Demand-side management data collection activities: The role of a national government

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1. SYNOPSIS

This paper describes the demand-side management (DSM) data collection activities of the U.S. Department of Energy (DOE).

2. ABSTRACT

The availability of comparative information about the true costs and benefits of DSM programs greatly increases the prospects for successful implementation of utility-sponsored demand-side management (DSM) programs. National governments have an important role to play in providing these data in a neutral and unbiased fashion. The beneficiaries include utilities, regulators, policymakers, equipment vendors, manufacturers, and researchers.

This paper describes four DSM data collection programs, sponsored by the U.S. Department of Energy's Integrated Resource Planning Program and include: (1) the Database on Energy Efficiency Programs (DEEP), (2) the Center for Electric End-Use Data (CEED), (3) annual DSM program reports by U.S. utilities, and (4) a triennial survey of residential, commercial, and manufacturing energy users. The last two data collection programs are carried out in conjunction with DOE's Energy Information Administration. The descriptions include types of data collected, intermediate analysis activities, and methods for disseminating information to users.

3. INTRODUCTION

Utility demand-side management (DSM) activities include all utility efforts to influence their customer's energy use.[1] Among these activities, which can also include rate design and load building, customer energy efficiency and load management programs have emerged as explicit new resource options that may partially or wholly substitute for new utility generating plant construction. Yet, promoting customer energy efficiency, for example, is a rather unprecedented activity for utilities which are more familiar with building power plants, operating reliable transmission networks, and selling electricity.

A primary challenge for utility demand-side management is the new data and analytical requirements associated with influencing customer's energy use. Issues to be considered include: the availability, cost, and performance of demand-side resources, the resource value of these resources as alternatives to utility supply options, and the programs and strategies available to acquire them.

It has been observed that a primary rationale for utility promotion of customer energy efficiency is that significant information barriers prevent energy markets from working efficiently (Krause and Eto 1988). While this observation is generally cast in the context of factors affecting consumer behavior, it is equally true of factors influencing utility behavior. Many utilities have only a rudimentary understanding of the energy services provided through their customer's energy use, and even less of the options for meeting these energy service needs more efficiently.

A fundamental rationale for the involvement of national governments in energy markets is to address these (and other) barriers to the efficient operation of these markets. This paper describes four inter-related activities sponsored by DOE which provide information needed to make rational utility energy resource

decisions. These activities included: (1) The Energy Information Administration's Electric Utility Report, (2) The Lawrence Berkeley Laboratory's Database on Energy Efficiency Programs, (3) The Electric Power Research Institute's Center for Electric End-Use Data, and (4) The Energy Information Administration's End-User Surveys.

Each activity reflects a distinct information requirement that is best undertaken on a collective or national basis. In other words, DOE has undertaken each of these activities in view of several considerations: (1) the importance of the information for the smooth functioning of economically efficient energy markets, (2) the absence of private sector participants to provide this information, in lieu of the government, and (3) the essential role of a national government as an un-biased or neutral provider of this information.

4. ANNUAL ELECTRIC UTILITY REPORT

Prior to 1989, there was no comprehensive survey of utility DSM activities.[2] At best, anecdotal evidence from individual utilities was used to make projections. While this situation was understandable at a time when utility DSM activities were marginal activities for most utilities, DSM is now being aggressively pursued by a variety of utilities as a direct resource alternative to power plant construction. Thus, to the extent that DSM activities account for a significant share of the utility's resource portfolio, the nature and extent of these activities assumes additional importance relative to traditional utility activities. National governments, therefore, have the same responsibility to monitor demand-side activities, just as they have always monitored traditional utility supply-side activities (such as fuel consumption or capital expenditures), which is to ensure adequate, reliable, and reasonably priced energy services for consumers.

DOE's Energy Information Administration (EIA) is charged with providing comprehensive and up-to-date information on the functioning of the nation's energy supply systems. For electricity, this involves the collection of data annually from over 3.000 investor-owned, publicly-owned, federal, and cooperative utilities.[3] The surveys have traditionally focused on supply-side questions, such as the amount and cost of fuel purchased for a utility's annual operation. However, in 1989, EIA revised its Annual Electric Utility Report (Form EIA-861) to also include DSM. All utilities, with the exception of those which had annual sales of electricity less than 120.000 MWh, are now required to answer questions about the size and cost of their DSM activities. This reporting requirement has resulted in the first comprehensive national collection of information on utility DSM activities.

The findings from the most recent EIA survey indicate that utility DSM activities have grown dramatically, from about 720 million ECU ($900 million) in 1989 to over 1.4 billion ECU ($1.7 billion) in 1991 (EIA 1993). Of the nearly 1.200 reporting utilities (i.e., those with annual sales in excess of 120.000 MWh), 439 have DSM programs designed to reduce demand or electricity consumption. Utility DSM activities to date have emphasized load management. According to the survey, utility DSM activities are reducing summer peak demands by 16.700 MW (or 3 percent of U.S. summer peak loads) but saving only 23.000 million kWh (or less than 1 percent of total electricity consumption) annually.

The survey also indicates that the contribution of DSM is expected to grow significantly, with an increase emphasis on energy savings. By the year 1996, DSM capacity savings are expected to almost double, while DSM energy savings are expected to more than double. Utilities anticipate spending about 2,9 billion ECU ($3,5 billion) annually to secure these savings.

In 1992, the growth in utility interest in DSM as a resource option led to major revisions in the types of data collected by EIA. For example, future surveys will now request information on DSM activities separately by sector (e.g., residential, commercial, industrial, and other) and by DSM objectives (e.g., energy efficiency, load management, etc.). In addition, more detailed information on DSM expenditures (e.g, customer incentives, program administration, etc.) will also be collected for inclusion in EIA publications starting in 1994.

5. DATABASE ON ENERGY EFFICIENCY PROGRAMS

Utilities and regulators are interested in the overall effectiveness of demand-side management programs and want to know how to implement programs that will have high participation rates and large energy savings at reasonable costs. Yet, promoting customer energy efficiency is a new activity for utilities and experience in delivering energy efficiency programs cost-effectively is not widespread. A major source of such information is a DSM program evaluation, usually produced to satisfy a regulatory requirement for recovering the costs of operating a DSM program. Unfortunately, these evaluations are not readily available to program analysts in other utilities who are involved in designing, implementing, and evaluating DSM programs. Many energy efficiency programs are being conducted without the benefit of the experience gained by other utilities offering similar programs. Moreover, there has been very little synthesis of information across programs. For example, the determinants of program participation have not been systematically assessed among various program designs in order to determine which delivery techniques work best and why, and more importantly, what can be successfully transferred to other program types, customer classes, or service territories.

The Database on Energy Efficiency Programs (DEEP) is being developed to answer this need (Vine 1992). Whereas the goal of EIA's annual DSM data collection activities is to assess the scope and magnitude of U.S. utility DSM efforts in aggregate, the immediate goal of DEEP is to develop a publicly available, unbiased, and critical compilation and synthesis of the performance of individual utility customer energy efficiency programs. The overall goal of the project is to lower the costs of utility promotion of customer energy efficiency by reducing or eliminating the need for utilities to 're-invent the wheel' with each new DSM program plan or program design, and hopefully, to avoid costly mistakes.

The origin of the DEEP project was a study performed by the American Council for an Energy-Efficient Economy, called *Lessons Learned: A Review of Utility Experience with Conservation and Load Management Programs for Commercial and Industrial Customers* (Nadel 1990), in which over 200 utility DSM programs were systematically examined to determine the factors leading to successful programs. DEEP will significantly expand upon this initial data collection by adding new information (and new program data) as it becomes available. Steady-state funding for the project is expected to be between 0,4 million ECU ($0,5 million) and 0,6 million ECU ($0,8 million) on an annual basis. The project, which is being developed and managed by the Lawrence Berkeley Laboratory (LBL), is expected to last 5 years and begins full-scale operation in the Summer of 1993.

The database itself will contain detailed information on all critical program design features and performance. Anticipated DEEP data fields include energy efficiency program descriptions (type, affected end uses and sectors, marketing methods, incentives, etc.), participation rates, program costs (administrative, evaluation, incentives paid, etc.), and program savings (energy and peak demand). Particular emphasis is being placed on the methods used to assess energy savings, which can range from simple engineering estimates to detailed end-use metering. The data will be collected from publicly available sources, such as filings by investor-owned utilities to state regulatory commissions and through interviews with utility staff. Unlike the EIA data collection, contribution of DSM information to DEEP is voluntary.

Dissemination of DEEP project findings is a central element of the research plan. The DEEP database will be made publicly available through on-line access. In addition, LBL staff will utilize the database to produce regular reports on selected topics of interest (such as commercial lighting programs, or compendiums of utility measurement and evaluation activities). The first report, on commercial lighting energy efficiency programs, is scheduled for release in mid-1993.

6. CENTER FOR ELECTRIC END-USE DATA

Integrating supply and demand resources requires detailed information on the structure of energy demand. For electricity planning, this detail must be represented at an hourly level of resolution. Yet, electric end-use metering to develop this data is very expensive and time consuming. It comes as no surprise, therefore,

that there are less than 100 U.S. and Canadian utilities with existing or planned end-use metering activities (Scheer and Brown 1992). Of these, only a handful boast metering samples of more than 100 sites.[4] The high cost of end-use metering has precluded the development of large, statistically significant samples from which the energy use patterns of utility customers (in aggregate) can be characterized reliably.

In 1987, a power marketing agency, engaged in a large end-use metering project, proposed a concept for sharing end-use data they had collected with other utilities. DOE conducted a survey of utilities and regulators to determine whether the level of interest in end-use metered data was sufficient to support the creation of a clearinghouse for the sharing of these data. The results of the survey were very positive and, in 1991, with EPRI's agreement to assume management and significant funding responsibility, the Center for Electric End-Use Data (CEED) was formed to help utilities more effectively satisfy their end-use data needs.

The goal of CEED is to be a key resource to utility staff by addressing a wide range of critical end-use data issues, including: (1) improving understanding of how electricity is actually used in homes, businesses, and factories, (2) verifying or validating the energy and peak demand impacts of utility DSM activities, (3) developing more accurate sales and peak demand forecasts, (4) designing and implementing successful end-use metering projects, and (5) minimizing the guesswork often associated with engineering and statistical simulations to develop end-use data.

CEED, like DEEP, is based on a strong commitment to technology transfer. CEED publishes a quarterly newsletter on recent breakthroughs in metering applications and approaches, and on lessons learned in managing complex end-use data gathering and analysis projects. CEED also plans to offer a technical monograph series, seminars, workshops, and consultations to help facilitate the development and exchange of metering experiences and data. The previously cited national survey of end-use metering projects is an early CEED product. All CEED products are available through EPRI.

A core element of CEED is the Data Request Service (DRS), which became operational in the fall of 1992. Through the DRS, access is being provided to end-use and characteristics data that have been contributed to CEED by utilities. By contributing data, utilities will have the opportunity to share findings and experiences without having to bear the burden of responding directly to data requests from others.

DOE and EPRI have been joined in funding CEED by a number of individual utilities and by a national utility organization representing small cooperative utilities, many of whom are just initiating DSM efforts and have limited access to end-use data. The CEED business plan envisions an annual direct budget of 0,7 million ECU ($0,8 million).

DOE played a key and unique role in CEED's initiation by providing start-up funds to determine the interests of the utility industry in the very idea of having such a center. DOE continues to support CEED through two means: direct sponsorship and coordinated research. In this latter regard, DOE is supporting its national laboratories to conduct research, coordinated with CEED, and to develop and enhance analytical methods that will facilitate meaningful transfer of end-use metered data between utilities.

7. END-USER SURVEYS

EIA, in addition to its survey of electric utility DSM activities, also conducts three, triennial surveys of energy users (EIA 1990). Separate surveys collect information on the annul energy use and characteristics of residential, commercial, and manufacturing energy end users. Unlike the annual survey of electric utilities, which collect data from all utilities, the end-user surveys are administered to random samples of energy users drawn from the U.S. population. Therefore, unlike the DEEP and CEED data collection efforts, direct inferences can be made to the entire population through the use of statistical weights developed as part of the sampling process.

Information on the energy use characteristics of the survey respondents are collected through personal

interviews of building managers, owners, or tenants. Following the collection of this information, authorization is requested to receive energy use information directly from the relevant suppliers (electricity, natural gas, fuel oil, district heat) with a mail survey. In addition, usage of other energy sources, such as wood, propane, coal, and solar, is determined.

Consumption and expenditures of major energy sources are presented in the form of net aggregate totals as well as consumption per building and dollars per BTU. Energy use intensities, which adjust energy use for the effects of, for example, size of building, number of workers, or number of operating hours, are also presented to facilitate comparisons of energy use across time, fuels, and buildings. The recent survey of commercial building consumption and expenditures, for example, presents estimates for the following categorizations: (1) building structure, (2) building use, (3) building size, (4) building age, (5) geographic location and climate zone, (6) energy source, (7) energy end use, (8) major end-use equipment, and (9) energy management practices.

Many utilities also collect this type of (and, indeed, often more detailed) information using much large samples. But utility-sponsored data collection activities are proprietary and, in any case, are restricted to a single utility service territory. Thus, the value of the EIA data collection activity is twofold. First, the data are collected using a standardized data collection instrument administered to a statistically-derived random sample. Therefore, the results can be used to make statistically-based inferences about the entire U.S. population of energy users. Second, for all utilities, the EIA data provide an important complement to existing data collection activities. For the many utilities not yet engaged in conducting end-user surveys, the EIA data becomes their primary source of information on how energy is being used.

8. CONCLUSION

The U.S. Department of Energy, an agent of the federal government, is engaged in a variety of demand-side data activities that collectively support utility acquisition of cost-effective DSM, as an important new resource option for integrated resource planning. Through the Energy Information Administration, aggregated data on the performance and cost of utility DSM are being collected to track the role of this new resource option in the Nation's utility resource portfolios. The Database on Energy Efficiency Programs is lowering the cost of implementing customer energy efficiency programs by compiling, assessing, synthesizing, and disseminating utility experiences in developing these programs. In a similar fashion, the Center for Electric End-Use Data is making expensive and hard-to-collect end-use information more widely available to utilities either not yet engaged in end-use data collection activities or in need of a quick and less expensive source of data. Finally, EIA's end-user surveys provide a statistically-based representation of how energy is being used in the U.S. economy.

Each activity illustrates a unique and critical role that a national government can play to improve economic and environmental well-being through provision of the information needed for the efficient operation of energy markets. That is, each activity fulfills an information need that is best met, at lowest cost, by coordinated federal, rather than individual, efforts. Moreover, federal involvement is crucial because of the role the federal government has as an un-biased or neutral provider of demand-side information.

The benefits of integrated resource planning cannot be acquired by the operation of the energy markets alone because these markets are hampered by significant barriers to their efficient operation. National governments have an obligation to address these barriers. This paper has described four related activities sponsored by the U.S. Department of Energy to address those barriers created by the absence of reliable information on true costs and benefits of demand-side resources.

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ENDNOTES

1. The original definition of demand-side management developed by the Electric Power Research Institute (EPRI) included six distinct load shaping objectives: peak clipping, valley filling, load shifting, strategic conservation, strategic load growth, and flexible load shape.

2. The Electric Power Research Institute did perform annual surveys of the types of DSM programs offered by its members, but these surveys did not report aggregate expenditures, savings, or projections.

3. U.S. electric utilities sold over 2.600 billion kWhs in 1989 to 109 million ultimate customers. Despite the large number of electric utilities, the 205 investor-owned utilities account for 76% of ultimate customers. The 1.994 publicly-owned utilities account for 14% and the 956 cooperatives account for the remaining 10% of ultimate customers (EIA 1992).

4. Sample sizes for whole-premise electric load metering for load research and rate design studies routinely run in the hundreds. Sample sizes of more than 1.000 meters are not un-common in larger U.S. utilities.

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