Gas Collaborative Issues in Maryland: Implementation of Gas Demand Side Management (Gas Conservation) Programs by Local Gas Distribution Companies Subject to the Jurisdiction of the Public Service Commission of Maryland

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This paper describes the theory and reality of pursuing DSM programs from one perspective of state regulatory staff. These are the activities and capabilities needed to develop and implement DSM programs 1) to identify the range of potential DSM programs, 2) to evaluate the potential market for each DSM program considered, 3) to evaluate the benefit-cost character of each DSM program proposed for adoption, 4) to choose and implement specific DSM programs, 5) to measure the impact of each DSM program offered, and 6) to evaluate the impact of each program.

Introduction

Pilot program development is likely to be a cost-effective way to determine how efficient full-scale conservation programs will be. Table 1 summarizes the several steps involved in the orderly development and implementation of gas conservation programs. This five-step process reflects the task breakout (as the Public Service Commission Staff [Staff] has discussed the scope of work) that the smaller LDCs might have to undertake in developing their conservation plans for Maryland.

Program monitoring and evaluation are critical to DSM efforts. Evaluation is a multipart effort that requires relevant data and appropriate analytical techniques by which one might review 1) the program's impact, and 2) the process by which DSM service is delivered. Absent effective evaluation of a program's implementation process and program impacts, neither the private nor public objectives of DSM programs will be secured. Unless evaluation is considered concurrently with the development of possible DSM measures, effective evaluation is unlikely to be achieved. In a real sense, evaluation begins just as soon as one initially considers those programs for possible inclusion in the LDC's program.

Methodology

LDC Size and Capabilities for Gas DSM

Although all of Maryland's Gas DSM plans must be judged by the same set of factors, each LDC's proposal will be measured against specific criteria appropriate to the size and capabilities of that LDC. The jurisdictional companies vary in what they can afford for appropriate programs and the infrastructure necessary to implement those programs.

The company infrastructure required for a utility to develop a natural gas DSM program is the hidden fixed cost of these energy conservation programs. These costs are hidden in the sense that one seldom considers the specific capabilities that a company must marshall in order to design and implement a given program.

These capabilities are constrained in a scale economy sense. There is, arguably, a minimum effort that must be mounted if the planning process is to be effective. If the LDC cannot find the resources to mount this (as yet

Table 1. Natural Gas Conservation (Demand-Side) Activities

A. Pre-Planning Review

1. Estimate consumption per customer.
2. Estimate natural gas end-use consumption.
3. Estimate appliance/equipment sales.
4. Estimate building stock features.
5. Compile range of estimates.

B. Pilot Program Planning

1. Develop list of all cost-effective measures.
2. Screen measures for a variety of factors.
3. Select investment level.
4. Select pilot programs.
5. Determine IRP cost recovery mechanism.

C. Pilot Program Implementation

1. Develop sample size and characteristics for each pilot program.
2. Determine evaluation criteria.
3. Implement pilot program measures.
4. Begin data collection.

D. Process Evaluation

1. Select methods of data collection.
2. Determine data format.
3. Note analytical limitations for LDC DSM evaluations.

E. Pilot Program Evaluation

1. Compile data from pilot program.
2. Analyze data according to specified parameters.
3. Determine changes (if any) to program features.
4. For iterative testing, go back to step C.
5. To complete program cycle, prepare evaluation report.

undefined) minimum effort, then the planning effort will probably prove to be wasteful and ineffective. Each of the requisite planning inputs is subject to a minimum size constraint that probably exceeds the ability of some LDCs to afford that input.[3]

For any given service area, one could consider implementation of programs deemed effective elsewhere without first identifying the potential demand for the program. That course of action should not be followed when the programs involve subsidies or other costs which would not be borne by the program beneficiaries. If non-beneficiary ratepayers or other parties are to pay all or part of the program costs then they must know the extent of their financial commitment.[4]

The smallest companies might be limited to programs demonstrated to be successful by the largest LDCs and to educational efforts which also would reflect experience at other LDCs. As a prerequisite, however, the small LDCs have to develop some competence in DSM concepts and capabilities. Thus, the initial focus of DSM efforts at the smaller LDCs should be the training of LDC staff, introduction to the DSM experience of larger companies, and education of its major customers.

Steps Required When Planning DSM Programs

As indicated above, the significant difference between LDC and electric utility DSM efforts is the greater uncertainty that LDCs encounter at each stage of the planning process. For this reason, the following sections will focus on ways by which LDCs can secure information or develop reasonable proxies for the requisite data: the load research and market data needs, program structure and load evaluation. While the individual steps are applicable to all LDCs, the discussion emphasizes activities that are within the capabilities of the smallest LDCs.

Pre-Planning Review. Pre-planning efforts center on a careful use of energy statistics in order to identify (and then service) energy conservation through pilot programs. Pre-planning efforts are needed to construct a framework for developing unbiased and reliable estimates of energy savings to serve as a basis for informed decisions regarding the feasibility of specific program features, delivery mechanisms, and rebate levels.

Estimating Aggregate Data. This is the LDC's first step for establishing its DSM planning parameters. LDCs must prepare estimates (from the number of customers and total demand) of total and average consumption for all customer classes for the preceding year. This is the most basic necessary information; it provides the benchmark for evaluating gas DSM proposals. Each company knows its prior year's demand and customers by tariff class, so this initial analytical requirement should present no problem.

Developing Ballpark Forecasts. Projections of future natural gas consumption by end-use is the next step. This ballpark estimate should identify appliance end-use consumption for natural gas end-uses such as space heating, water heating, cooking, clothes drying and cooling. Depending on the size and its service territory, an LDC may not have kept statistics on specific appliance saturation.

Even if a utility does not normally identify its heating and non-heating customers, a company's meter books of individual demand can be used to develop estimates of customer uses of natural gas. For residential customers the company can identify ranges of consumption that are believed to reflect basic uses, e.g., home heating and water heating, and, perhaps, the combination of water heating and non-heating uses. For example, one can subtract non-heating season consumption from peak season heating consumption in order to estimate customer heating loads. Admittedly, such estimates will be inexact, but they can provide baseline estimates for comparison with similar information that might be gathered from other sources.

The Potential Equipment Demand. Consumer demand for replacement units and new construction sales of natural gas end-use appliances must then be estimated. This is done to arrive at a loose estimate of a) the likely efficiency of existing equipment and b) the target market for new construction and replacement equipment. The replacement rate can be derived from local vendor installations of space and water heaters as well as national estimates of the average age of equipment, and the likely turnover.

The number of new homes that are (expected to be) completed in a given year will provide a basis for estimating the number and types of gas appliances that would have been installed in new houses in the absence of a DSM program. Some LDCs, particularly those which also service appliances or conduct periodic customer surveys, may have some relevant in-house information that can be adapted to develop these replacement estimates.

Energy Efficiency Characteristics. Specific features of energy use must be estimated for the principal types of buildings that comprise the local building stock for areas of new constraints or year of new constraints. These estimates can also be developed from company or local planning board records that identify those areas in which buildings were constructed with some comparable time period.

Typically, the relevant information includes such data as age, construction type, and thermal integrity. For buildings of any given age class, the construction and thermal characteristics may be estimated in several ways, e.g., by long-time members of the community or local weatherization service providers. An active and knowledgeable LDC sales/service force may also be able to develop useful descriptions of the housing stock served by the LDC.

Baseline Estimates. The baseline is determined using the range of estimates developed in these four efforts, for the a) technical and b) market potential for conservation in the LDC's service territory. This is the basic type of information needed to determine the type and extent of any utility investment in developing appropriate DSM pilot programs.

The technical potential denotes the extent to which high efficiency gas equipment and other conservation measures can be used in that service territory and suggests the likely impact energy conservation measures on current energy uses.

The market potential estimates indicate the extent to which conservation might reasonably be secured through DSM measures over time. The market potential estimates may

be developed from a number of sources outside the utility. The relevant market research data includes estimates of the saturation level of appliances in a utility's service area.

The potential for replacing inefficient residential gas furnace and appliances with energy efficient units is uniquely dependent upon 1) the age distribution of existing gas equipment and 2) net conversions from the use of other energy sources for given applications. The age distribution data may be developed from several sources, including LDC surveys, trade ally (distribution or service contractor) records, company records for new installations, or the application of national appliance distributions to local population data.

When the LDC has data that indicates the age distribution of housing stock, some "educated guesstimates" may be developed about the energy efficiency characteristics of the local housing stock. These estimates may be based. upon the typical construction standards that were prevalent during given time periods, by major builders or in particular housing developments. The analyst may be able to truncate these estimating efforts by focusing largely upon those years in which natural gas may have been secured from an interstate pipeline.[5]

Given, e.g., a distribution of housing for a 100-year period (1890-1990) and the knowledge that natural gas service was initiated in 1965, then the age distribution of current furnace installations could be approximated by first estimating the average gas use for 1960-era furnaces and then estimating the number of furnaces based on total residential class sales in 1960. The approach then could be implemented for subsequent years. The underlying aggregated data might even be adjusted for estimated gas used for other residential applications.

Through such massaging of data, an LDC can develop an estimated age distribution of the residential gas equipment in its service territory. Such age distributions can be used to estimate of the potential demand for new, higher efficiency" equipment by those LDC customers. By applying average lifetime data to equipment age distributions, one can estimate replacement rates. The size of that potential interest in replacement units could, in turn, be used to tailor DSM programs to encourage purchases of higher efficiency equipment. Similar efforts can be used to gather additional information and to estimate the potential for weatherization measures that would secure gas conservation.

Accurate load research data is an important feature of a successful DSM effort. Gas utilities have few if any end use consumption statistics for their service territories. Actual installation or survey data can be used as benchmarks for those years in which such data is available. The process permits iterative adjustments to account for those customers who use gas only for heating hot water or space heating equipment. Information from similarly situated LDCs also could be used for additional benchmark comparisons.

Such data bases constitute baseline estimates of housing stock and energy using equipment that are, admittedly, inexact. Why, then bother to develop such baseline information? These efforts are encouraged, because the alternative is complete ignorance with little hope of future knowledge. The effort is also encouraged, because the compilation process channels our analytical thought processes. The process focuses our attention upon the principal influences of gas usage. The data can be used with broad ranges of reliability. These ranges can be estimated from the personal experiences of LDC personnel or other knowledgeable individuals.

Pilot Program Planning

The next set of planning activities uses the data that was developed in the pre-planning efforts (above) to identify and select appropriate conservation measures and pilot programs.

Appropriate DSM Measures. This list must be developed by each LDC for its service territory and the jurisdiction. This list will be used (as discussed below) to develop a shorter list of all cost-effective measures that might be considered for implementation in a pilot conservation program. The basic list of appropriate DSM measures can be developed from the work undertaken by others. This is one instance in which LDCs will not have to "reinvent the wheel." In Maryland, for example, Washington Gas, Maryland Division, has provided a lengthy list of possible measures in its initial DSM filing. That can serve as the point of departure for the smaller LDCs at this stage of the planning process.

Measure Screening. The selection of energy conservation measures for the DSM program must be conducted for a variety of factors. DSM measure screening can be a very complex task. Screening criteria commonly include estimated energy savings, market penetration rates, estimates of the material and likely implementation costs for each measure.

For a large LDC with a sophisticated market research group, this screening effort may include comprehensive surveys of statistically valid sample groups of customers, detailed end-use data, thermal integrity of buildings, likely equipment efficiency improvements, and estimates of site-specific conservation potential.

For small LDCs, however, the screening process would be considerably less complex. Because of its smaller customer base and investment level, a small LDC might review the measures, screening procedures and program options that were developed by a larger LDC with a similar (albeit larger) service area; the DSM efforts of smaller LDCs are discussed in a subsequent section.

A broad array of energy efficiency options may be developed, and then evaluated, according to a number of criteria. These criteria are likely to include program administration, program action, program technologies, program type, target market, marketing method, program delivery system, utility administrative responsibility, and evaluation. All of these features are included in a DSM program options. All affect the cost and labor resources that are associated with each program.

The utility staff performing the screening would use these categories of detail on each program option to calculate the advantages and disadvantages of several different program options and combinations. It is important to design programs that are cost-effective for the utility and that also fit in with overall IRP objectives.

Appropriate Investment Levels. A utility must carefully select the amount of money to be invested when planning its pilot program. This investment level includes only the money that the LDC is investing in the pilot program implementation; it does not include data collection and evaluation requirements. The data collection and evaluation costs will have to be prepared in light of the initial program measures and scope selected. It may be necessary to cull these initial decisions into a more acceptable financial package as the planning process proceeds.

The limits to DSM investment efforts are the avoided costs that are associated with each proposed conservation measure. Preliminarily, however, the target level of investment can be identified as an acceptable percentage of the ratepayers' bills. After the planning process has proceeded, it may be possible to adjust the investment level to reflect the extent to which all ratepayers might benefit from the conservation efforts being considered.

Pilet Programs. The DSM program must then be composed from those measures which passed the screening test and which also can be implemented for the selected investment level. Delivery mechanisms are also developed at this step, because the delivery mechanisms will involve cost gradations that vary with the program's scale. The selection of winning measures and delivery mechanisms will reflect the incremental savings associated over the range of incremental costs for each delivery mechanism.

The development of DSM programs that are likely to achieve significant energy reductions is an ongoing process. The first round of development efforts usually results in a number of unresolved issues (such as measure or program screening, or incentives), which are left for the second or third round of DSM program development. Consequently, some electric utilities have taken about two years to develop the first round of programs to be included in their least-cost or integrated-resource plans.

Pilot program implementation schedules vary according to program objectives. For example, a pilot demonstration project may have a short-term objective to test a new technology or method, but a boiler/furnace rebate program could have a long-term objective to move the market towards high efficiency equipment in order to reduce consumption over the life of the equipment.

The sequence of tasks in the pre-planning review phase may be accomplished in as little as six weeks or as long as one year, depending on the type of information available. The pilot program planning phase often takes two years to complete. A few pilot programs may be implemented in the second year, but the full array of DSM programs is likely to take at least two years of planning prior to implementation.

Pilot Program Implementation

Pilot program implementation can present a number of challenges to utility managers, particularly when the programs are developed through a collaborative process that seeks to secure common understanding of program implementation. For example, the number of pilot programs to be implemented should not out-pace the utility's ability to deliver and manage the programs. It is widely believed to be wiser to implement a smaller number of programs, two or three at the most, in order to achieve program objectives. The difficulty of fielding more than three programs to begin with is a common complaint amongst natural gas utility DSM managers. This is due to the many details involved in implementing a DSM program, and the limited resources allocated to administration. Ideally, all implementation efforts should be preceded by collaborative agreement about such issues as participant sample sizes, evaluation criteria, delivery of services, data collection, and the method to be used in making any changes to programs. Descriptions of each of these steps are listed below.

Sample Selection. Sample size and sample characteristics should be developed for each pilot program. Statistical integrity must be developed so that subsequent decisions will be as sound as possible. In the larger LDCs

with more extensive resources and DSM programs, sample size may be determined using more complex and sophisticated statistical methods. Where LDCs lack in-house statistical expertise or costs preclude the hiring of an established consulting firm, low-cost options are available for developing statistically sound samples. The simplest method is used by smaller utilities that are under tight budget constraints or in the very beginning stages of developing energy efficiency programs.

By this point, the utility must have determined the significant characteristics of each program. These characteristics include the classification of customers intended for participation in the program and selection of the specific DSM measures to be installed. These decisions will help to determine whether the program should include a rebate, educational material or equipment. The program's marketing or advertising approach is chosen, and its management structure and lines of communication are established within the utility.

Evacuation Criteria. The determination of appropriate evaluation criteria must reflect program objectives. This will influence how the utility will be made accountable for the success or failure of the program. This is especially important whenever utility cost recovery or shareholder incentives are under consideration. Data collection plans are made for each program to outline the type of data to be collected, the time periods to be used, and the method of collection. Depending on the program schedule, data collection may begin with the first installation or may begin at the end of a specified time period, e.g., the end of the heating season.

Pilot Program Implementation. Pilot program or phased implementation of measures must be initiated when all planning tasks are completed. The first piece to be implemented is the marketing plan for the initial program offerings. Several different marketing approaches can be used in implementing a DSM program. The direct mail approach, supplemented with telephone follow-ups to recruit. participants, is a common method for residential and small commercial programs. Door-to-door solicitation and presentation to community organizations have also proven to be an effective methods of marketing.

Local community groups have been used successfully to access target markets and to assist in obtaining an adequate sample of participants in DSM programs. The advantages of such groups as community action agencies, local church or civic groups, schools, housing rehabilitation agencies, and senior citizen groups is the ability of the group's leadership to interpret the utility DSM program to their members and influence participation on a more personal level.

Program Changes. An iterative review and fine-tuning of program measures and delivery systems should occur at this time. As information describing the implementation becomes available, DSM program managers may want to adjust such program features as rebate amounts, participation target and target market. Possible refinements include small changes in eligibility requirements, adjusting rebate amounts for a high efficiency equipment program, adding telephone follow up calls to each participant, and adding or eliminating certain DSM measures in the program. Thus, a program might be considered as unsuccessful and the rebate level reduced if the program reached participation target levels far ahead of schedule.

Pilot programs have two purposes: 1) to indicate the likely efforts of a full scale program, and 2) to permit program adjustments as experience is gained on a particular program. For small LDCs, it's probably cost effective to rely upon the experience of larger LDCs to suggest the effects of a full-scale program. This development and analysis of a sample study seem to be superfluous. The small LDCs have such imperfect information concerning ratepayer population characteristics that sampling would lack its normal value.

After these efforts have been completed, the major concern is how to identify when a program has moved a market sufficiently to permit reduction in program investment or cessation of the program. That thoughtful review of pilot programs comprises the tasks and objectives of process evaluation.

Results

Process Evaluation .

Purpose. Process evaluation methods are used to answer two questions: 1) How was the program implemented? 2) How can service delivery and overall operations be improved? These questions may be answered by collecting and evaluating qualitative information that provides timely feedback on program design and implementation features. The information required in a process evaluation includes consumer behavior, intentions and motivations. DSM program managers will need this information for both participants and non-participants in the DSM program.

As discussed below, the evaluators will use this information (on the opinions and attributes of DSM program participants) to develop a stratified statistical analysis rather than simpler average or aggregate measures. By developing this greater level of detail,

evaluators can give DSM managers important information about such program features as where to target efforts to increase participation, the most appropriate rebate or incentive level, and factors involved in consumer decision-making. Such feedback is used to refine or change programs features in an effort to improve the end results by broadening participation to achieve energy efficiency by consumers. In addition, advertising and information can be targeted more effectively.

Process evaluation can help to improve overall program operations. Data collected within a process evaluation framework can help utility managers to solve program management problems and improve the service from vendors who have been hired to implement (parts of) the DSM program. Process evaluation might identify utility management problems, such as staffing shortages, red tape and paperwork bottlenecks, and inadequate communication between utility departments.

Methods of Data Collection. Data collection methods used in preparing a process evaluation will vary according to the size, length of time, utility investment level and utility experience with delivering DSM program services. The variety of methods includes surveys, one-on-one interviews, focus groups, field observations, and analyses of database and program materials. Depending on the needs of the process evaluators, questions may be in a discrete choice format for more quantitative uses; or open-ended for more anecdotal or explanatory uses.

Data Format. Process evaluation data is frequently structured to allow evaluators to quantify the results (e.g., a multiple choice format in a questionnaire). Such quantification may be used to support impact evaluation efforts. It should be noted that not all DSM programs lend themselves to productive process evaluation. Indeed, a very small participant sample, or a pilot program given a short time period are examples of DSM programs where a less structured process evaluation is more appropriate. Data collection would be limited to participant surveys and informal interviews with DSM program managers, vendors or others with direct experience with the program implementation.

Process evaluation examines implementation issues such as advertising, service delivery, consumer perceptions of energy efficiency measures, and ways to improve further implementation of the DSM program. Data is collected through careful sample design and consists mainly of interviews with DSM program participants. Process evaluations are almost always qualitative providing the interpretative basis for impact evaluation. As an important management resource, process evaluation supplies program managers with real-time feedback on the success of DSM program objectives.

Analytical Limitations on LDC DSM Evaluations. Given the limited load research currently available at LDCs, each type of evaluation methodology has more limited application to LDCs than has been demonstrated by many electric utilities. LDC experience has most often been limited to residential energy audit and low-income weatherization programs. LDC programs generally are not based on reliable forecasts of future gas demand, sensitivity testing via pilot programs and incentive mechanisms, or even limited evaluation.

To achieve real gains in DSM program development at LDCs, more rigorous analysis (e.g., end-use models to forecast gas demand for each customer class) should be conducted to quantify the DSM potential in specific market segments. In addition, lessons from electric utility evaluations may be judiciously applied.

Conclusion

Pilot programs have two purposes: 1) to indicate the likely efforts of a full-scale program, and 2) to permit program adjustments as experience is gained on a particular program. The critical path of the pilot DSM program is determined by the objectives of the pilot. The screening efforts undertaken during the larger utilities' DSM planning processes serve as a (preliminary) working screen for programs that the smaller LDCs might consider.

DSM programs can influence the purchase of higher efficiency equipment. The development of pilot programs can be shaped with greater confidence when the planners can develop reliable information concerning the potential market for the proposed programs.

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Endnotes

1. Mary Ellen F. Hopkins is a Staff Scientist at Battelle, Pacific Northwest Laboratories in Washington, D.C.

2. Henry Einhom, formerly of the Maryland Public Service Commission, is presently the Director of the Gas Division at the Massachusetts DPU.

3. This minimum scale constraint is evidenced if one 1) reviews the activities necessary to implement effective DSM programs, 2) identifies the minimum resources needed to perform each activity, and 3) apportions these costs among the affected ratepayers. To implement as effective DSM program, LDCS should develop information as to the potential market for each DSM program, identify current levels of energy use and evaluate the impact of the implementing the DSM program.

4. The underlying policy concern is the propriety of requiring nonparticipants to subsidize the payment of incentives for equipment purchases that benefit primarily the recipients of those subsidies. As indicated elsewhere, the Maryland Public Service Commission Staff believes that such subsidies amount to regressive taxation and should be avoided. See: "Gas Collaborative Issues in Maryland: Development of Energy Conservation Programs Subject to the Jurisdiction of the Public Service Commission of Maryland," Henry A. Einhom, Barbara Black, Calvin Timmerman, and Mary Ellen Hopkins, Eighth Naruc Biannual Regulatory Information Conference at the Ohio State University, September 11, 1992.

5. Easton started receiving gas about 1965, and Elkton started receiving gas in the late 1950s.