentives to Conservation

Currently, each industry or business is allotted a fixed amount of electricity demand. If that amount is exceeded or not reached, penalties are imposed. In addition, if the limit is not reached, the allotment is reduced the next year. It is essential that the LECs eliminate this "allotment" and penalty mechanism to eliminate this DSM disincentive.

For many state-owned industries, profit is tied to expenses. A profit of a set percentage of operating costs is allowed. If energy costs are reduced, operating costs are reduced, thus reducing profit. Again, industries operating under this sort of government control face a strong disincentive to implement conservation. As more industries become privatized, this problem will disappear.

Document Management/Lack of Computerization

Implementing a DSM program presents significant challenges for managing a large volume of documents. Among the documents and computer files that will have to be written, guided through the organization, and filed for occasional retrieval are:

- promotional materials
- application guidelines
- project applications
- application reviews
- project agreements
- project completion reports
- project impact evaluations
- customer audit/field reports
- customer interview reports
- incentive payment records.

This is just a partial list. When added to the many other documents that will be required to manage the program, they present a major documents management challenge.

Because of the very low level of computerization within the LECs, much financial and energy use data are still recorded and compiled by hand. If this practice is employed for implementing DSM, the project will be made unnecessarily difficult to administer. It is recommended that part of the budget for implementing the pilot DSM project be devoted to the purchase of computers and software for better document and records management.

Lack of Marketing Experience

A successful DSM program, even a targeted program requires good marketing. Even North American utilities that have had many years of marketing experience often have trouble marketing their programs and services.

Marketing is a new concept for Ukrainian utilities. Given the small amount of experience the LECs have had with marketing, it is expected that they will require assistance in developing and implementing a marketing plan for this pilot program.

Customer Service Focus

In a competitive environment, utilities must develop a strategy and objectives for customer retention and growth. Besides price, what distinguishes one utility from another is often customer service. Offering DSM as a customer service is one strategy for retaining customers in a competitive environment. LECs will have to learn a new way of doing business, similar to what utilities in the United States are currently having to do to remain viable.

LEC Knowledge, Skills, and Technical Capabilities

Utility sector restructuring in Ukraine has resulted in new organizations that will be acting, in part, in new capacities. As discussed previously, a necessary part of their role will be to provide customer service in addition to selling power. It will be necessary for LECs to develop a better understanding of their customers' needs, their processes, opportunities for DSM, and economic viability. It will be necessary for the LECs to organize in such a way as to facilitate this, for example, establishing customer service representatives and customer tracking records. The LECs may have to make available training for staff in industrial energy efficiency, customer service concepts, contract management and negotiation, etc. Some of this training will be provided through this DSM demonstration.

3.4 Verification and Evaluation

This section provides an overview of verification and evaluation concepts. Since both the Load Management and Energy Efficiency Pilot Programs will prove to be feasible only if economic benefits outweigh the costs, it is crucial to provide stringent guidelines for evaluating savings attributable to measure installation or load shifting. Additional information on the verification and evaluation process to be followed for the load management bidding and DSM energy efficiency projects are contained in the respective sections of this report. A detailed evaluation workplan will be developed concurrently with program implementation as actual sites are selected for participation in the pilot projects.

A few brief definitions will help clarify the role of each process.

Verification is the confirmation that a particular measure was installed and that the differences in energy consumption and demand before and after the measure(s) installation, or with and without load management, are confirmed at the site.

Impact evaluation is the estimation across an entire DSM program of impacts associated with program implementation, in terms of energy and demand savings.

Process evaluation is the systematic study of a program's implementation to assess the efficiency and effectiveness of the program delivery process.

Verifying the savings that result from the pilot project is essential to:

- show participating customers, LECs, and ESCOs that measurable energy and demand savings have actually occurred
- provide a basis for payments related to these savings.
- Estimating total impact of the pilot program is important to:
- prove the feasibility and cost-effectiveness of an industrial DSM project in Ukraine
- provide input into the design of a subsequent full-scale program, based on estimating the impact of such an expanded program.

Verification and impact evaluation methodologies for both the Load Management Pilot Program and the Energy Efficiency Pilot Program are discussed in more detail in Chapter 6.

Conducting a program evaluation is essential. Apart from the savings impacts, the evaluation team must be concerned with how effectively the pilot project was implemented. DSM programs are seldom implemented as designed, and during the course of a program's operation, a number of unanticipated problems generally arise. Process evaluations document in field modifications to the program that are sometimes referred to as "lessons learned." Program goals and targets may change during the course of program implementation as well. Process evaluations also provide timely feedback for program management and for reporting purposes. A discussion of the key issues to be addressed during the process evaluation of the Demonstration Project are included in Chapter 6.

3.5 Future Vision

A full evaluation of the demonstration DSM as discussed in the previous section will be conducted. The findings from this process and impact evaluation will provide critical input into the design and success of future full-scale DSM efforts in Ukraine. One of the goals of the demonstration is to develop a long-term, sustainable DSM infrastructure in Ukraine. By demonstrating the effectiveness of DSM as a customer service and retention technique through the pilot project, LECs throughout Ukraine are expected to choose to undertake their own DSM programs after the pilot project is complete.

By building local engineering expertise and partnerships between local and U.S. trade allies, as well as enhancing general awareness of the benefits and cost-effectiveness of DSM, a continuing and sustainable private sector market for energy efficiency is envisioned. This market should continue to build to the point that it is sustainable without further interference and support from outside players.

The Load Management Pilot Program is expected to demonstrate that demand-side resources can be successfully and cost-effectively bid into the Energomarket pool. Evaluation of this pilot will assess whether time-of-use rates alone (without the additional resource payment) will provide sufficient market incentives to encourage and achieve cost effective load management in Ukraine.

The establishment of ongoing sources of financing for energy efficiency and load management through this DSM Demonstration will ensure that critical financial resources are available for continued DSM in Ukraine long after the pilot projects are over.

Chapter 4 - 4Overview of the Industrial DSM Assessment

Industrial electricity usage constitutes the majority of usage in Ukraine. For the purposes of this report, this type of usage is defined as including all usage by the industrial sector and also industrial-like pumping usage by the commercial/institutional sector for distribution of water, wastewater, district heat, and district hot water. The DSM assessment presented in Part 1 of this report identified industrial usage DSM as having the largest share of savings potential.

This chapter summarizes the DSM assessment, focusing exclusively on industrial usage. The characteristics of industrial electricity usage are presented. Next, the costs and savings of candidate DSM measure are presented, as well as the results of a preliminary economic screening. The measure are then aggregated into generic industrial DSM programs that serve as the basis for the proposed industrial pilot project.

4.1 Overview of Industrial Electricity Usage

As identified in Part 1 of this report, in 1994, industrial sector consumption was 88.6 TWh, and commercial/institutional pumping usage was 17.2 TWh. Total industrial electricity usage was, therefore, 105.6 TWh, which is 65 percent of 1994 net sales. Although the composition of industrial usage may change, reflecting broader economic trends and the decline of large, primary industries, industry will most likely continue to use the most electricity.

The analysis presented in Part 1 attributed 90 percent of electricity consumption in the industrial sector to motors, 5 percent to lighting, and 5 percent to process use. The analysis attributed 97 percent of industrial-like usage in the commercial/institutional sector to motor usage, with the remaining 3 percent attributed to street lighting.

The key characteristics of industrial electricity usage, discussed in more detail in Part 1, include the following:

- Very large motors (greater than 212 kW) use a significant portion of electricity sold to industry, reflecting the high degree of industrial centralization in the former Soviet Union.
- Industrial motor usage is relatively constant throughout the day and night, with little seasonal variation.
- Over half of industrial lighting usage is from incandescent lamps. Mercury vapor lighting is also common. Both lighting types are good candidates for efficiency improvements.
- Pumping in the commercial/institutional sector has seasonal variation, since a large part of consumption in this sector is for district heating. Usage for water, wastewater, and district hot water pumping has less seasonal variation.
- The most significant types of electricity consuming processes are furnaces and welding.
- Forty-six percent of an industrial survey sample reported that electricity costs were a major concern.
- Twenty-four percent of the sample wanted more information on energy efficiency.
- Twenty-five percent were interested in having an energy specialist visit their enterprise.
- Forty-one percent were interested in price incentives for energy-efficient equipment.
- Respondents were more interested in energy-efficiency programs offered by a private company than by their Energo, or local distribution company (64 versus 40 percent).

4.2 Industrial DSM Measures

The following sections describe potential DSM measures for each industrial end use, which, if shown to be economically justified, could form the basis for a DSM program. Economic screening is discussed in Section 4.3. Only measures that provide the same quality of service as the standard equipment are considered. Appendix C lists their economic and technical characteristics.

Industrial Motors

Given the widespread use of motors in Ukraine industry, motor measures can provide substantial energy savings. There are four principal ways in which motor performance can be improved:

- **Efficiency improvements.** Motors can be manufactured with improved cooling fan designs to reduce windage losses, larger cross sections, thinner laminates, special steel alloys for stators and rotors to reduce magnetic losses, better ball bearings to reduce friction losses, and larger gauge conductors to reduce resistive losses.
- **Improved control.** Standard alternating current motors operate at fixed speeds, although loads vary in many motor applications. A variety of technologies can be used to better match motor speed with load. Electronic adjustable speed drives (ASDs) have emerged as one of the most flexible technologies for motor control. ASDs typically use invertors to vary the motor voltage or current and thereby vary motor speed.
- **Motor downsizing.** Many motors are installed with capacities far greater than that required by the load. Motors operating at less than 45% of full load typically have lower efficiencies. Oversizing of motors is common in Eastern Europe.
- **High-efficiency drive applications.** By improving the efficiency of such drive rotating equipment as pumps and compressors, overall drive system energy consumption can be reduced. Better controls, seals, bearings, and belt and lubrication systems can contribute to high applications efficiency. In addition, there is often room for selecting better pump and compressor technologies to match user needs.

A total of 25 motor measures were identified, including 16 efficiency improvements, eight improved control (primarily ASDs) and high efficiency drive applications, and one motor downsizing measure. Motor efficiency and ASD measures were defined for both high and low use motors in each of four size classes. Drive measures were considered on a retrofit basis only, whereas efficiency measures were defined for both replacement and replace upon rewind (in lieu of retrofitting).

Hours of operation were derived from the industrial customer survey. Standard efficiency levels were based on experience in the United States with motors of similar sizes; these levels may not be much less in Ukraine. This is because over the years, U.S. motors became less efficient because of lower electricity costs and competitive market forces to reduce first costs. In centrally planned economies, these market forces did not exist and motors retained efficiency (e.g., through the use of larger diameter conductors and magnets). Counteracting this effect is the prevalence of rewinding motors in Eastern Europe.1 The process of rewinding motors tends to reduce their efficiency over time, particularly if ovens without adequate temperature controls are used to burn out the windings.

The motor downsizing program assumes that existing motors are switched among enterprises, or within individual enterprises, to yield better use of total motor capacity and to avoid additional expenditures on the purchase of new motors.

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[1] According to FEWE in Poland, a technical organization that conducted market research for USAID, motors are typically rewound about five times before they are replaced.

Industrial Lighting

The industrial sector uses the widest range of lighting technologies, including incandescent, fluorescent, and mercury vapor. Other lighting types are found in the sector, but are not considered as candidates for DSM measures because they are already sufficiently efficient or there are limited opportunities for exchanging them.

Eight fluorescent lighting measures are proposed, and these are virtually identical to those put forward for the commercial sector. Measures are also proposed to retrofit mercury vapor lights with high pressure sodium, and to retrofit high wattage incandescents with metal halide lamps. Mercury vapor lights are typically used for lighting large exterior areas such as service yards, but may be used for large interior applications such as warehouses where color rendering may not be important. They generally offer the lowest efficacy ratio of luminous output to power input of all high intensity discharge lamps, and emit a bluish light with poor color rendering properties. High pressure sodium lights have been developed for similar applications, but typically offer far higher efficacy.

Incandescent lamps are available in sizes up to 1,000 W. Some of these lamps may be used in large-area lighting applications where color rendering is more important. Metal halide lamps can approach the color rendering of incandescent lamps, and do so with much higher efficacy. Compact fluorescent lamps can replace incandescents in the lower wattage.

Process Optimization and Facilities Maintenance Measures

As part of USAID's Emergency Energy Program for Eastern and Central Europe, 27 energy audits were conducted of industrial facilities in eight countries, including Ukraine. The audited firms represented a comprehensive cross section of industries and covered all forms of energy forms, including electricity.

These audits identified two principal electricity saving measures. First, most industrial facilities in Eastern Europe lack even rudimentary instrumentation and monitoring equipment, not to mention automated control systems. Many processes are operated solely on the basis of operator experience and without the benefit of real-time information on process status or operating parameters. This is understandable, since the previous economic system valued gross production rather than economic efficiency and optimization; instrumentation that could help optimize processes was an unnecessary expense. Therefore, the first measure recommended involves the installation of instrumentation, monitoring, and low-cost control systems that can be used to optimize production processes using economic criteria. The audits estimated that simply providing operators with such information and capability would typically save 2 to 3 percent of total plant electricity consumption. Cost estimates for systems proposed for the audited plants ranged from US$4,500 to US$37,000 per plant. Here it has been assumed that 3 percent energy savings are achieved with an investment of US$5,000. The investment cost has been taken at the lower end of the range of costs noted in the audit reports since the audits focused on large industrial consumers. In this assessment, we consider all industrial consumers. This measure was applied to all consumers, large and small.

Similarly, incentives were also previously insufficient to encourage an adequate level of maintenance justified under current economic conditions. The audits revealed that simple maintenance such as the proper lubrication of motors and machinery, repair of compressor leaks, frequent cleaning of filters and screens, and replacement of door gaskets and curtains could reduce electricity consumption by 5 percent on average. The audits estimated that improved maintenance measures for the large plants evaluated would include initial costs of $5,000 to $9,000 and up to US$500 per year thereafter. As with the process optimization measure, costs have been taken at the lower end of this range to reflect the large number of smaller companies that would be included in the program to implement these measures.

Load Management Options

Load management options are those that cause usage to be shifted from or reduced during peak periods. In the industrial sector, these options generally involve rate designs or incentives for customers to modify their energy usage, sometimes in conjunction with existing equipment.

Rate measures are generally effective for peak clipping and load shifting. Time of use (TOU) tariffs in which consumers pay different electricity rates depending on the time of day or season will be standard for industrial customers under the new power sector structure. Interruptible or curtailable rates (I/C) are an option for Ukraine that could be implemented to provide a resource that can be bid to the pool. Curtailable rates provide a rate reduction or an incentive payment in exchange for the utility calling up the consumer on short notice and requesting a reduction in demand of a predetermined amount for a specified period. Interruptible rates involve automatic cutoff of customers' power supply with no notice. The total amount of interruption or curtailment per year, season, or day can be capped by mutual agreement between the consumer and the utility; failure by the consumer to provide the agreed demand reductions will usually result in financial penalties. Both TOU and interruptible rates require the installation of a meter that for the TOU rates can tally consumption during different rate periods, and for the I/C rates can verify consumer compliance with the interruption call. Since TOU rates will be required for industrial customers, there will be no incremental hardware cost associated with I/C rates.

One variation of I/C rates that is being used in the United States is group load curtailment. By bidding a certain load reduction as a group, the group can obtain better rates and conditions than individual bids, and not necessarily curtail as great a portion of their load. Local group curtailment programs have been proposed by PG&E to deal with distribution constraints.2 An example of a variation on this concept is an energy load cooperative, described in Chapter 2. Typical reductions seen are approximately 10 to 20 percent, and curtailment periods range from four to six hours, up to 20 times per year. Such programs generally require that automatic control systems already be in place and that they can be preprogrammed to shut down certain processes. Verification is done through time-of-use meters and econometric techniques. Because of the lack of modern control systems in Ukraine, this option is likely to be limited in the near future.

Real-time pricing is another alternative that is seeing increasing use in the United States. This involves notifying customers what the next day (or sooner) hourly prices will be. Notification techniques include faxes and modems. Customers can then decide what levels of production they want to have. Because of the state of the telecommunications system in Ukraine, this is not a feasible option at this time.

Standby capacity networks were considered for screening. This type of program involves customers allowing the utility to take control of on-site generators installed as emergency backup. This gives the utility additional capacity. As discussed in Chapter 3, few customers reported available standby generation, so this measure was not screened.

Communal Services Pumping

This type of motor usage is similar to industrial-sector motor usage. The same types of measures were assumed to apply to this end use. Hours of operation are likely to be somewhat longer for this category of use, since the district heating motors operate almost continuously in the heating season.

Street Lighting

Mercury vapor lamps are common in Ukraine. In Eastern Europe, typically about half of all streetlights still use mercury vapor lamps. Mercury vapor lighting was discussed in the section on industrial lighting. The same measure described for the industrial sector, retrofitting mercury vapor lights with high pressure sodium, is also proposed here for street lighting.

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2 _ "Evaluation of Pacific Gas & Electric Company's Pilot Interruptible Bidding Program," The Tellus Institute, Boston, MA, October 1994.

4.3 Screening DSM Measures

All of the above measures are technically feasible, though not necessarily economically justified. By screening these measures in terms of whether they can save electricity for less than the cost of generating and distributing it, the most promising measures can be selected as a basis for subsequent program design and a more detailed assessment of DSM potential in Ukraine. Economically justified measures are a necessary condition for feasible programs.

Chapter 4 of Part 1 describes how the cost of saved energy (CSE) and cost of saved capacity (CSC) can be derived from technical and economic characteristics of measures and compared with avoided energy and capacity costs to decide whether a particular measure would be a good candidate for inclusion in a program. The CSE and CSC for each measure are shown in Appendix C along with the physical energy and capacity savings that would be expected if each measure applied to every eligible end-use device currently in use.

Load management programs were not included because they are not amenable to this type of analysis. Unlike energy-efficiency measures, there are typically minimal hardware costs associated with these types of programs — the costs are primarily transfer payments to customers, which are typically not included in supply curves. Load management was screened using a simplified dispatch model, discussed in the next section.

To avoid double counting of energy savings, the following rule was adopted to determine which measure would be listed: If two mutually exclusive measures have a CSE below the avoided energy cost, the one that offers quicker implementation would be selected. For example, retrofit measures would be selected over replacement measures since retrofit measures would not have to wait for standard equipment retirement. If both measures could be implemented with the same speed, the one with the lower CSE is selected.

Out of 63 measures initially identified, 38 measures pass the screening test (plus the load management measures that were not considered in the screening analysis). If all of these measures were implemented for all eligible customers or end-use devices, the energy savings would total 24.2 TWh, or 14.7 percent of total 1994 total domestic electricity sales. This is referred to as the economic DSM potential, as opposed to the achievable potential, which takes into account market penetration rates of the measures. Achievable potential is assessed in the next section.

4.4 Design and Assessment of Industrial Programs

Measures cannot install themselves at the customer's premise; economic potential remains just potential unless steps are taken to market and implement measures. This section identifies DSM programs that would result from packaging the measures with marketing and delivery mechanisms.

4.4.1 Developing Program Concepts

To design a program, all the similar measures that passed the economic screening are grouped. For example, in designing a motors program, all the motor measures that passed the initial screening should be considered together in a motor program. The program benefit/cost results reflect the participation assumptions made at the measure level, the administrative costs at both the measure and program level, and the load shape impacts of the program based on the magnitude of energy and demand savings for each measure.

Exhibit 4-1 presents the characteristics, such as participation rates, administrative costs, and expected impacts, of the 10 industrial usage DSM programs analyzed.

4.4.2 Financial Assessment of Programs

Energy efficiency will be paid for by LECs and IESs, while load management will be paid for by the national power pool as a part of the bidding process. As discussed in Chapter 2 of Part 1, the objective functions of these two types of entities are different. Consequently, the financial feasibility of the proposed programs was assessed differently for these two types of programs. As discussed in Chapter 6, participating ESCOs may also pay for energy efficiency.

Energy-Efficiency Programs

In a competitive environment, LECs and IESs will only pursue DSM programs that offer some type of financial benefit. These benefits may be either lower rates or increased or maintained market share. Programs that have avoided energy costs greater than the sum of the resulting revenue losses and the program costs will tend to reduce rates. The Ratepayer Impact Measure (RIM) test, which compares avoided costs with the sum of revenue losses, incentives, and administrative costs, identifies whether this is the case. To increase or maintain market share, LECs and IESs are likely to offer DSM as a customer service to those customers who may be pursued by competing suppliers. These customers are generally high voltage, industrial, or commercial/institutional customers that have high load factors.

To prevent cross subsidies, payment for any such programs that do not pass the RIM test would have to come from shareholder profits or from an unregulated subsidiary. In either case, the funding organization would attempt to recover costs, and profits, from the participating customer. A typical financing approach is shared savings, where costs for equipment and technical expertise are paid for through utility bills from the savings realized by the installed measures. Payments are designed so that total bills are less than before implementation — no customer out-of-pocket costs are required. A financing program of this type was described in Chapter 2.

Exhibit 4-1

Industrial Usage Program Summaries

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Commercial/Institutional Motor Program Summary

	1996	**1997**	**1998**	**1999**	**2000**	**2001**
Capital Cost (‘000)	350	350	701	701	794	794
Administrative Cost (‘000)	533	283	316	316	323	323
New Participants*	2,049	2,049	4,097	4,097	4,574	4,574
Energy Savings (GWh)	7	14	27	41	56	72
Peak Demand Savings (MW)	1	2	3	5	7	9

Participants are defined as units (motors).

Commercial/Institutional Drives Program Summary

	1996	**1997**	**1999**	**1999**	**2000**	**2001**

Capital Cost ('000)	2,178	4,339	6,513	8,699	10,895	10,895
Administrative Cost ('000)	586	422	508	595	681	681
New Participants*	431	862	1,293	1,724	2,155	2,155
Energy Savings (GWh)	15	45	89	149	224	300
Peak Demand Savings (MW)	2	6	13	22	32	43
Participants are defined as units (motors).						
Commercial/Institutional Motor Downsizing Program Summary						
	1996	**1997**	**1998**	**1999**	**2000**	**2001**
Capital Cost ('000)	64	129	194	259	323	323
Administrative Cost ('000)	393	236	279	322	365	365
New Participants*	215	431	646	862	1,077	1,077
Energy Savings (GWh)	1	4	8	14	20	27
Peak Demand Savings (MW)	0.3	1	2	3	5	6
Participants are defined as customers.						
Industrial Lighting Program Summary						
	1996	**1997**	**1998**	**1999**	**2000**	**2001**
Capital Cost ('000)	1,000	2,910	3,911	3,911	3,956	3,956
Administrative Cost ('000)	486	491	630	630	666	666
New Participants ('000)*	34	85	120	120	129	129
Energy Savings (GWh)	13	53	107	151	177	193
Peak Demand Savings (MW)	2	9	19	26	31	34
Participants are defined as fixtures.						

Industrial Motor Program Summary						
	1996	**1997**	**1998**	**1999**	**2000**	**2001**
Capital Cost ('000)	3,663	3,663	7,331	7,331	8,295	8,295

Administrative Cost ('000)	842	592	934	934	1,013	1,013
New Participants ('000)*	21	21	43	43	48	48
Energy Savings (GWh)	34	68	136	205	278	352
Peak Demand Savings (MW)	4	9	18	26	36	45
Participants are defined as units (motors).						
Industrial Drives Program Summary						
	1996	**1997**	**1998**	**1999**	**2000**	**2001**
Capital Cost ('000)	12,207	24,460	36,662	48,944	61,151	61,151
Administrative Cost ('000)	887	1,024	1,411	1,799	2,186	2,186
New Participants*	1,935	3,879	5,806	7,744	9,679	9,679
Energy Savings (GWh)	58	174	348	581	871	1,161
Peak Demand Savings (MW)	8	23	47	78	117	156
Participants are defined as units (motors).						
Industrial Motor Downsizing Program Summary						
	1996	**1997**	**1998**	**1999**	**2000**	**2001**
Capital Cost ('000)	674	1,348	2,022	2,696	3,370	3,370
Administrative Cost ('000)	799	1,049	1,498	1,948	2,397	2,397
New Participants*	2,247	4,494	6,741	8,988	11,235	11,235
Energy Savings (GWh)	6	17	34	57	86	115
Peak Demand Savings (MW)	1	2	4	7	11	15
Participants are defined as customers.						
Industrial Operations Optimization Program						
	1996	**1997**	**1998**	**1999**	**2000**	**2001**
Capital Cost ('000)	2,270	4,540	9,080	11,350	11,350	6,810
Administrative Cost ('000)	1,408	2,066	3,882	4,790	4,790	2,974
New Participants*	454	908	1,816	2,270	2,270	1,362

Energy Savings (GWh)	15	44	103	176	249	293
Peak Demand Savings (MW)	2	7	17	29	41	48
Participants are defined as customers.						

Street Lighting Program Summary						
	1996	**1997**	**1998**	**1999**	**2000**	**2001**
Capital Cost ('000)	143	287	574	717	717	430
Administrative Cost ('000)	379	207	265	293	293	176
New Participants ('000)*	14	29	57	72	72	43
Energy Savings (GWh)	7	21	49	83	118	132
Peak Demand Savings (MW)	2	5	12	20	29	33
Participants are defined as fixtures.						
Load Management Bidding Program						
	1996	**1997**	**1998**	**1999**	**2000**	**2001**
Capital Cost ('000)*	18,900	37,800	56,700	75,600	94,500	94,500
Administrative Cost ('000)	1,195	2,015	2,960	3,905	4,850	4,850
New Participants**	1,890	3,780	5,670	7,560	9,450	9,450
Energy Savings (GWh)	191	572	1,143	1,906	2,860	3,813
Peak Demand Savings (MW)	175	525	1,050	1,750	2,625	3,500
Complete consideration of capital costs from a participant's perspective requires information on lost production costs that cannot be quantified at this time. Participants are defined as customers.						
Total for Energy Efficiency Programs						
Capital Cost ('000)	22,551	42,028	66,988	84,608	100,851	96,024
Administrative Cost ('000)	6,315	6,371	9,723	11,626	12,715	10,842
Energy Savings (GWh)	156	440	902	1,457	2,081	2,646
Peak Demand Savings (MW)	23	65	134	217	309	389

Total for All Programs						
Capital Cost ('000)	41,451	79,828	123,688	160,208	195,351	190,524
Administrative Cost ('000)	7,510	8,386	12,683	15,531	17,565	15,692
Energy Savings (GWh)	347	1,012	2,045	3,363	4,941	6,459
Peak Demand Savings (MW)	198	590	1,184	1,967	2,934	3,889

The programs must also be financially attractive to customers. This implies that the programs must pass the participant test, which compares bill reductions and incentives with the costs to the participant of implementing the measures.

These market-based requirements imply that the financial criteria for programs must be as follows:

- Programs for low-voltage customers and low load factor, high-voltage customers must pass the RIM test and the participant test.
- Programs for high load factor, high-voltage customers (i.e., industrial customers and communal services pumping) must pass the participant test and must help to retain customers.

The analysis of energy efficiency measures relied on a sophisticated demand-side planning tool, DSManager, to evaluate the cost-effectiveness of these potential DSM programs. It takes into account the impediments to full adoption of these measures and also the overhead costs associated with program implementation. DSManager also calculates the Total Resource Cost (TRC) test, an economic assessment more detailed than the supply curve analysis discussed in the previous section. The TRC test was also calculated to establish overall DSM economic feasibility.

Load Management

As was described in Chapter 2 of Part 1, the pool will accept bids for DSM up to the amount that increases rates. The amount of DSM bid and accepted is dependent on the cost and available capacity of competing supply-side resources, and the customers' lost production costs. Because of the sensitivity of a load management program to hourly pool prices, which, at the time of this report, are unknown, industrial load management measures were analyzed using a simplified dispatch model to simulate pool prices. To evaluate the potential for load management, a simplified pool model was developed. The model contains data on energy costs and available capacities of nuclear, hydro, coal, gas, and oil supply-side resources in Ukraine. Actual system demands for 1994 were used in the model. Two cases were run: with and without DSM. In the without DSM case, supply side resources are bid to the pool, in each hour of each typical day, in order of energy cost, until the demand is met. In the DSM case, load management priced at several levels is allowed to be bid to the pool, to the extent that rates charged to suppliers are not increased.

4.4.3 Summary of Results

Using DSManager, TRC and participant tests were conducted for each measure, each program, and all programs together, excluding load management bidding. The assessment of individual measures did not include any fixed administrative overheads. The assessment of the each aggregated program includes not only the direct costs of the individual programs, but also the fixed administrative costs that accrue to the aggregated program.

The assessment of all programs took into account direct program costs, fixed overheads for each program, and the national program overheads that pertain to all programs. The assessment was built up in this way because there was no clear way to allocate fixed overheads to individual programs.

Exhibit 4-2 summarizes the benefit/cost results for each energy-efficiency program outlined in this chapter (including the national DSM aggregate), for the TRC, RIM and participant tests. It also shows the net benefits from each of the three perspectives, and the energy and demand savings attributable to each program and for all programs.

Exhibit 4-2
Summary of Assessment Results

Program	TRC Test B/C Ratio	Participant Test B/C Ratio	TRC Test Net Benefits ('000)	Net Energy Savings for 2001 (GWh)	Net Demand Savings for 2001 (MW)
Commercial/Institutional Motors	3.23	7.69	8,618	72	9
Commercial/Instit. Motor Drives	1.56	2.22	16,454	300	43
Commercial/Instit. Motor Downsizing	2.65	10.51	3,547	27	6
Industrial Lighting	1.72	2.57	10,918	193	34
Industrial Motors	2.15	3.62	32,962	352	45
Industrial Motor Drives	1.08	1.50	12,756	1,161	156
Industrial Motor Downsizing	1.30	3.36	4,433	115	15
Industrial Facilities Maintenance	0.85	1.47	(7,566)	293	48
Street Lighting	3.12	7.20	6,374	132	33
Total Energy-Efficiency Programs	**1.29**	**2.01**	**88,495**	**2,645**	**389**
Load Management Program*	**na**	**na**	**na**	**3,813**	**3,500**
All Industrial Programs*	**na**	**na**	**na**	**6,458**	**3,889**

Benefit-cost ratios and net benefits for load management and all programs cannot be calculated because a complete consideration of capital costs requires information on lost production costs which cannot be calculated at this time.
Numbers may not add up perfectly due to rounding.

Results show that all programs pass the participant test, with benefit-cost ratios ranging from 1.47 for the industrial facilities maintenance program to 10.51 for the commercial/institutional motor downsizing program. All programs also pass the TRC test, except the facilities management program with a TRC B/C ratio of 0.85.

The benefit/cost ratio of the set of energy-efficiency programs is 1.29 for the TRC test and 2.01 for the participant test. These results are based on streams of benefits and costs that often go beyond the lifetime of the program since measures installed during the program yield savings during their entire lifetime, which is usually longer than the program.

Industrial usage programs can save 6,458 GWh per year and 3,889 MW cumulative capacity additions and plant rehabilitation by the year 2001. These savings represent almost 100% of the total energy and capacity savings, respectively, estimated for all economic programs identified in Part 1. Except for a commercial lighting program, which has a relatively small potential impact given the small size of the commercial sector in Ukraine, programs affecting other uses were not found financially viable in the deregulated power sector.

The sign (i.e., positive or negative) on the value of the net benefits from a total resource perspective is related to the TRC benefit-cost ratio. Programs with a benefit-cost ratio greater than one have positive net benefits; if the benefit-cost ratio is less than one, the net benefits are negative. Consequently, all but one program have positive net benefits, as shown in Exhibit 4-2.

The total net benefits from programs from a total resource perspective are $88 million dollars. This represents a net present value. It signifies that Ukraine's energy requirements can be met at a substantial cost savings through DSM.

The results conclusively show that industrial usage DSM programs that can be implemented in the near term represent a significant power sector resource with substantial economic benefits. Consequently, industrial DSM pilot programs would be appropriate candidates for financing from multilateral development banks.

Given that industrial DSM programs represent almost all of the achievable near-term potential, industrial pilot programs would lead to the most rapid realization of substantial DSM benefits. Industrial pilot DSM programs can:

- provide the experience and technical proof of concept necessary for implementing full-scale programs in Ukraine
- help to more accurately assess DSM costs and benefits based on actual field experience
- help provide a better perspective on regulatory design by taking into account actual consumer response to programs.

The rest of this part of the study proposes an industrial DSM pilot program that would serve as a bridge toward the full realization of demand-side resources in Ukraine.

Chapter 5 - 5End-Use Load Research

The DSM Demonstration contains an end-use load research element as an integral component of pilot project design. End-use load research is important to demand-side management activities being considered. By understanding how its customers use electricity in their facilities, utilities can more accurately gauge the DSM resource potential available to them. Load research also plays an important role in impact evaluation, through which the actual costs and savings of efficiency measures are accurately determined. Finally, the establishment of a load research staff or department at a utility can go a long way toward increasing the level of customer service, as utility staff interact with their customers and learn more about their needs for energy services. This last point is especially relevant in Ukraine, where utilities are realizing the need to change their market outlook, from a strong tradition as commodity vendors to one of energy service providers.

In this Demonstration, a pilot end-use load research task was undertaken as a preliminary means of introducing the basic concept of load research to the DSM pilot project design process. Load research is defined as a separate pilot project activity because it typically involves different people at the utility whose tasks are performed independently and at different times than the DSM project implementation staff. This independence is essential for the integrity of the load research results, which for impact evaluation must be objective and impartial. This section of the report includes the objectives and methodology of the load research element of the DSM Demonstration. The section then discusses the sample plan, monitoring equipment and staff training, and the data collection and processing protocols. The section concludes with a discussion of data analysis activities and shows the results of the first round of end-use data collection and analysis activities.

5.1 Background

Historically, load research activities focused on the acquisition and analysis of “whole premise” customer data (i.e., billing data). However, load research has evolved to include the collection and analysis of customer end-use consumption data to better understand how customers use electricity. Load research data are also necessary to evaluate the cost-effectiveness of DSM and load management programs and their impact on utility operations.

Exhibit 5-1 shows the activities of a typical load research process. Thorough planning of a load research project is essential to gathering relevant data. Then the actual samples must be drawn and the metering equipment installed. The data must be stored, checked for errors, and transmitted to the analysis team. Load shapes can be produced and analyzed along with process data (if available) to determine specific energy consumption. Then these data are available for determining the program impacts associated with any energy efficiency improvements made as a result of a DSM program.

Exhibit 5-1

The Load Research Process

Although load research will be conducted at industrial, commercial, and residential facilities, the focus of the pilot project in Ukraine will be the industrial sector, which accounts for the major portion of the country’s electricity demand. The program’s primary sources of data will be:

- whole-premise data (kW and kWh)
- survey data collected from a wide range of customers
- end-use data measured by monitoring instruments.

5.2 Load Research Objectives

The objectives of the load research task are:

1. to help the utility gain a better understanding of how consumers use electricity as a basis for enhancing customer service
2. to help identify specific DSM measures and estimate their impacts
3. to the extent possible, to use the data to more accurately characterize the end-use load shapes developed in the National Assessment portion of this demonstration.

5.3 Research Sample Design

The sampling plan helps to ensure that the meters yield data of maximum usefulness, which can be extrapolated with some degree of confidence as a typical loadshape. The specifics of how sites are selected for metering, the amount of time each participant was metered, and the ways in which the data were processed and extrapolated are discussed below.

The goal of sampling design is to have a simple approach, yet one that yields meaningful results with reasonable statistical reliability. This involves placing limitations on both the sample customer selection and the end uses to be monitored. The design selected for this plan segments the population into market sectors, and further subdivides the sectors according to specific criteria based on end uses, and on consumption.

Developing the Sample

The key variables investigated in the sampling were the timing of electricity use and the amount of electricity use per customer group, per end-use group.

In preparation for the end-use metering task, a telephone survey of the commercial, industrial, and residential sectors in Ukraine was conducted by a survey house (Socis). The survey gathered data on electricity consumption patterns and equipment. The survey data were reviewed in order to select a representative sample of sites for end-use metering and site visits. While the data did not provide enough information to make final selection of individual sites, data concerning subsectors and the relative importance of various end uses allow for preliminary decisions regarding load research activities. Final selection of sites and end uses was made during the site visits with Energo staff.

The review of load data provided for sites in the Dneprenergo and Vinnitsaenergo, when compared to the aggregate load shapes for industry sectors across all Energos, provides some insight for selecting sites for auditing and end-use metering. There were 231 sites in the total sample of CT-5000 data sites. These sites provide whole-facility data collected by the Energo with the use of the CT-5000, a type of datalogging equipment developed in Ukraine. They are assigned to the following industrial sectors, according to the codes provided:

Industry Sector	Number of Sites
Coal Industry	17
Ferrous Metallurgy	28
Nonferrous Metallurgy	4
Chemical and Petrochemicals	16
Machine Building and Metalworking	86
Timber, Woodworking and Paper/Pulp	7
Construction Materials	20
Glass Industry	5

Light Industry	20
Food Industry	13
Miscellaneous	2
Transport	6
Municipal and Everyday Use	1
Nonindustrial Users	3
Printing Trade	3

The 60 sites in the CT-5000 sample that reside in the Dneprenergo (56) and Vinnitsaenergo (4) are weighted heavily toward the machine building and metalworking, and ferrous metallurgy categories, similar to the aggregate sample across all Energos. To select a representative sample of sites to visit in Dnepr and Vinnitsa, individual site load shapes were compared to the aggregate load shapes for the entire country for the particular industrial sector they belong to.

These whole premise load shapes were collected during a one-week period in December 1994, during which there were mandatory power curtailments; therefore they may not be representative of these sites or sectors for the entire year. The ferrous metallurgy sector accounts for about 40% of the total system load, but the load shapes generated from the December data reflect a forced curtailment during the system peak hours.

A list of potential sites for the end-use metering activities was provided to each Energo, along with additional criteria to be used by them for final site screening. These criteria include cooperation of the enterprise staff, probability that the enterprise will survive the current economic transition, and their interest in improving energy efficiency.

5.4 Metering Equipment

The load research project staff developed a specification for metering equipment and training, and then purchased eight power demand analyzers for use in the field. Because of the nature of collecting and storing data at equipment locations in industrial environments, the metering equipment had to:

- not require an external power supply; it must be battery operated for the duration of the monitoring period
- collect and store data on actual voltage and current, as well as reactive power, for both single and three phase loads over time
- work with a 220 V, 50 Hz system and other voltage levels, for both recording and battery charging operations
- accommodate data downloading directly to a DOS or Windows based computer, and/or download to a data reader that can be downloaded directly to a PC
- be packaged in a rugged, water-resistant case, capable of operating over a temperature range of 20ºF to 150ºF
- have adequate load profile storage to hold a minimum of 8 days of data at 1 minute sampling intervals.

The meter selected was the *Rustrak Ranger Harmonics Power Logger*. This unit is capable of recording three phases of voltage of up to 600 vac, current up to 1000 amps on each phase, neutral currents, and potential from neutral to ground. The unit uses these values internally to calculate wattage, power factor, and other required values. Rustrak also provided the *Pronto* software package, which does data analysis in a DOS environment (a Windows version will be available during Fall 1995).

In addition to the multi-channel data loggers, battery-powered time-of-use loggers were also purchased. Loggers with the ability to mount directly to lighting fixtures and motors and another model which uses a small current transformer were selected from Pacific Science and Technology (PST).

Each Energo was provided with a set of four each of these loggers, as well as the data reader, cables, and software for downloading the data to a PC.

Training

During the May 1995 mission, a training course was offered to staff from the participating Energos and Minenergo. This course covered the technical aspects of using the meters that had been selected, and included practical exercises in the field to provide participants with hands-on experience with the equipment. The major topics covered during the training course are shown in the course outline in Exhibit 5-2. A detailed outline is provided in Appendix D.

The list of attendees for the training program is located in Appendix D.

5.5 End-Use Selection and Field Installation

Field installation of load monitoring equipment varied somewhat for each end use. The instruments themselves are very adaptable. The key to the success of any field installation is the cooperation extended toward this program by the host facility. Hagler Bailly and Energo staff met with customer representatives from each site during the May 1995 mission.

Energo engineers that participated in the training class and were familiar with the hardware and software installed the monitoring equipment at each of the selected sites.

For all end uses except residential, monitoring was carried out for one week to study the weekday and weekend differences in profiles. Plants that have continuous operation will provide the most reliable data.

The metering equipment was moved from site to site to cover as large a sample size as possible during the course of the summer. When seasonal variation is an important factor (as it is, for example, with the hot water pumps at a district heating plant), then the monitoring should be done once in-season and once off-season. It is recommended that followup data collection be carried out by the Energo after 6 months.

Exhibit 5-2

Training Session Outline: Rustrak Ranger

May 3 through May 6, 1995, Kiev

Wednesday, May 3rd:

Introduction
Ranger Theory of Operation
Sample Rate vs. Record Rate
Inputs
Recorded Modes
4. Menu Tree
Unit Set-Up
Pacific Science & Technology
1. TOU Light Loggers
2. TOU Motor Loggers
3. TOU Load Loggers

Thursday, May 4th:

In Field Hook-Up to Actual Ckt. Panel
In Class, Answer Question on Hook-Up
Pronto Software
1. View a Few Samples
2. Set-Up
3. Playback
Pacific Science Software

Friday, May 5th:

In Field, Retrieve Data-Loggers
In Class, Playback Data
1. Analyze Data in Software
2. Produce Reports & Graphs
Applications & Open Discussions
Wrap-Up and Close

During the scheduled site visits in May, Hagler Bailly and Energo staff together determined the specific end-use equipment to be metered with the Rustrak Logger at each site. The end uses were selected based on the following criteria:

1. The end use contributes significantly to the total electrical load for the facility.
2. There is potential for load shifting or replacing the load with more efficient equipment.
3. The location for datalogger installation is secure.

The recommended end-use equipment to be metered at each site is listed in Exhibit 5-3.

Specific production data were requested from each site by Hagler Bailly to accompany the load data collected by the Energos. Ideally, this would allow the analysis team to quantify energy intensities (kW/ton for instance) of each end-use process. In practice, sites were not able to provide this information for same time periods that monitoring was conducted. Some additional information on systems was collected during the detailed site audits in August, and the load data has been considered in the reporting of those audits.

5.6 Data Collection and Processing

After the initial visit to each site and identification of equipment to be monitored, the Energo staff determined a schedule to collect data at each site for one week during the following two months. This schedule was confirmed with the plant engineer at each site, so that the date of meter installation was known to him. It was recommended that the Energo engineer provide this schedule in writing to the plant engineer, and also telephone the site the day before arrival to remind the plant engineer of the schedule.

Each Rustrak Logger was programmed during the training with SETUP 1, which contains the parameters required for the load research, including:

- sampling interval = 15 minutes
- length of recording = 7 days
- type of sampling = Enhanced Point Store
- channel 9 = 3 phase kW
- channel 10 = 3 phase power factor.

Details of the two logger setups used as templates are contained in Appendix D.

Exhibit 5-3
Recommended End-Use Equipment

Dneprenergo Metering — *Site & Equipment List*	
Zaparoshye FerroAlloy	(2) 28 MW furnaces; 1 with capacitors, 1 without (1) 7.5 MW furnace with periodic cycle **Note:** 2 phase power at this enterprise.
Nikopol FerroAlloy	(1) 75 MW Japanese furnace (1) 50 MW Soviet furnace (1) 16 MW melting furnace
Nikopol PipeWorks	(1) 3.6 MW pipeforming motor [850 V, AC side of transformer] (1) 1.4 MW pipe stretcher motor [850 V, AC side of transformer] (1) 1.0 MW compressor [6 kV]
Electroautomatika	(1) 90 kW compressor [meter the 2nd compressor, periodic load] (1) 250 kW chiller (1) 75 kW supply fan
TsGOK	(1) 3200 kW water pump [6 kV] (1) 320 kW mill [6 kV] (1) 2500 kW drum [6 kV]
Vinnitsaenergo Metering — *Site & Equipment List*	
School #26 — Vinnitsa	(1) largest kitchen oven (1) kitchen total (1) building total

Machine Building — MogilevKirov	(1) 120 kW paint drying oven (1) 320+337 kW compressor [6 kV] (1) 104 kW metal treating oven [24 Hz, but measure on 380 V side] **Note:** CT5000 data to be gathered on compressor for same time period.
Texterno Textile Plant — Ternopol	(1) 1600 kW compressor (1) 160 kW supply fan (1) 630 kW chiller [6 kV], or (1) 200 kW boiler pump
Water Pumping Station — Vinnitsa	The plant has already provided us with data on 16 pumps in the river water pumping and city supply portions of the plant. Their computer system does not record data for the sewage treatment portion of the plant. Therefore, please select (3) significant pumps in Sewage treatment plant.
Recommended End-Use Equipment	
Vinnitsaenergo Metering — *Site & Equipment List* (cont.)	
Hospital Pirogov — Vinnitsa	(1) X-ray machine [in 24-hour clinic] (1) 39 kW soup cooker in kitchen (1) 32 kW pump in new pumping station **Note:** meter this site after new pumping station begins operation.
Agricultural Collective	We did not visit such a site, but it was agreed that Vinnitsaenergo will visit a collective and meter (3) significant loads for one week.
Residential Sector	Three homes of the following type will be metered: detached home with CHP (combined heat and power) service detached home without CHP service apartment flat with CHP service In each home, the PST loggers should be used to record time-of-use for a refrigerator, any electric heating devices, electric cookers or ovens, and a key light source.

At each site, it was anticipated that all three Rustrak loggers would be used for the one-week data collection. The equipment was to be operated as normal for the site during the data collection period.

It was requested that the small PST loggers be used at each site to monitor lighting and small motor loads. Locations where equipment was to be used throughout the week are best. Adjusting the sensitivity of the lighting loggers, and resetting all loggers before mounting them is necessary. If possible, current testing with amp-probes was recommended for each piece of equipment metered and this information recorded along with the equipment location.

At the Energo, the datapak was downloaded to the PC using the datapak reader that connects through the serial port. The data were then transferred to a diskette and delivered to the Hagler Bailly office in Kiev. The procedures to be followed for these activities are outlined in Appendix D.

Data editing and validation is also required for any load research activity. The first issue is housekeeping, which involves minor editing to adjust start and stop times, summing kWh over the appropriate time interval, and applying meter multipliers if necessary. The second step is to identify and correct for missing or bad data, whether they occurred for power outages or other reasons. If only a few pieces of data are missing, the data will be smoothed; when larger gaps appear, information on the status of the equipment during the time period is requested.

Over the course of the summer, data were received from the two Energos as each site monitoring program was completed. The engineering staff at the Energo completed their own internal analysis of the data through the use of the *Pronto* software, and then forwarded a copy of the data to Hagler Bailly. The data were processed to sum the 15-minute data into hourly average demand. These hourly values were then used to produce hourly load shapes that reflected the average weekday and weekend consumption.

Zaporozhie FerroAlloy

- Data were received for two melting furnaces: a 28 MW furnace with installed capacitor banks, and a 7.5 MW furnace that cycles periodically.

Nikopol FerroAlloy

- Two datasets for melting furnaces were received from this site, including a 50 MW model and a 16 MW furnace.

Nikopol Steel Tube

- A motor that drives a pipe stretching process and another that handles the pipe forming operation were monitored.

Mogilev-Podolsky

- Data from the air compressor system at the plant and a small melting furnace were received.

Texterno

- The loadshape data were received for one of the supply fans at this textile plant.

Vinnitsa Hospital

- Data were received for the x-ray machine.

Pumping Station

- The Vinnitsa Municipal Pumping Station is actually a special case since the data analyzed were provided through the monitoring system permanently installed at the facility. They provided us with 5-minute data for a set of pumps used for the municipal water supply. Additional Rustrak data were received for wastewater treatment pumps.

5.7 End-Use Load Shapes

Each load shape included in this section shows a 24-hour profile for the respective end uses, where the value on the y-axis is the average power reading during the corresponding hour of the day as indicated on the x-axis, averaged over each day in the monitoring period. A few example plots are included here, and the remainder of the load shapes developed for end-use load data collected are included in Appendix D. The raw plots produced from the Rustrak data for these end uses are also included in Appendix D.

Exhibits 5-4 and 5-5 provide examples of equipment that may prove to be candidates for load management bidding. The first example is for an electric furnace used for alloy production. As shown in the load shape, this furnace is generally cycled throughout the day. Depending on the electric price structure, it may be advantageous to alter the pattern of operation in order to receive payment for idling during peak hours. Operational parameters of the furnace would need to be considered in any decision in this regard. Exhibit 5-5 shows the profile for air compressors at a machine building plant. The profile matches quite closely the hours of operation for the facility. Once again, depending on the ability to alter production schedules and/or store the compressed air, some shift in the load may be possible.

Exhibit 5-6 provides an example of equipment that might benefit from an efficiency retrofit. While the compressors and furnace discussed above may also fall into this category, the supply fan represented here is clearly needed during all hours of plant operation, and improving the equipment efficiency is more applicable than attempting to shift the load to an off-peak time. A complete review of the efficiency of the entire air handling system is recommended in this case.

The water pump profiles shown in Exhibit 5-7 are very flat. These are pumps for a municipal pumping operation that runs continuously. There may be some efficiency improvements to be made in some of the pumps (this is already being investigated by on-site staff), but the most likely opportunity for savings would come from piping system improvements that would decrease pressure drops in the network.

Appendix D also includes CT-5000 data for some sites. These data provide a glimpse of the consumption patterns for the entire enterprise during the same time period that the end-use data were collected. There is also a set of system data for the LEC during the monitoring period associated with some of the end-use data collected at Nikopol FerroAlloy Plant. These additional data are provided to assist in determining which end uses may be the best candidates for retrofit or load bidding, based on the potential hourly cost of electricity in the new spot market. Actual hourly pricing data for the LEC and pool will soon be available for more detailed economic analysis.

Exhibit 5-4

Chapter 6 - Pilot Project Design Specifications

6.1 Introduction

This chapter presents preliminary specifications for the DSM Demonstration, which includes two industrial DSM pilot projects — load management bidding and energy efficiency — and training and education. As such, it provides "blueprints" for the practical implementation of the pilot projects in Ukraine. Although every effort has been made to provide as much detail as possible, a more complete project design should be undertaken just before project implementation. These specifications can be used as guidelines for that more complete design. The current status of utility regulation and the economy in Ukraine should be considered at the actual start of the project.

The pilot project specifications cover the following topics:

- the project's content and features
- mechanisms and contractual relationships for financing and payment
- marketing strategy (for the energy efficiency pilot)
- program design issues
- field delivery and implementation issues
- monitoring and verification.

In addition, the following general topics pertinent to both pilot projects are discussed:

- sources of project financing
- training of local trade allies
- process and impact evaluation approaches
- DSM cost recovery.

6.2 Load Management Bidding Pilot Program

6.2.1 Project Content and Features

The Load Management Bidding Pilot Program is designed to provide a mechanism through which dispatchable load can be bid to the hourly spot market pool in competition with supply side resources. All accepted bids will receive a payment from the pool, much as will supply-side (generation) resources. This resource payment, as explained in Part 1 of this report, will be equal to the highest accepted $/kWh bid (demand or supply side resource bid). Demand side resource bids will only be accepted when the bid price and quantity result in a decrease in the overall marginal pool price.

In this pilot, two or more energy service companies will be solicited to provide turnkey services to six prescreened industries. The selected ESCOs will identify retrofits and dispatchable load shifting opportunities; work with the industries to arrange financing; design, specify, and procure equipment; and install and start up selected projects under a shared savings contract. The ESCOs will act as an agent to the industries and as an intermediary between the industries and their LEC to bid dispatchable load to the Energomarket. The ESCOs will be responsible for providing the monitoring and verification and in some cases the operation and maintenance of projects.

Each prescreened industrial site is served by one of the newly organized local electric companies (LECs), which have responsibility for power distribution in the reorganized Ukraine power system. Four LECs are participating in this ESCO pilot program and will have an integral role its development and implementation.

A Request for Qualifications (RFQ) solicitation and subsequent procurement process will be administered by an international DSM consultant on behalf of the Minenergo. The purpose of this procurement is to arrange turnkey energy services contracts and investments between U.S.-based ESCOs and the prescreened industrial firms in Ukraine. All participating U.S. ESCOs will be expected to undertake projects in conjunction with Ukrainian companies that have expertise in engineering, mechanical and electrical contracting, project management, equipment sales, or other allied fields.

The pilot program is also designed to serve additional goals: to promote development of the energy efficiency industry in Ukraine, to develop the mechanics and demonstrate methods for the sale of demand management resources to the new Ukraine central power pool (the Energomarket), and to design and test innovative contract and financing mechanisms that can be replicated.

The RFQ will contain background information needed by ESCOs to make informed proposals. U.S. businesses face daunting challenges doing business in Ukraine. A major goal of the procurement design is to reduce the ESCOs' barriers to entry. For ESCOs interested in developing ground-floor business opportunities in Ukraine, this procurement program will organize and offer the following:

- identification and introduction to qualified, decision-ready, major industrial end users and LECs
- assistance with project development and arrangement of financing
- USAID capital grants for equipment in each participating industry
- introductions to Ukrainian energy efficiency businesses who can serve as local partners
- other measures to mitigate ESCO development risk.

The pilot project features are described below:

- Two to four U.S. ESCOs will be solicited through a competitive procurement process to provide turnkey energy services to preselected industrial sites in Ukraine.
- A meeting will be held in Ukraine with selected ESCOs and participating industries to describe the pilot project in more detail and to provide the opportunity for the ESCOs and industry management to meet. One goal of this meeting is to ensure that the ESCOs and industries are compatible.
- The ESCOs will partner with local engineering or ESCO firms.
- A Project Development Agreement will be drafted for each industry and signed by the industry, the LEC, and the ESCOs. This document will define roles, responsibilities, and commitments of the parties to the project.
- The ESCOs and their partner Ukrainian engineering firm will conduct energy audits of the selected industrial sites to identify opportunities for both energy efficiency improvements and load management.
- The ESCOs will arrange a package of financing from one or more sources (described in Section 6.6) for identified DSM measures. The financing will be paid back through an energy services contract between the industry and the ESCO.
- The industry is responsible for making payments for the financing to the ESCO. The intent is that the payments would be no greater then the sum of the savings on the industry's energy bills and the resource payment, thus yielding an immediate positive cash flow for the industry.
- USAID grant money will be available to offset the costs of metering or equipment at each site. A portion of this money will be allocated to each participating industry. The ESCO will specify equipment or instrumentation that will be purchased with the grant monies that the international energy consultant will procure.

- Participating industries will contribute a minimum of 10% of the total capital costs to ensure they have an upfront, vested interest in the project.
- Working with the industry and its serving LEC, the ESCOs will put together a bid for identified dispatchable load. If acceptable to the LEC, the LEC will bid the demand-side resource into the pool. The DSM consultant will develop protocols for submittal of bids to the Energomarket pool. The protocols may include a sample bid proposal form and will include guidelines on the timing and quantity of bid submittals, the payment structure and mechanism, and verification requirements and protocols.
- The minimum pool bid is 2 MW.
- The Energomarket pool must accept competitive DSM bids.
- The ESCOs will specify, procure, install, and start up the DSM equipment and measures at each site. ESCOs are also responsible for verifying savings resulting from the measures. In some cases, the ESCOs may be contracted to maintain the savings.
- The Energomarket pool, using preestablished verification protocols, will verify that the load bid to the pool was in fact dispatchable. Resource payments for accepted bids will be paid by the pool to the LEC and will be equal to the highest accepted pool price bid (generation or DSM) at each hour. The LEC in turn may charge the industry processing fee for their time, then submit the resource payment to the industry.

6.2.2 Financing and Contract Structures

Project Finance and Risk Analysis

As part of its procurement design, the DSM consultant will prepare a preliminary project finance and risk analysis, anticipating issues that must be addressed and resolved to close financing for the projects. This will include preparation of a preliminary credit analysis on project payers (i.e., the end users and the LECs as applicable and with available information).

The following type of financial information will be requested from prospective industries:

1. financial statements — income statement, balance sheet, annual and quarterly budgets, budget projections, description of budget procedures.
2. revenues
    - historical (last three years) revenues and sales, in production units and currency units
    - projected revenues, next 3-5 years
    - breakdown of methods/forms of revenues earned, i.e., barter and use of bartered items (for raw materials, compensation exchanged for raw materials, barter for other finished goods that are exchanged for currency)
    - key customers, concentration of sales, financial stability of customers
    - export earnings
    - revenue support from state/government, basis and future outlook for revenue support
3. cost structure
    - breakdown by raw materials, labor, communal services, energy and utilities, general and administrative, historical and projected values, including future uncertainties
    - imported inputs or materials and foreign exchange requirements (export earnings balances)
    - utility bill payment history and methods of payment to utilities
    - Capacity utilization and production: history and projections

4. balance sheet and existing banking relationships
   - existing debt obligations, term, payment schedule, lender
   - prior foreign currency loans
   - banking relationships and references
   - willingness to take hard currency loans to finance energy efficiency projects
   - capital budgeting procedures, current capital budget and capital spending priorities, including description of projects, energy efficiency/productivity linkages for current priority capital projects

5. ownership structure
   - description of privatization process under way
   - stockholders and owners (identify and break out ownership shares), background, resources, equity commitments

6. general business description
   - description of products, markets and customers, market share, distribution system, labor relations, management and their resumes/background, current production processes
   - international competitive status of company, i.e., prices of their products versus international prices
   - business relationships with other Western companies, as customers, distributors, suppliers, consultants, lenders, etc.

Similar information (as applicable) for the LECs will also be requested.

A risk analysis of the project contract structure, indicating evaluation and allocation of key risks, and a preliminary loan memorandum for prospective lenders will be prepared. The DSM consultant will identify prospective project lenders, introduce them to this program, solicit their interest and advice on credit and financial structuring matters, and determine, to the extent possible, their criteria and financing terms for financing projects generated by this program.

As described in Section 6.6, prospective financing sources include the EBRD, the International Finance Corporation (IFC), the World Bank, and commercial project finance lenders. Particular attention will be paid to EBRD and IFC; creation of a formal, explicit financing facility for projects generated by this program will be explored. The results of this research will be shared with ESCOs during the RFQ, selection, and project development period. The goals of this effort are to lower barriers to entry for prospective ESCO participants and assure that projects developed will ultimately be financeable.

As a condition of financing, it is likely that a large portion of project payment streams must be in the form of hard currency payments from end users. Their willingness to commit these resources remains to be confirmed. Since the quality and extent of readily available financial information are limited in Ukraine, extra development costs associated with preparation of high quality financial information (income statement and balance sheet) on the site business operations will be incurred.

Mitigating ESCO Development Risk

Significant effort will be made to make this opportunity attractive for U.S. ESCOs and to mitigate their development risk. In addition to the preparations discussed above — preparing the site managers, assistance with project development and financing, etc. — two other mitigation methods will be explored. First, the Project Development Agreement can include breakup fees, which the end user would pay to the

ESCO if the end user did not go forward with contracts to implement projects that met the minimum defined economic criteria. The willingness and ability of site management to commit to breakup fees remain to be determined.

Second, the DSM consultant will explore and attempt to secure concessionary financing for project development costs. Potential sources include the World Bank Global Environmental Fund (GEF), the U.S. Trade Development Agency (TDA, part of the Department of Commerce), and International Fund for Renewable Energy and Efficiency (IFREE).

USAID Capital Grants

USAID is providing capital grants for equipment costs for the six sites. These monies will be made available to selected ESCOs for equipment purchases. The monies may be used during the project development period for on-site metering equipment or implementation of low cost efficiency measures. The ESCO and end user will specify the equipment, which must be of U.S. manufacture. The DSM consultant will buy the equipment subject to USAID procurement regulations and the specifications and directions of the ESCO and end user. The U.S. ESCO can specify foreign equipment if it is funded with non-USAID financing. The allocation of these monies between sites remains to be determined. There will probably be a minimum amount per site, with some portion of the monies to be allocated following negotiation of the Project Development Agreements.

Contract Structures

The parties involved in the ultimate transactions anticipated by this program include the ESCOs (and their equipment suppliers, subcontractors, and Ukrainian partners), the end user companies, the LECs, and the Energomarket. Several possible contract structures are described below.

1. ESCO/End User Energy Services Agreement. This primary agreement will address all ESCO services, including equipment installation and commissioning, equipment performance standards, operations and maintenance, measurement and verification of savings, and performance guarantees. End-user payments to the ESCO and the disposition of the equipment, including ownership, insurance, termination, and other provisions, will also be addressed. Financing for projects will be provided via the ESCO or arranged by the ESCO to be provided directly to the end user. The ESCO and the end user may create a separate project-specific joint venture for the purposes of the project.

2. LEC Contract. The LEC will have a contract with either the end user or the ESCO (or both) concerning the program and the sale of DSM resources (dispatchable load) to the LEC. LEC payments for sale of DSM resources will be made to the end user or through the ESCO to the end user. These payments will be accounted for in the ESCO/end user agreement and be incorporated into the ESCO's compensation in some fashion.

3. LEC/Energomarket DSM License Provision. This provision will include forms and protocols for bidding and payment for spot sales of DSM resources to Energomarket. The bid will include the following components: quantity of load reduction, time and duration of load shedding, price, and measurement and verification methods.

6.2.3 Marketing Strategy

During Phase 1 of this project, candidate industries were selected by the former Dneproenergo and Vinnitsaenergo for participation in this pilot project. Subsequently, site visits were conducted for the 10 sites selected — 7 industrial sites, a hospital, a school, and a water pumping facility to market the project and to assess their economic viability, willingness to participate in the pilot project, and their DSM potential. A summary site report for each of these sites is included in Appendix B.

Sites were selected based on their energy load size, energy savings potential, level of interest in the project, the response of their respective energo management, relative financial stability of the site operation, and ability to make payments in hard currency. Detailed information gathered on energy cost, consumption, tariffs, and load profiles as well as the background and financial information on the sites will be appended to the ESCO RFQ. Six of the 10 sites will be selected for participation in this program.

The procurement process will be discussed and modified with input from key management for each site and LEC. Site managers may be asked to prepare written statements of their objectives for participation in this program. Their priorities and decision-making procedures will be fully vetted. This process is critical for achieving mutually agreeable contracts in a timely fashion. Managers will be briefed on what to expect; the types of proposals, contract arrangements, and terms that will be offered; and what will be required of them. Their assent to participate after these discussions will qualify them as “decision-ready” before RFQ issuance.

6.2.4 Field Delivery and Implementation Issues

Following is the planned schedule for the procurement. The draft RFQ is scheduled to be completed in late November 1995 and then made available for industry comment. The National Association of Energy Services Companies (NAESCO) will assist in soliciting and gathering comments from its membership. In January 1996 the DSM consultant will go to Ukraine to conduct site visits. All sites and LEC management will be contacted to brief them, obtain their input, and prepare them to make decisions during the procurement process. The DSM consultant will issue the RFQ by February 1996 with a proposal response date of March. Since the proposals will primarily require only qualifications and general approach to the project, a one month period has been deemed adequate for response. No site visits and relatively little site-specific proposal information will be required in the RFQ responses.

The DSM consultant will review proposals and, in conjunction with a USAID representative (and potentially one or two Ukrainian representatives), will select a maximum of two proposers per LEC region, for a minimum of two and a maximum of four proposers. Proposers may indicate which sites they want to pursue. Selection at this stage will be made based on evaluation criteria defined in the RFQ, including qualifications, experience in Central and Eastern Europe, technical approach, and financing and contracting approach. Selection will be made within 30 days following receipt of proposals and is scheduled to take place by April 1996.

Once this initial screening has been conducted, the DSM consultant and an interview team that includes representatives from the respective sites and LECs will conduct interviews in Ukraine with the selected proposers. Thus, the LECs and the individual sites will participate in selecting the ESCO for contract negotiations. These interviews will take place in mid-May, thus allowing over 45 days for selected ESCO proposers to arrange for their Ukraine trips. Selected ESCOs will provide proposal materials translated in Russian before the interviews. Selection and notification of contractors will be made immediately after the interviews. The parties will then negotiate a Project Development Agreement for each site. The DSM consultant will assist in these negotiations. A term sheet describing anticipated provisions of the Project Development Agreements will be included in the RFQ and reviewed with site and LEC managers Before to RFQ issuance.

The Project Development Agreement will define the process to develop projects and the mutual roles, responsibilities, and commitments of the parties during this process. The conclusion of the project development period will be marked by the execution of the operative contracts, including an Energy Services Agreement between the ESCO and the site, and the closing of project financing. Project Development Agreements are commonly used in the ESCO industry to carry a project past the point of confirming a facility’s energy savings potential and to justify the ESCO’s investment to develop detailed engineering, firm pricing, and guarantees, and final contract and financing arrangements.

The DSM consultant will be fully engaged during the project development period to facilitate communications, assist in contract development and negotiations (representing the sites and LECs), further define the methods for sale of DSM resources to the Energomarket, assist in financing arrangements, manage the grant monies of USAID and other concessionary sources of financing, and provide other assistance as applicable.

The LECs will be involved during project development to assist with customer power planning, provide load data, possibly negotiate contracts with ESCOs and end users, complete mechanics for sale of DSM sale of resources, develop load management, value system load management benefits, and generally assist with program development. The LECs have each appointed a key person for administration of this program.

Load Management Bidding

On any given day that a participating industry has dispatchable load available, they may submit an hourly bid to the Energomarket pool through their LEC according to established protocols. The bid will specify the MW load they can dispatch, the hours during which they can supply the load curtailment, their bid price, and how the bid will be verified. It must be submitted 24 hours before the load is proposed to be dispatched. The bid must pass two screens — the LEC's screening and the pool screening. First, since the bid must be submitted through a LEC, the bid must be approved initially by that LEC. Other than for special customer relation purposes, the LEC generally will only approve a bid if it is for a peak load period in which the LEC is purchasing power for a wholesale price higher then their retail price, i.e., only if they project that they will be losing money on power sales during those hours. In this situation, the bid will reduce the LEC's costs. If the LEC approves the bid, it will aggregate all of the acceptable bids, add a processing fee, and submit them to the Energomarket pool.

The Energomarket pool reviews all supply-side bids received in relation to the needed load for those hours. As explained in Part 1 of this report, the pool will accept generation and DSM bids sufficient to supply the anticipated demand at each hour. A DSM (dispatchable load) bid will be accepted if it is less than the marginal generation bid. A DSM bid will reduce wholesale rates when the percentage reduction in the marginal bid is greater than the percentage reduction in the system demand. An example of the economics using simulated pool pricing is shown below.

If the DSM bid reduces the pool price from 4.0 cents/kWh to 3.9 cents/kWh (a 2.5% reduction) and reduces system demand from 30.0 GW to 29.5 GW (a 1.7% reduction), then the pool will make payments of (29.5 + 0.5) million x 3.9 cents/kWh = $1.7 million for one hour of electricity resources. To recover these costs, it must charge $1.7 million/29.5 million kWh = $0.0397/kWh, so wholesale rates have been reduced. However, if the pool were to accept twice that amount of DSM (1.0 GW) at the same bid price, then demand would be reduced by 3.3% and wholesale rates would have to rise to $1.17 million/29 million kWh = $0.0403/kWh. In this case, because the DSM increased the pool price, the pool would not accept the bid.

The Energomarket verifies that the generation or DSM resource bid into the pool was actually received according to the verification plan submitted. This verification takes place seven days after the resource is delivered. Once receipt has been verified, the Energomarket will submit a resource payment to the bidding LEC, who in turn will pass the resource payment on to the bidding industry (less an administration fee).

Industrial customers must be sufficiently motivated to be willing to reduce their load during peak periods. Based again on simulated pool prices, the following example demonstrates the total amount of resource payments an industry could receive if a 10 MW dispatchable load curtailment was made available (and bid) to the pool during peak periods. The pricing used in this example are likely prices based on simulated pool prices over a one year period. The actual accepted bid prices are subject to conditions at the time of submittal. (To simulate pool prices, the year was divided into winter, shoulder, and summer weekday and weekend periods. As was explained in Part 1 of this report, the electric system load peaks in the winter.)

Exhibit 6-1 shows that there are 2,150 hours during the year in which a 10 MW load bid for 3 cents/kWh would receive a resource payment. If the 10 MW load was bid for each of those hours, the resource payment over a year would be $826,975. The LEC, however, will require a small "administrative fee" for bidding those resources to the pool. Note that based on these simulated prices, no DSM bids would be accepted during the summer months because the system peak can be met by lower cost generation.

It should also be noted that 2,150 hours represents the total number of hours during which a 3 cents/kWh bid would be accepted by the pool. There may not be any industry that is willing to shift or curtail load for that many hours. Referring to Exhibit 6-1, to receive this total resource payment would require the example industry to shift or curtail the 10 MW load for 1,105 hours over the 65-day winter weekday period. This averages 17 hours per day. While this represents the maximum achievable resource payment at that rate, it is more realistic to expect that any one industry may actually be only willing to bid for a portion of those days and hours.

Alternatively, if the industry was only willing to shift or curtail load for 4 cents/kWh, they would be able to receive a resource payment at that rate for 280 hours per year. This would result in a total resource payment of $159,200. Again, the LEC will require an administrative fee in order to process the bid.

In addition to the resource payment, shifting load off-peak or curtailing load may also reduce a customer's energy bills and affect production rates, labor costs, or other factors. All of these factors must be taken into account when determining the net benefit to the customer of load management bidding.

6.2.5 Verification

Verification of load management will be essential for payments by the pool. Simple comparisons of use before and after load management will not be acceptable, since these approaches do not take into account changes not related to load management that may have occurred anyway; e.g., if load management was bid for an hour with a shift change, much of a measure load reduction may have normally occurred. In addition, it would be easy to "game"

Chapter 7 - 6Program Administration and Schedule

This final chapter of the industrial DSM Demonstration project design for Ukraine details some of the practical administrative issues of project implementation. The overall project structure presented indicates the various organizations that would be involved in project implementation and their respective roles and relationships. Following that is a proposed schedule. The chapter concludes with a discussion of the tracking system requirements for record keeping and data management.

7.1 Organization

Each of the pilot projects will be organized and managed differently. However, a variety of organizations will be involved in some way in both of the pilot projects. Exhibit 7-1 shows the key parties that will be involved in the Load Management Pilot Program. Exhibit 7-2 shows the key parties that will be involved in the Energy Efficiency Pilot Program. The specific relationships between the parties and their role in the implementation of each of the pilot projects are discussed below.

It is assumed that the LECs would be the central management and administrative leads in the development and implementation of the Energy Efficiency Pilot Program. The Load Management Pilot Program would be organized and administered by an international DSM consulting firm in cooperation with other project participants. Other key participants would be an expert international DSM consulting firm to support the LECs, the implementation contractors and consultants (perhaps a half dozen or more individuals, firms, and ESCOs specializing in audits, engineering analysis, end-use metering, and installation), a coordinating committee, and other interested agencies and parties such as equipment vendors, engineering firms, business and professional associations, university faculty, and nonprofit groups.

The coordinating committee established for the original Ukraine Demand-Side Management Project, the Coordinating Committee on Development of a Draft for a System for Demand-Side Management for the Ukraine, will continue to serve in an advisory capacity for the final pilot project designs and implementation. The original members that will continue to serve on the committee and proposed new committee members are shown in Exhibit 7-3.

Appendix A

Definitions

Appendix B

Site Data Request Form

Site On-Site Discussion Guide

Focus Group Interview Guides

Appendix C

Technical and Economic Characteristics of Potential DSM Measures

Cost of Saved Capacity (CSC)

Cost of Saved Energy (CSE)

Appendix D

End-Use Load Research

List of Seminar Attendants

Site Visit Contacts

Detailed Training Outline

Data Collection and Download Procedures

Rustrak Ranger Meter Information and Setup Programs

Rustrak Ranger Site Date (graphs)

Weekday and Weekend Load Shapes for Selected End-Uses

Appendix E

Summary of Recommended Measures

Site Reports

Site Load Profiles

Acronyms

ACEEE	American Council for an Energy-Efficient Economy
AEE	Association of Energy Engineers
ASD	adjustable speed drive
CEM	Certified Energy Manager
CFL	compact fluorescent lamp
CHP	combined heat and power
C&I	commercial and industrial
CSC	cost of saved capacity
CSE	cost of saved energy
DSM	demand-side management
EBRD	European Bank for Reconstructive Development
EPRI	Electric Power Research Institute
ESCO	energy service company
GDP	gross domestic product
GOU	Government of Ukraine
HVAC	heating, ventilation, and air conditioning
I&C	interruptible and curtailable
IES	Independent Energy Supplier
LEC	local electric company
MDB	multilateral development bank
M&V	monitoring and verification
NERC	National Energy Regulatory Commission
NAESCO	National Association of Energy Service Companies
OECD	Organization for Economic Cooperation and Development
RFP	request for proposals
RFQ	request for qualifications
T&D	transmission and distribution
TOU	time of use
TRC	total resource cost
USAID	United States Agency for International Development
WB	World Bank