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Demand-Side Management and Integrated Resource Planning: Findings from a Survey of 24 Electric Utilities

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DEMAND-SIDE MANAGEMENT AND INTEGRATED RESOURCE PLANNING:

FINDINGS FROM A SURVEY OF 24 ELECTRIC UTILITIES

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LIST OF ACRONYMS

DSM	Demand-side management
East-West-Wis	Pacific Coast, Upper East Coast, and Wisconsin
EIA	Energy Information Administration
GWh	Gigawatt hour
MW	Megawatt
NA	Not Applicable
NASUCA	National Association of State Utility Consumer Advocates
ORNL	Oak Ridge National Laboratory
PUC	Public Utility Commission

EXECUTIVE SUMMARY

Integrated resource planning differs from traditional utility planning practices primarily in its increased attention to demand-side management (DSM) programs and its integration of supply- and demand-side resources into a combined resource portfolio. This report details the findings from an Oak Ridge National Laboratory (ORNL) survey of 24 electric utilities that have well-developed integrated planning processes. These utilities account for roughly one-third of total capacity, electricity generation, and DSM-program expenditures nationwide. The ORNL survey was designed to obtain descriptive data on a national sample of utilities and to test a number of hypothesized relationships between selected utility characteristics and the mix of resources selected for the integrated plan, with an emphasis on the use of DSM resources and the processes by which they are chosen. The survey solicited information on each utility's current and projected resource mix, operating environment, procedures used to screen potential DSM resources, techniques used to obtain public input and to integrate supply- and demand-side options into a unified plan, and procedures used in the final selection of resources for the plan.

FINDINGS

The contribution of DSM resources to meeting both required capacity and electricity generation needs in the year 2000 is expected to increase substantially from current levels. However, DSM savings will continue to account for a larger share of required capacity than of electricity generation. This relatively greater importance of DSM in responding to capacity requirements can be explained by the finding that several utilities have substantial underutilized resources that can be used to increase the total amount of electricity generated, but that there is very little surplus for meeting peak demand. Peak reduction programs also avoid the loss in utility revenues typically associated with energy-efficiency programs.

Key findings from the tests of hypothesized relationships between utility characteristics and the resource mix selected for the integrated plan are presented in Table ES-1. Because only 24 utilities were studied and these utilities were not selected randomly, these findings may not be valid for the population of all U.S. utilities.

Utilities that have less immediate need for additional capacity and lower projected electricity generation growth rates plan to use more DSM and less new utility-owned generation and/or purchased power in the year 2000, suggesting that greater use of DSM resources can lead to less growth in electricity generation and postpone the date when new capacity will be needed. In contrast, utilities that do **not** reduce their growth rate and postpone the need for new capacity through the use of DSM will require more new utility-owned generating facilities and/or purchased power. New utility-owned generation also is more favored by small utilities than by large ones.

Table ES-1. Summary of key relationships between utility characteristics and resource mix

• Utility size is negatively related to the amount of new utility-owned generation planned for the year 2000.
• The number of years until new capacity will be needed is positively related to the amount of DSM selected and negatively related to the amount of new utility-owned generation that is planned.
• Utility growth rate (in terms of electricity generation) is negatively related to the amount of DSM selected and positively related to the amounts of new utility-owned generation and purchased power that are planned.
• Utilities that are required to prepare integrated resource plans select more DSM than do other utilities.
• Utilities located on the Pacific coast, upper east coast, and in Wisconsin select more DSM than do other utilities.
• Utility dependence on gas and oil as a fuel for generating electricity is positively related to the amounts of DSM and purchased power selected and negatively related to the amount of new utility-owned generation that is planned.
• The importance attributed by utilities to input from technical advisory groups or consumer panels when identifying potential DSM options during screening is positively related to the amount of DSM selected.
• The importance attributed by utilities to evaluations performed by **other** utilities when assessing potential DSM options during screening is negatively related to the amount of DSM selected.
• The importance attributed by utilities to potential environmental effects and to their **own** experience with DSM programs when selecting DSM options for further consideration is positively related to the amount of DSM selected.
• The importance attributed by utilities to the use of workshops as a public involvement mechanism is negatively related to the amount of DSM selected and positively related to the amount of new utility-owned generation that is planned.
• The importance attributed by utilities to collaborative planning with non-utility interests is positively related to the amount of DSM selected.
• Utilities that give simultaneous and equal treatment to both supply- and demand-side resources when developing an integrated plan select more DSM than do other utilities.
• Utilities that subtract projected DSM savings from the load forecast and meet remaining needs only with supply options when developing an integrated plan rely more on utility-owned generation than do other utilities.
• Utilities that begin their integration process with the preparation of a supply-only plan select less purchased power than do other utilities.
• The importance attributed by utilities to cost when choosing options for the integrated plan is negatively related to the amount of DSM selected.
• The importance attributed by utilities to environmental concerns when choosing options for the integrated plan is positively related to the amount of DSM selected.

Utilities in states where regulators require them to prepare integrated resource plans placed more emphasis on DSM than did other utilities. This relationship between regulation and the selection of DSM options is corroborated by the finding that utilities located on the Pacific coast, upper east coast, and in Wisconsin, where regulatory requirements generally are more stringent, included more DSM in their plans. More reliance on DSM also was found among utilities with greater dependence on gas and oil as a fuel for generating electricity; these utilities relied more on purchased power and less on new utility-owned generating facilities than did other utilities, suggesting that reliance on expensive and potentially scarce fossil fuels encourages utilities to reduce their electricity generation and capacity requirements and to buy power from other sources, while avoiding construction of new facilities.

Utilities that attributed greater importance to input from technical advisory groups or consumer panels in identifying potential DSM options during the screening process placed more emphasis on DSM in their resource plans. When assessing potential options during the screening stage, utilities that placed greater importance on DSM program evaluations performed by **other** utilities produced plans that contained fewer DSM resources. When selecting DSM options for further consideration at later stages of the planning process, utilities that attributed more importance to potential environmental effects and utilities that relied more heavily on **their own** experience with DSM programs placed more emphasis on DSM.

Of the various mechanisms used to obtain public input into the utility planning process, the use of advisory groups and the establishment of collaborative planning efforts involve a substantial amount of two-way communication, while the use of workshops, focus groups, and customer surveys entail much less interaction among the parties involved. The placement of greater importance on the use of workshops as a public involvement mechanism was associated with less use of DSM resources and more use of utility-owned generation, suggesting that DSM resources might be less attractive to utilities that favor less interactive methods of public involvement. Conversely, DSM resources played a larger role for those utilities for whom collaborative planning with non-utility interests was considered important. When combining supply- and demand-side resources into an integrated plan, simultaneous and equal treatment of both types of resources is associated with greater use of DSM, while subtracting projected savings due to DSM programs from the load forecast and then meeting remaining needs only with supply options is associated with more reliance on new utility-owned generation. Those utilities that begin their integration process with the preparation of a supply-only plan were found to use less purchased power than did other utilities.

Utilities that attributed greater importance to cost as a selection criterion when choosing options for their integrated resource plan produced plans with less DSM than did other utilities. In contrast, utilities that ascribed more importance to environmental concerns chose significantly more DSM than did utilities that attached less value to the environment.

RECOMMENDATIONS

While increased use of DSM options can provide benefits for utilities and customers under the proper conditions, the specific DSM resources selected and the emphasis placed on them relative to other types of resources must be determined based on the individual circumstances of the utilities and other parties that are affected by these decisions. Greater emphasis on DSM resources is recommended only where the options to be used are cost-effective and appropriate for the utility in question.

Where utilities and other interested parties find it desirable to postpone the need for additional capacity, this might be accomplished by increasing the use of cost-effective DSM resources. Where regulators find the postponement of the need for new capacity to be beneficial, they could possibly achieve this by requiring utilities to prepare integrated resource plans in light of the finding that a regulatory requirement for plan preparation is associated with greater use of DSM. It also might be helpful for state and federal agencies to offer information and/or assistance on DSM opportunities to those utilities that rely heavily on gas- and oil-fired generation, in light of the predisposition of this group to undertake DSM activities.

State regulators can encourage utilities to take greater advantage of the technical potential of DSM resources to reduce electricity generation where this is judged to have important environmental benefits or other desirable effects. This could be done through the design and enactment of economic incentives that will give energy-savings programs some of the attractiveness now held by peak-reduction efforts. State regulators and other interested state and federal agencies also could provide assistance to smaller utilities in the identification of appropriate DSM options and in the design and implementation of cost-effective programs.

To ensure that utilities give full and fair consideration to cost-effective DSM options, state regulators could encourage utilities to use technical advisory groups or consumer panels during their screening process and to seriously consider the input from these sources when identifying potential DSM options. Where DSM resources appear to be beneficial but underutilized, regulators also could encourage utilities to consider potential environmental effects when selecting DSM options for further consideration and to perform more evaluations of their own DSM programs so they will have more first-hand experience on which to base their resource selection decisions. Assistance in designing and performing evaluations could come from state and federal energy agencies.

To ensure that cost-effective DSM resources are fully considered in the integrated planning process, state regulators could encourage utilities to use more interactive public involvement mechanisms, like collaborative planning, and to pay serious attention to the input received from non-utility interests through these interactions. Another way to ensure that the potential benefits of DSM resources receive full consideration is for utilities to consider supply- and demand-side resources simultaneously and to give equal treatment to each type of resource.

Where a strong emphasis on narrowly-defined cost considerations is causing DSM options to be systematically underutilized, state regulators could encourage utilities to attach more importance to environmental concerns when choosing resources for their integrated plans and to include environmental externalities in their cost calculations. Technical assistance from state and federal agencies concerning methods for internalizing environmental costs could prove helpful.

1. INTRODUCTION

BACKGROUND

In recent years, the practice of integrated resource planning has been adopted by a growing number of electric utilities. Integrated planning techniques differ from traditional utility planning practices primarily in their increased attention to demand-side management (DSM) programs and their integration of supply- and demand-side resources into a combined resource portfolio. A recent Oak Ridge National Laboratory (ORNL) study examined the integrated resource plans and planning processes of 29 utilities and 5 non-utility government agencies throughout the United States with a reputation for competent integrated resource planning (Schweitzer, Yourstone, and Hirst 1990). This report details the findings from a follow-up survey of 24 of those utilities. It describes the mix of resources selected by these utilities, their key organizational characteristics, and important features of their operating environments. It also presents findings from tests of hypothesized relationships between selected utility characteristics and the mix of resources selected for the integrated plan. A companion document (Hill, Hirst, and Schweitzer 1991) focuses on the planning processes of five of the utilities included in this study, which were studied in substantially more detail through on-site visits and interviews.

This study emphasizes the use of DSM resources and the processes by which they are chosen because the authors believe that DSM is underutilized in many instances where its use could benefit both utilities and their customers. By identifying those utility characteristics that are associated with greater use of DSM programs, it is hoped that other utilities will consider adopting similar procedures (where appropriate) to ensure that cost-effective DSM options are not overlooked in their plan development process.

RESEARCH METHODS

A questionnaire was mailed to all 29 of the utilities described in Schweitzer, Yourstone, and Hirst (1990), and completed survey forms were received from 24 of them. The responding utilities, along with the states in which they operate, are shown in Table 1.1.[1] Twenty-two of these utilities are privately owned, one (Seattle City Light) is a municipal utility, and one (Bonneville Power Administration) is a federal power marketing

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[1]One of the responding utilities, Georgia Power Company, is a subsidiary of the Southern Company, which also responded. The decision was made to keep the responses from both utilities, since Georgia Power described its own operations, over which it has considerable autonomy, while the Southern Company provided answers for the entire system. By keeping both sets of answers, the individuality of Georgia Power's operations was not hidden. The only exception to this practice was when total capacity requirements, electricity generation, and DSM expenditures were calculated for all sample utilities combined. In these cases, double-counting of resources was avoided by dropping Georgia Power's response and using the Southern Company's response to represent the entire Southern system.

Table 1.1. Utilities responding to ORNL survey[a,b]

Bonneville Power Administration (OR, WA, ID, MT)
Boston Edison Co. (MA)
Central Maine Power Co. (ME)
Commonwealth Edison Co. (IL)
Consolidated Edison Co. (NY)
Florida Power and Light Co. (FL)
Georgia Power Co. (GA)
Idaho Power Co. (ID, OR, NV, WY, MT)
Montana Power Co. (MT, WY)
Nevada Power Co. (NV)
New England Electric System (MA, RI, NH)
Northeast Utilities (CT, MA)
Pacific Gas and Electric Co. (CA)
Pacific Power/Utah Power (OR, WA, CA, ID, MT, WY, UT)
Potomac Electric Power Co. (Wash. D.C., MD)
Puget Sound Power and Light Co. (WA)
Seattle City Light (WA)
Sierra Pacific Power Co. (NV, CA)
Southern California Edison Co. (CA)
Southern Co. (GA, AL, MS, FL)
Union Electric Co. (MO, IL, IA)
Virginia Electric Power Co. (VA, WV, NC)
Wisconsin Electric Power Co. (WI, MI)
Wisconsin Power and Light Co. (WI)

[a]States served are in parentheses. Company headquarters are in first state listed.
[b]All utilities are privately owned except for Bonneville Power Administration and Seattle City Light.

agency. The geographic location of each respondent is shown in Fig. 1.1. In combination, the responding utilities represent approximately one-third of total capacity and electricity generation for all electric utilities nationwide.

The written questionnaire used in this study is shown in Appendix A.[2] It solicited information on utilities' current and projected resource mix, their operating environment, the procedures they use to screen potential DSM resources, the techniques they use to obtain

[2]Before the questionnaire was sent to the full sample of utilities, a preliminary version was pre-tested on three utilities, whose responses were used to clarify the questions and produce the final survey shown in this document.

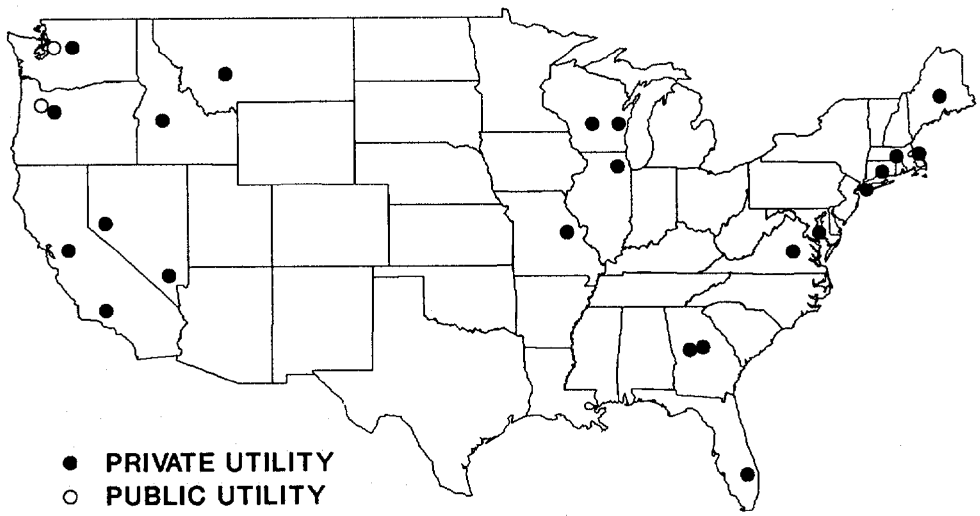

Fig. 1.1. Location of utilities responding to ORNL survey.

public input and to integrate supply- and demand-side options into a unified plan, and the procedures they use in the final selection of resources for an integrated plan.

Descriptive statistics were calculated for all questionnaire items; the most interesting of these are reported in subsequent chapters. Simple means[3] were calculated for continuous numerical variables as well as for the many five-point Likert scale items[4] contained in the

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[3]**Weighted** means, which adjust a utility's answer based on its size, are not used in this report. Such means would provide a picture of the entire utility industry on certain items (such as the % of total capacity requirements provided by DSM programs) **only if** each of the responding utilities were representative of other utilities of similar size. Since this sample was chosen non-randomly, and no attempt was made to stratify by utility size, weighted means were not used.

[4]The five-point Likert scale is used in questions four through ten (except for question 8) in sections II.B through II.D of the survey. The purpose of these scaled questions is to allow the respondent to express the intensity of their attitude or belief on a specific item (Kerlinger 1973). For example, utilities were asked how important (on a scale of 1 to 5) environmental concerns were in assessing options for their most recent long-term plan.

survey. Frequency charts were created for all categorical variables.[5] Graphically, distributions were displayed with bar charts for selected numerical and categorical variables. Box and whisker charts were used to compare the range of responses for selected groups of numerical variables. The mean contribution of various resources to the total resource portfolio was illustrated with pie charts.

Thirteen hypotheses were developed (Appendix B), describing possible relationships between a utility's resource mix and key aspects of its operating environment and planning procedures. These hypotheses were based on experience gained through previous studies of utility planning performed at ORNL (Schweitzer, Yourstone, and Hirst 1990; Hirst et al. 1990) and elsewhere (Eto, et al. 1988; Gellings, Chamberlin, and Clinton 1987; Nadel 1990; Northwest Power Planning Council 1986).

Four different measures of the importance of DSM, purchased power, and new utility-owned generation were used as dependent variables in testing the hypotheses shown in Appendix B. They are: (1) the percent of a utility's total capacity requirement[6] projected for the year 2000 that is provided by each resource; (2) the percent of a utility's total electricity generation[7] projected for the year 2000 that is accounted for by each resource; (3) the percent of a utility's **additional** capacity requirement[8] projected for the year 2000 that is provided by each resource; and (4) the percent of a utility's **additional** electricity generation[9] projected for the year 2000 that is accounted for by each resource. While most of these measures are interrelated, they are not identical.

The hypotheses concerned with the effects of utility environment on resource mix were tested mainly with linear regression analysis (which uses a single dependent variable and a single independent variable), while the remaining hypotheses were tested primarily with multiple regression (which uses a single dependent variable but more than one

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[5]Categorical variables are those for which the possible answers comprise separate and distinct categories, such as the type of planning requirement imposed by state regulators or the method used to integrate supply- and demand-side resources into a unified plan.

[6]"Total capacity requirement" (also known as "total resource requirement") is the amount of peak resources (in MW) needed to meet peak demand, losses, and reserves. It includes peak resources that would have been needed in the absence of the load-reducing effects of all utility-sponsored DSM programs.

[7]"Total electricity generation" is the amount of electricity sold, plus losses, plus electricity that would have been sold in the absence of all utility DSM programs.

[8]"Additional capacity requirement" (also known as "additional resource requirement") is that portion of total capacity requirement (defined in footnote 6) to be added to the resources in existence at the time the most recent resource plan was prepared.

[9]"Additional electricity generation" is that portion of total electricity generation (defined in footnote 7) that exceeds electricity generation at the time the most recent plan was prepared.

independent variable).[10] Where the independent variable(s) were categorical, analysis of variance techniques were used. When interpreting the results of multiple regression, it is important to note that the relationship identified between a given independent variable and the dependent variable(s) exists **in the presence of all other independent variables in the equation.**

The statistical tests that were used to test hypotheses allow inferences to be made about all U.S. utilities. In fact, the p-values that are reported for each significant relationship discussed in the remainder of this report represent the probability that a relationship that was found for the sample utilities is a chance occurrence, and would not be duplicated in the larger population of **all** utilities.[11] However, because only 24 utilities were studied and these utilities were **not** selected randomly, the inferences made in this report (and the associated p-values) may not be valid for the entire population of U.S. utilities. While the authors believe that the responding utilities are in many ways representative of all utilities nationwide, the fact that they were selected non-randomly requires that caution be used when accepting generalizations for the entire utility industry.

SCOPE OF REPORT

The body of this report follows the structure of the questionnaire on which it is based. Chapter 2 describes current and projected peak resource requirements and energy use, and explains the current role of DSM and the projected role of **all** major resources. Chapter 3 describes five key aspects of the utility environment—the need for additional capacity, growth rate in peak demand and energy use, state regulatory requirements, utility dependence on gas and oil, and geographic location—and discusses the relationships between these and utility resource mix. Here, as in all succeeding chapters, explanations of the observed relationships are offered, even though these sometimes involve speculation on the part of the authors. Chapter 4 discusses the techniques used to identify, assess, and select DSM options during the screening stage of the planning process and explores relationships between these and the amount of DSM selected for the integrated plan. Chapter 5 addresses two key elements of integration and analysis—the mechanisms used to obtain public input into the planning process and the methods used to integrate supply and DSM options—and how they affect the

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[10]Where many independent variables were to be analyzed through multiple regression, correlation analysis was run on these variables to identify any highly correlated terms. One member of each highly correlated pair was eliminated from the analysis to avoid problems with multi-colinearity. In the seven cases where a search for highly correlated variables was conducted, it was necessary to delete independent variables in only four of them (for hypotheses 7, 8, 10, and 13). In three of these four instances, only one variable was dropped from the analysis; in one case, two variables were deleted.

[11]For example, a p-value of .03 indicates that the probability is 3% that the finding in question occurred merely by chance and does not apply to the entire population. The lower the p-value, the greater the confidence with which a finding can be accepted. For this study, findings are considered statistically significant if the p-value is .05 or less.

mix of resources selected. Chapter 6 deals with the techniques used to select supply- and demand-side resources, and how the various approaches relate to the contents of the integrated plan. Finally, Chapter 7 summarizes important findings from all preceding chapters and recommends steps that utilities and their regulators can take to increase utility use of DSM resources in those cases where these resources are cost-effective and appropriate.

2. UTILITY RESOURCE MIX

A utility's resource mix is the combination of resources it uses to provide electricity to its customers and maintain necessary reserve margins. Not only does this mix vary substantially **among** utilities but it also can vary **within** a utility, depending on the time frame considered and the type of resource (capacity or generation) that is involved. For example, based on the responses to the ORNL survey, a utility's planned resource mix for the year 2000 is likely to include more DSM than does its current resource portfolio. Similarly, the projected importance of a given resource in some future year typically will vary substantially depending on whether one is looking at **total** resources in that year or **additional** resources to be added to the existing stock. Also, the contribution made by any given resource to meeting a utility's **capacity requirement** may differ in magnitude from the contribution of the same resource to overall **electricity generation**. New utility-owned generating facilities, for instance, may account for a larger share of a utility's required capacity than of its electricity generation.

In the following sections, aggregated data from the 24 utilities that responded to the ORNL survey will be presented for three distinct types of resources: (1) current resources; (2) total resources planned for the year 2000; and (3) additional resources planned for 2000. Within each of these categories, the utility resource mix associated with both capacity requirements and electricity generation will be discussed.[12]

CURRENT RESOURCES

For the most recent year for which data were available (typically 1989 or 1990), the 24 utilities had a capacity requirement of 9,335 MW, on average. This is the total amount of resources needed to meet peak demand, losses, and reserves. Mean reported electricity generation, which consists of electricity sales plus losses, was approximately 41,000 GWh. Figure 2.1 illustrates the range of responses on required capacity; there was substantial variability, but many utilities were clustered at the lower end of the scale. Similar distributions were observed for current electricity generation as well as for **future** required capacity and electricity generation.

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[12]The data provided by utilities on their current and planned total use of DSM resources could be misleading in some cases. Because of some ambiguity in the wording of the survey questions in these areas, it is possible that some utilities reported savings resulting from utility-sponsored DSM measures undertaken in past years while other utilities reported only those savings anticipated from **new** programs or incremental effects from ongoing programs. In the latter cases, some amount of DSM-induced savings goes unreported, meaning that the importance attributed to DSM in this report would underestimate its actual importance by some undetermined amount.

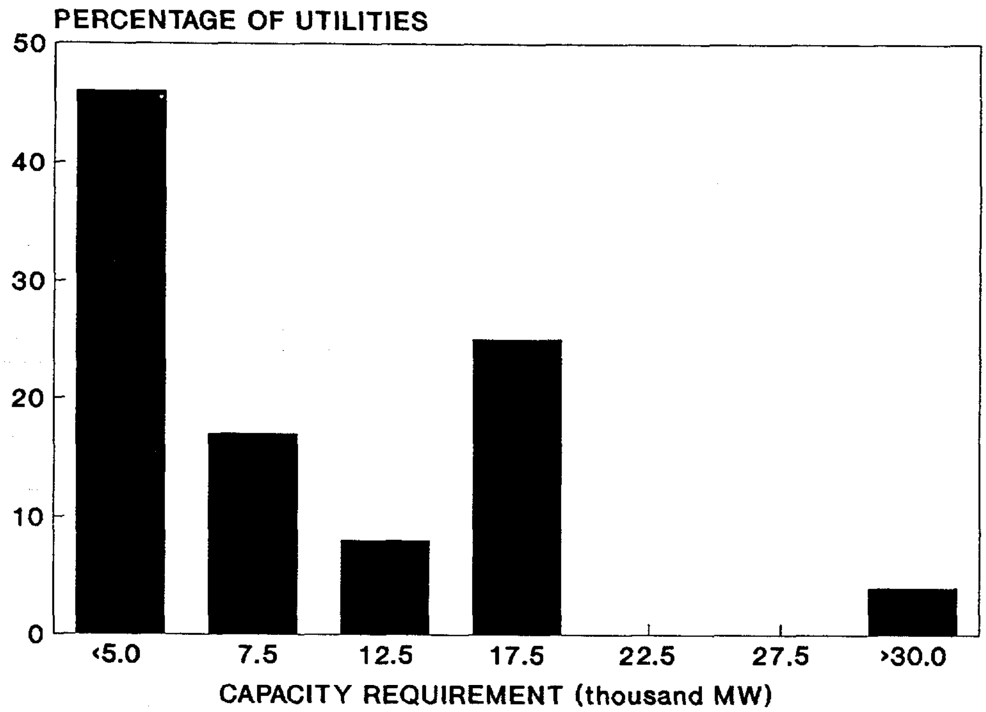

Fig. 2.1. Distribution of responding utilities on current capacity requirement. Single numbers on horizontal axis represent midpoints of each grouping of responses.

Utilities were asked how much they had saved in the most recent year as a result of their DSM programs, both for capacity requirements and for electricity generation. Capacity requirement reductions averaged 1.7%, almost twice the average electricity generation savings of 0.8%. The range of savings is shown in Fig. 2.2. There was a great deal more variability among utilities in capacity requirement reduction than in electricity generation savings. It also is clear that utilities have worked harder at, and/or been more successful in, reducing required capacity than in reducing electricity generation. Also, average summer peak reductions (1.5% of current capacity requirements) were slightly greater than average winter peak reductions (1.3%).[13]

As with utility size, there was considerable variation in the total amount spent on DSM programs in the most recent year, with most utilities clustered at the lower end of the scale. The mean expenditure was just under $30 million, but nearly half of the responding utilities spent less than $15 million. Annual expenditures on DSM programs for these utilities totaled over $700 million. This figure is consistent with the results from other studies that show a total expenditure of approximately $2 billion for all U.S. electric utilities.

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[13]The average summer and winter peak reductions reported here are both less than the previously-mentioned reduction of 1.7%, which was calculated from each utility's **largest** peak reduction, regardless of the season in which it occurred.

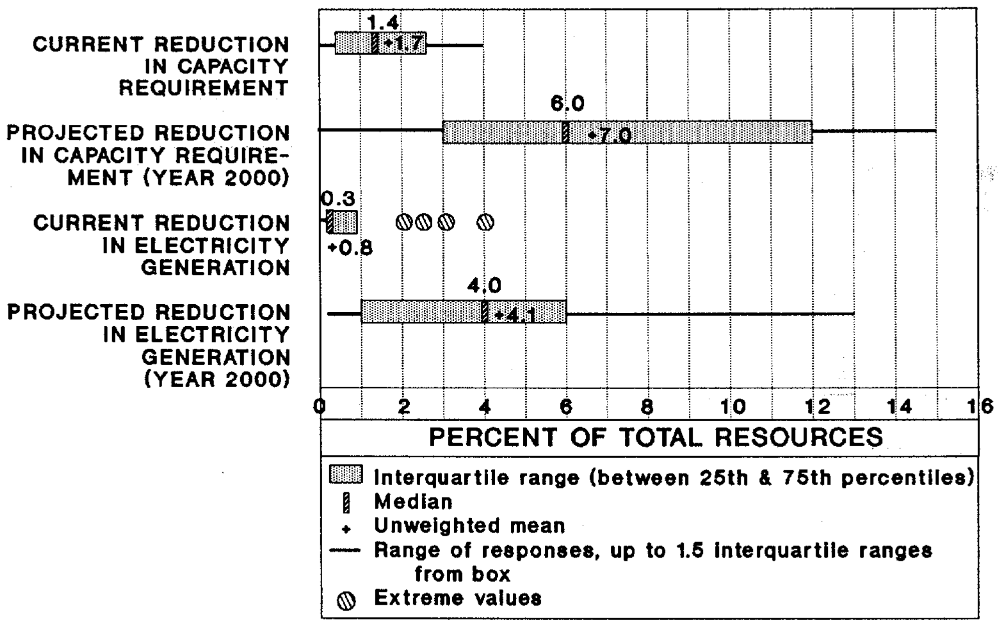


Fig. 2.2. Current and projected DSM-induced reductions in capacity requirement and electricity generation.

Not only do the utilities in the ORNL survey represent roughly one-third of total capacity and electricity generation, they also account for one-third of DSM-program expenditures nationwide.

In addition to showing current savings resulting from DSM programs, Fig. 2.2 shows projected DSM-induced savings as a percent of total capacity requirements and total electricity generation in the year 2000. The overall resource mix planned for the future will be discussed in the following sections, but it is worth contrasting current and projected DSM savings here. As can be seen, the contribution of DSM resources to reducing both total capacity requirements and total electricity generation is expected to increase substantially in the next 10 years.

TOTAL RESOURCES PLANNED FOR THE YEAR 2000

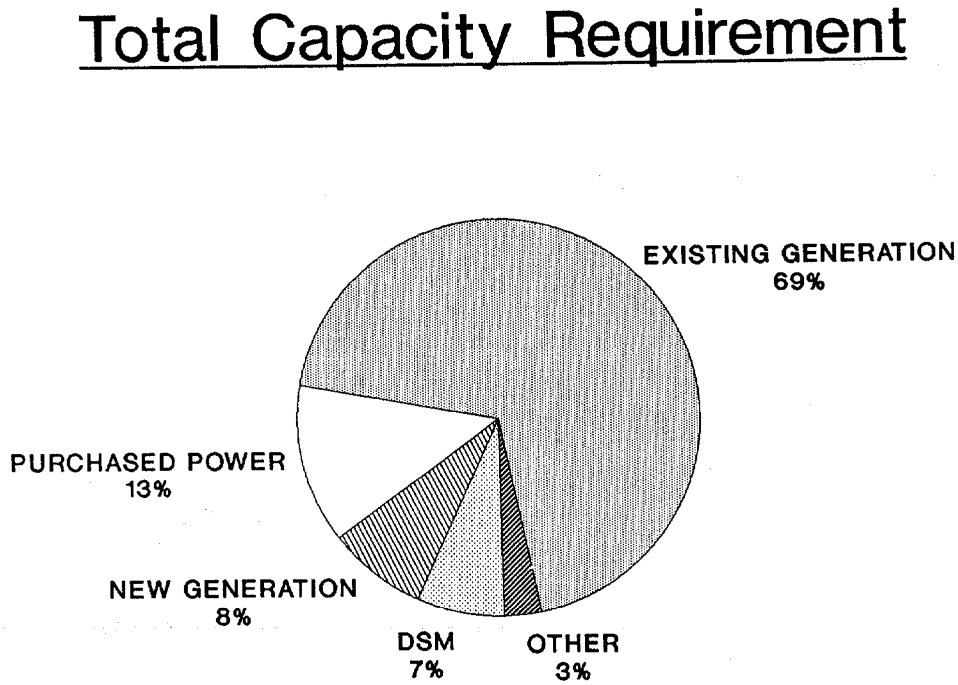
Capacity Requirement

For the responding utilities, the average projected total capacity requirement to meet peak demand, losses, and reserves in the year 2000 was 11,754 MW. The average contribution made by various resources to total required capacity in the year 2000 is shown in Fig. 2.3. Existing generating facilities provide over two-thirds of the total capacity requirement projected for the year 2000 with purchased power (12.8%) a very distant second. New utility-owned generation accounts for 8.4% of total required capacity and DSM programs account for 7.1% of the total. Faruqui et al. (1990) estimated DSM-induced reductions of 6.7% in summer peak demand for the year 2000, close to the average reported by these 24 utilities. Regression analysis revealed no statistically significant relationship between utility size and the amount of new generation, purchased power, or DSM selected. This indicates that, overall, total peak resources are selected without regard to the utility's size.

Figure 2.4 also describes the projected mix of total resources for all responding utilities, but it focuses on the **range** of contributions by various resources. The ranges shown in this figure indicate how much variation there is among utilities in their dependence on different resources. The 24 utilities vary least in their dependence on DSM and vary most in their dependence on existing utility-owned generating facilities. In the latter case, one utility anticipates getting only 40% of its capacity requirement from existing facilities in the year 2000, while another utility plans to meet all of its future required capacity with existing generation.

Electricity Generation

Among the utilities surveyed, total electricity generation in the year 2000 is projected to average approximately 52,000 GWh, an increase of 30% over current generation. Figure 2.3 presents average contributions by various resources to projected total electricity generation. As with capacity requirements, existing utility-owned generation is by far the largest contributor to total electricity generation, accounting for nearly three-fourths of the total. Once again, purchased power is the next most favored resource, but it accounts for a slightly larger share (17%) of electricity generation than it did for required capacity. New generation accounts for 5% of total electricity generation, while DSM programs account for 4.1% of the total. Faruqui et al. (1990) estimated DSM-induced reductions of 3.0% in annual electricity consumption for the year 2000, slightly less than the average reported by these 24 utilities. Regression analysis revealed a systematic negative relationship between utility size and reliance on new generation as a component of total electricity generation, meaning that larger utilities will be less dependent on this resource than will smaller ones. This relationship was found when measuring utility size by current capacity requirement as well as by current electricity generation ($p=.03$ in both cases). No statistically significant relationship was found, however, between either measure of utility size and the importance of DSM or purchased power as components of total electricity generation. Both new utility-owned generation and DSM account for smaller shares of total electricity generation than of total capacity requirements. This indicates that utilities are more interested in new generating facilities **and** DSM programs as a way of responding to growing peak demand than as a way of increasing overall electricity generation capabilities.



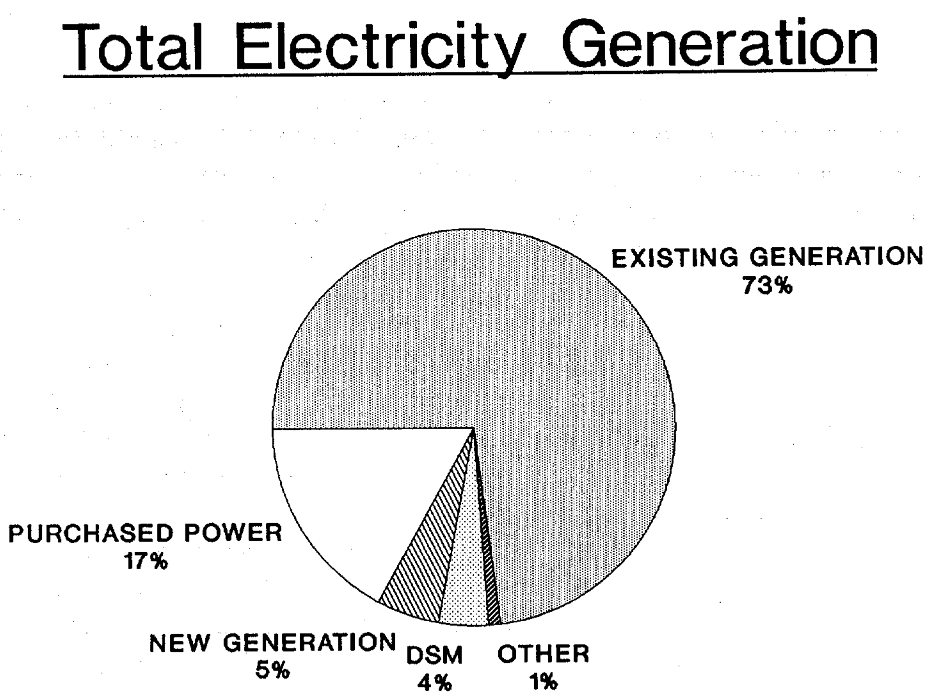


Fig. 2.3. Average contributions (in %) of various resources to total capacity requirement and electricity generation in the year 2000. Totals differ from 100% due to rounding error and incomplete data from one of the 24 responding utilities.

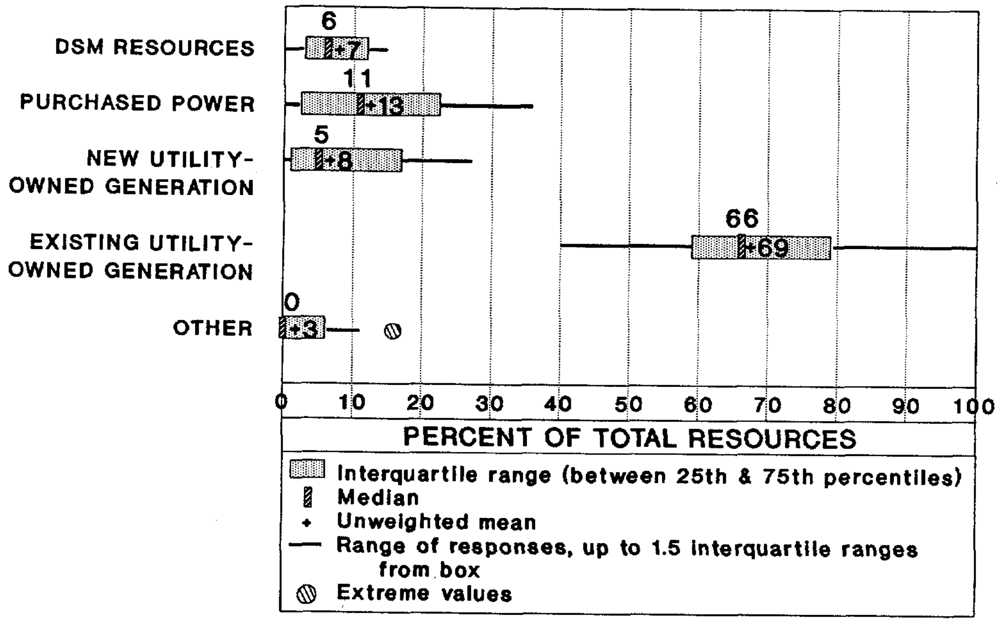


Fig. 2.4. Range of contributions (in %) by various resources to total capacity requirement in the year 2000.

The range of contributions to total electricity generation by various resources is shown in Fig. 2.5. As with capacity requirements, utilities vary least in their dependence on DSM and vary most in their dependence on existing utility-owned generating facilities. However, the importance of purchased power shows more variability as a component of total electricity generation than as a component of capacity requirement.

A comparison of the pie charts in Fig. 2.3 shows that the contribution of a given resource to total capacity is quite similar to the contribution of that same resource to total electricity generation, although the two resource mixes are by no means identical. This similarity among capacity requirement and electricity generation resource mixes does not apply only to the aggregation of all utilities. If a given utility relies more heavily than another utility on a specific resource to meet its capacity requirement, that utility also is likely to rely more heavily on the same resource in its electricity generation portfolio. This is indicated by the results of a correlation analysis, which found strong positive correlations (with r values between .88 and .67) for existing generation, purchased power, DSM, and new utility-owned generation when comparing the importance of each resource for meeting capacity requirement with the importance of the same resource for electricity generation.

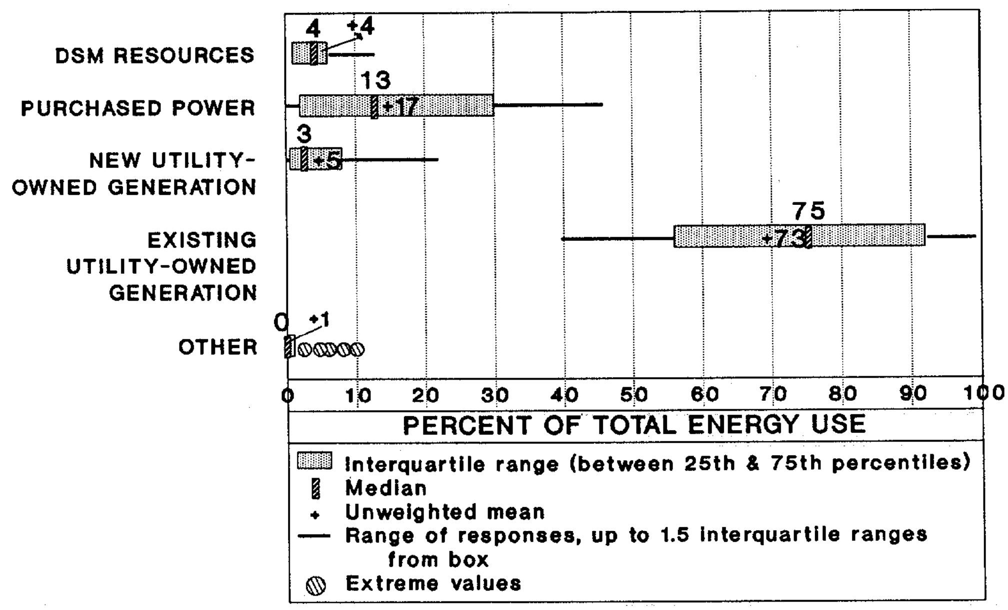


Fig. 2.5. Range of contributions (in %) of various resources to total electricity generation in the year 2000.

ADDITIONAL RESOURCES PLANNED FOR THE YEAR 2000

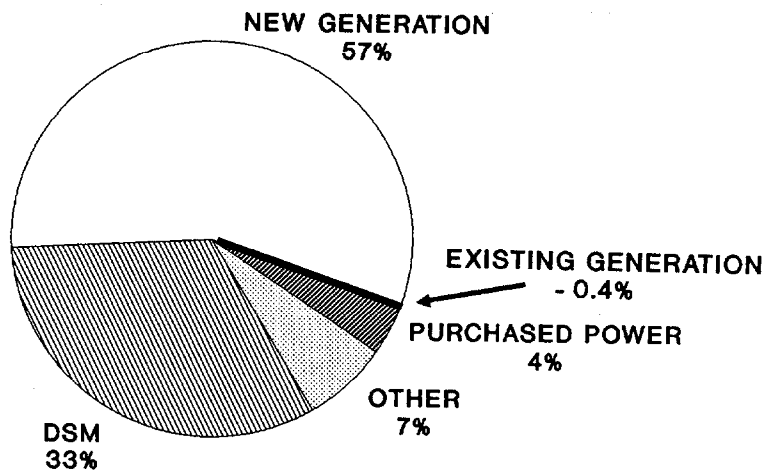
Capacity Requirement

In addition to asking about anticipated **total** capacity requirement and electricity generation in the year 2000, the ORNL survey asked utilities to predict **additional** resources that would be needed by that year. These resources are defined as that portion of capacity requirement or electricity generation planned for the year 2000 that will represent an addition to the capacity requirement or electricity generation existing at the time the most recent resource plan was prepared (generally 1989–1990). On average, the utilities plan for an increase of slightly under 2,000 MW in required capacity.

A pie chart showing the average contribution made by various resources to additional capacity requirements in the year 2000 is presented in Fig. 2.6. New utility-owned generation is the largest component of additional capacity (57%), followed by DSM programs (33.3%), "other" resources (6.7%), purchased power (3.7%), and existing generation (-0.4%).[14] "Other" resources are dominated by unspecified future capacity but

[14]A resource can represent a **negative** addition to capacity requirements if the amount to be contributed by this resource in the future is less than its current contribution.

Additional Capacity Requirement



Additional Electricity Generation

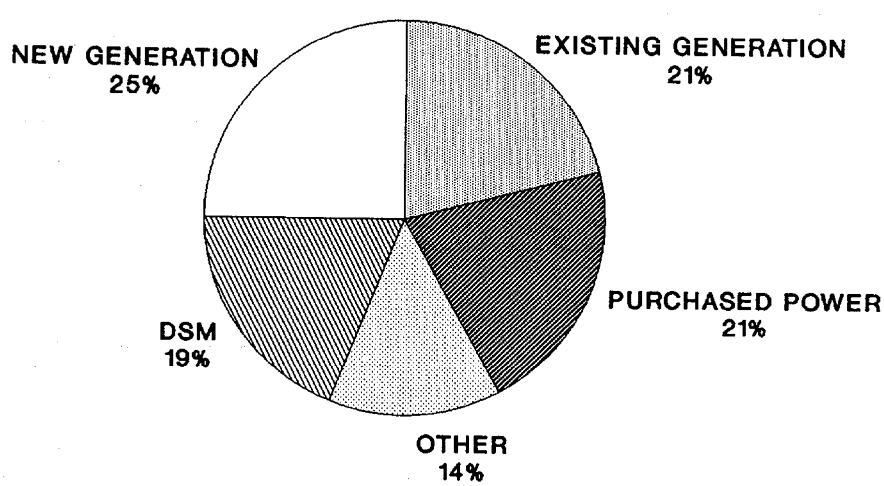


Fig. 2.6. Average contribution (in %) of various resources to additional capacity requirement and electricity generation in the year 2000. Total for capacity requirement differs from 100% due to rounding error.

also include items such as self-generation by industry and municipal utilities and lower reserve margins.

It is important to note the fundamental difference between the resource mix described earlier for total capacity requirement (which primarily consists of resources already in existence) and the mix of **new** resources described here. While new utility-owned generation was relatively unimportant as a component of total capacity, it is the most important single contributor to meeting additional required capacity. DSM resources also comprise a much larger part of the additional resource mix than of the total mix. Existing utility-owned generation, which dominates total capacity, essentially does not contribute to additional capacity requirements; it plays a positive role only for one utility that currently has underutilized capacity that it intends to use more fully in the future. Regression analysis revealed no relationship between utility size and the contribution of DSM, purchased power, or new generation to additional required capacity.

With only one exception, the results of a correlation analysis indicated no systematic relationships across utilities between the importance of a resource in meeting additional capacity requirements and the importance of the same resource in meeting **total** capacity requirements. This implies that there is no industry-wide pattern for basing additional use of peak resources on past usage. The only exception to the above finding was in the "other" category.

Figure 2.7 shows the range of contributions to additional required capacity by various resources. For all resources except existing utility-owned generation, the variation among utilities is much greater than for total peak (Fig. 2.4). The ranges for DSM resources and new generation represent especially dramatic increases over the ranges shown in Fig. 2.4.

Electricity Generation

Additional electricity generation in the year 2000 by the surveyed utilities is projected to average slightly less than 11,000 GWh. Average contributions by various resources to projected additional electricity generation are presented in Fig. 2.6. This resource mix differs dramatically from the mix for additional capacity requirements shown in the same figure. New utility-owned generation and DSM programs are much less important components of additional electricity generation than of additional capacity, indicating once more that these options tend to be most valued for their ability to respond to growing peak demand. On the other hand, existing utility-owned generation, purchased power, and "other" resources are **more** important contributors to additional electricity generation than to additional capacity. "Other" resources are dominated by energy that was formerly committed to unit sales but will be returning to utility control as contracts expire; other items in this category include energy from self-generation and municipals and from efficiency improvements at existing power plants.

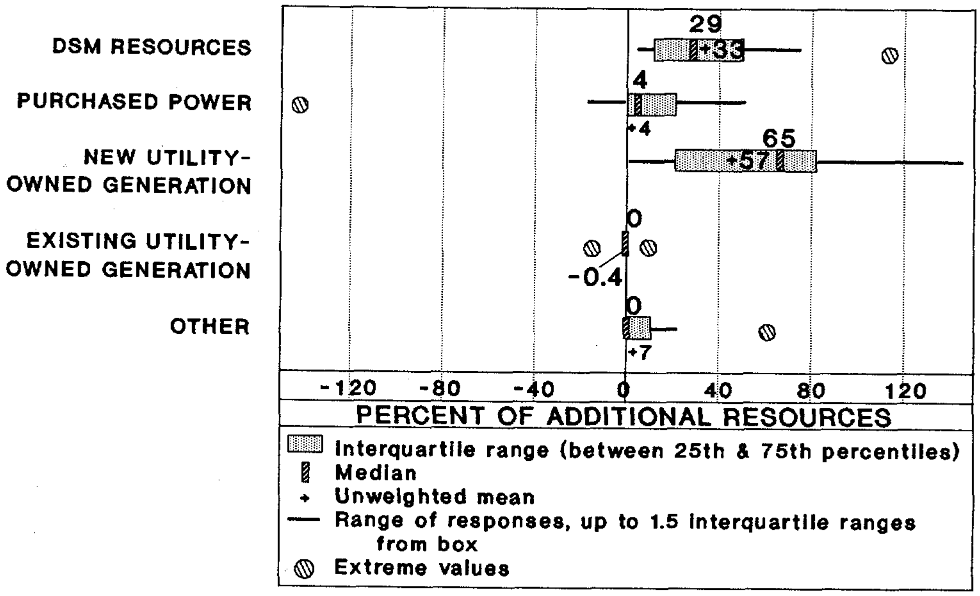


Fig. 2.7. Range of contributions (in %) by various resources to additional capacity requirement in the year 2000.

The importance of the various resources is much more evenly distributed than in any of the situations described earlier. This implies that, in preparing for additional electricity generation, there is less agreement in the utility industry on the superiority of any single option and a tendency to diversify the resource portfolio. Also, according to the results of a correlation analysis, there is **no** systematic relationship between the degree of dependence on a given resource to meet additional capacity requirements and dependence on the same resource for additional electricity generation. This implies that utilities are making individualized decisions on the appropriateness of various options to meet additional required capacity and additional electricity generation without applying any industry-wide formula for linking the two.

Regression analysis revealed a systematic negative relationship between utility size and new generation as a component of additional electricity generation. As with total electricity generation, this relationship was found when measuring utility size both by current peak capacity (p=.01) and by current energy use (p=.02). No statistically significant relationship was found between either measure of utility size and the use of DSM or purchased power.

A comparison of the resource mix for additional electricity generation (Fig. 2.6) with the resource mix for **total** electricity generation (Fig. 2.3) provides an approximation of how new resources differ from currently existing ones. By definition, new utility-owned generation includes **only** additions to existing resources, so this resource naturally accounts for a much larger share of additional than of total resources. In contrast, existing generation accounts for a much **smaller** share of additional than of total resources. However, existing utility-owned generation still contributes substantially to the resource mix, accounting for slightly over one-fifth of additional electricity generation.[15] This means that a few utilities currently have substantial underutilized generating capacity that can be tapped in response to increasing future sales. DSM and "other" resources[16] are both substantially more important contributors to additional than to total electricity generation, while purchased power plays a slightly larger role in the mix of additional resources.

Unlike the situation in the area of required capacity, the importance of a given resource in contributing to additional electricity generation often is related to the importance of the same resource in contributing to **total** electricity generation. Strong positive correlations (r-values between .87 and .73) of this kind were found for new utility-owned generation, DSM, and purchased power. This implies that, for these resources, there is a widely-followed pattern of basing the contribution to additional electricity generation on the contribution to past electricity generation. While the importance of each of these resources is changing, the magnitude and direction of the change for any given resource is similar for most utilities.

The range of contributions to additional electricity generation by various resources is shown in Fig. 2.8. The amount of variation among utilities is substantial, as was the case with additional capacity requirements. However, in the case of additional electricity generation, utility dependence on DSM and new generation is concentrated in a somewhat narrower range, while the distribution for purchased power is somewhat broader. The largest difference between the additional electricity generation and additional capacity requirement mixes is in the case of existing utility-owned generation, where the range of responses is very narrow for capacity and extremely broad for electricity generation.

For all resources, the variation among utilities in the resource mix for additional electricity generation is greater than for total electricity generation (Fig. 2.5). The ranges for DSM resources and new generation represent especially dramatic increases over the ranges in the mix for total electricity generation.

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[15]The substantial contribution of existing utility-owned generation is due to the fact that four utilities anticipate getting between 45% and 92% of their total resource mix from this source. Most of the sample utilities report **no** contribution from existing generation.

[16]"Other" resources are all resources other than DSM, new utility-owned generation, existing generation, and purchased power.

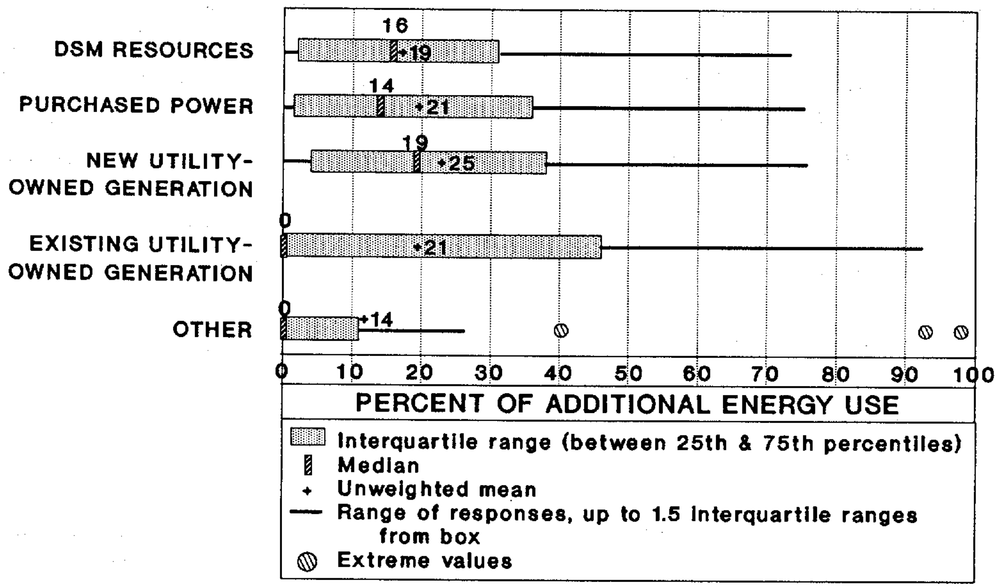

Fig. 2.8. Range of contributions (in %) by various resources to additional electricity generation in the year 2000.

Load-Building

In addition to soliciting information on the contribution of various resources to required capacity and electricity generation, the ORNL survey asked utilities for the percent of their additional capacity requirement and electricity generation that could be attributed to utility-sponsored load-building programs. The 24 responding utilities did not include many that are actively involved in building load. Only two of these utilities reported any additional capacity requirement as a result of load-building initiatives. Of these, one reported that these activities will account for less than 1% of its additional capacity requirement. The other, however, credited load-building programs with 9% of its additional capacity requirement. For electricity generation, the same two utilities reported that load-building programs will account for the same shares (less than 1% and 9%, respectively) of their additional electricity generation. A third utility reported that its load-building efforts will account for 3.1% of its additional electricity generation. All other utilities reported no increases due to such programs.

3. UTILITY ENVIRONMENT

The environment in which a utility operates can strongly influence the mix of resources it selects for its long-term resource plan. For any given utility, key characteristics of its internal and external environment include the following: (1) the urgency of its need for additional capacity; (2) its rate of growth in capacity and generation; (3) the regulatory requirements applied by the Public Utility Commission(s) (PUCs) in the state(s) in which it does business; (4) its dependence on gas and oil; and (5) its geographic location. The attributes of the surveyed utilities in each of these key categories will be discussed in the following sections, along with any relationships that are identified between these environmental characteristics and utilities' projected resource mix for the year 2000.

NEED FOR ADDITIONAL CAPACITY

Utilities were asked when they will first need additional capacity, based on the forecast of most likely trends in load growth contained in their most recent long-term plan. The distribution of responses to this question is shown in Fig. 3.1. While the mean response was 5.7 years, the distribution is skewed toward the lower end of the scale, with two-thirds of the responding utilities reporting that they will need additional capacity in 5 years or less. This indicates that a substantial majority of our sample utilities will need to add new resources to their current portfolio in the near future.

The number of years until additional capacity will be needed was found to be significantly related to the percent of additional capacity requirement to be met by DSM ($p=.009$) and also to the percent of additional electricity generation to be avoided through the use of DSM ($p=.03$). The importance of DSM was found to be greatest for utilities whose need for additional capacity was furthest in the future. This finding contradicted the relationship originally hypothesized by the authors. That hypothesis was based on the assumption that a pressing need for new capacity would stimulate utilities to concentrate on DSM options as a way to minimize the additional resources to be acquired. In other words, a utility's need for capacity was taken as a precondition for its decision of whether or not to use DSM. The observed findings suggest, however, that a utility's need for capacity can be seen as **following**, rather than leading, the selection of DSM for a long-term plan. Utilities that decide to concentrate on DSM resources, and begin implementing these programs in the near-term, will postpone the date when new capacity will be needed.[17]

[17]Several of the respondent utilities were contacted by telephone and asked to comment on this interpretation. All confirmed that new capacity would be needed sooner in the absence of their DSM programs, although several pointed out that other factors (such as slow economic growth) also were important in postponing the need for new capacity.

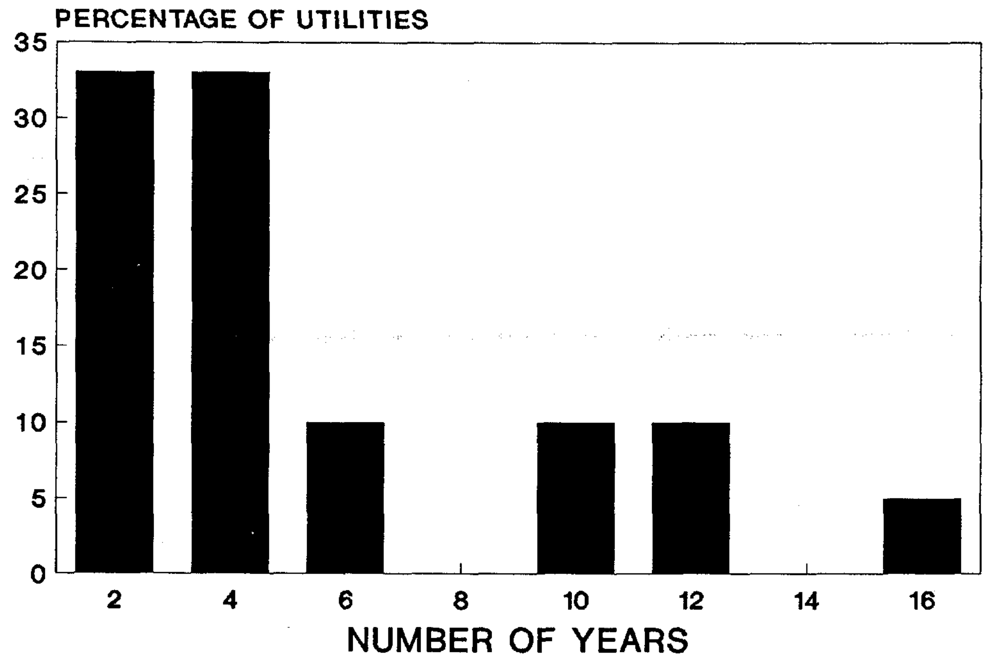

Fig. 3.1. Distribution of utilities on number of years until additional capacity is needed. Numbers on horizontal axis represent midpoints of each grouping of responses.

A statistically significant relationship also was found between the number of years until new capacity is needed and the percent of total capacity requirement provided by new utility-owned generation ($p=.007$). In contrast to the finding concerning DSM, the importance of new generation was found to be greatest for utilities that need additional capacity in the **near** term. This indicates that, where the need for additional capacity has not been postponed through the selection of DSM resources, new utility-owned generation will be necessary to meet this need.

No statistically significant relationship was found between the importance of purchased power in a utility's resource portfolio and the number of years until new capacity is needed.

UTILITY GROWTH RATE

Growth rates were calculated for the responding utilities in two different ways. First, current **capacity requirement** was subtracted from projected total capacity requirement in the year 2000 and this number was divided by current capacity requirement to yield the growth rate over the next decade. Next, the same type of statistic was calculated using current and projected **electricity generation**. Both growth rates turned out to be very similar.

The mean rate of growth in required capacity was found to be 26.6% over the next 10 years, while the mean rate of growth in electricity generation was calculated as 27.7%. The Energy Information Administration (1990) estimates that electricity use will grow by 29% during the 1990s, very close to the mean estimate from these 24 utilities.

The range of projected growth rates reported by the responding utilities is presented in Fig. 3.2. While some extreme values were reported, there is substantial clustering around the mean value, as evidenced by the relatively narrow interquartile ranges for both growth rates. The results of a correlation analysis show that there is a significant positive correlation between the two growth rates ($r=.54$, $p=.006$), indicating that utilities with relatively high (or low) growth rates in required capacity also have relatively high (or low) growth rates in electricity generation.

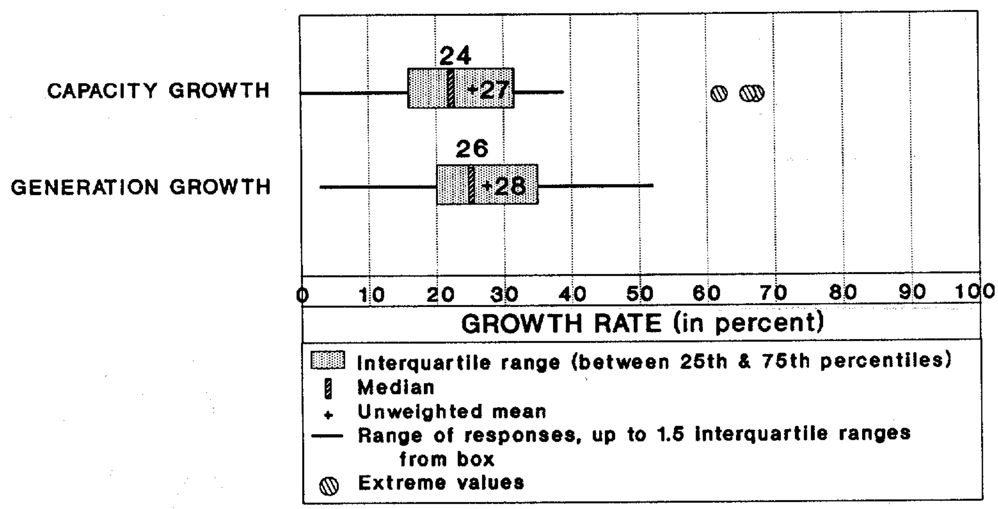

Fig. 3.2. Range of projected utility growth rates (present to 2000).

The relationship between utility growth rate and resource mix is similar to that identified above between resource mix and need for additional capacity. Larger contributions of DSM to the mix of resources chosen to meet additional required capacity are associated with lower projected growth in electricity generation ($p=.05$). Conversely, higher electricity generation growth is associated with more dependence on new utility-owned generation to meet total capacity requirement ($p=.008$) and more dependence on purchased power as a component of total electricity generation ($p=.03$). These findings suggest that utilities that favor DSM resources reduce their growth through adoption of these measures, while utilities that fail to reduce their growth in this manner will rely more heavily on new generation and purchased power to respond to their growing need for energy.

STATE REGULATORY REQUIREMENTS

The ORNL survey asked utilities whether or not the state(s) in which they operate require them to prepare integrated resource plans, whether or not such plans must be formally approved by state regulators, and whether or not state permission for proposed utility resource acquisitions depends on inclusion of those activities in the integrated plan. Based on their responses, each utility was placed into one of four categories, depending on the most stringent requirement placed on them by at least one of the states in which they operate. A requirement for plan approval was considered more stringent than a requirement for plan preparation alone, and the granting of permission for proposed actions based on plan contents was considered the most stringent requirement of all.

As shown in Fig. 3.3, nearly half the respondents reported that at least one state in their operating territory based approval for proposed actions on inclusion of those actions in the integrated plan. Approximately one-fifth of the utilities reported a state requirement for plan approval, and the same number reported no state requirement beyond the order to prepare an integrated plan. Less than 15% reported having no planning-related regulatory requirements of the kinds described here.

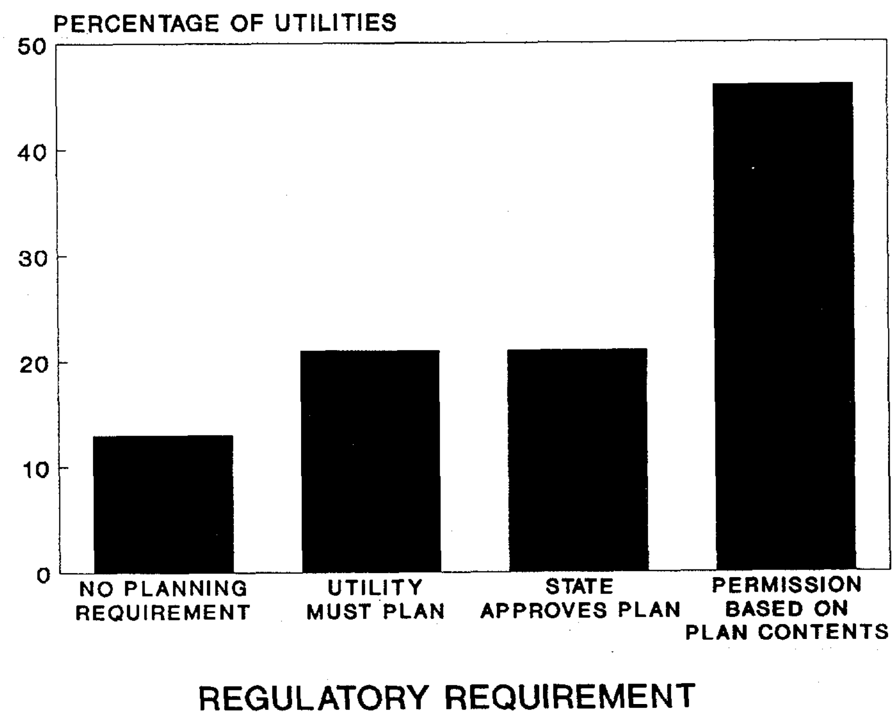

Fig. 3.3. Distribution of utilities on state requirements for integrated resource planning.

The regulatory requirements placed on a utility by its PUC was found to be related to the share of additional capacity requirement in the year 2000 to be provided through DSM programs. Most notably, those utilities required by legislation or administrative order to prepare long-term integrated resource plans were found to rely more heavily on DSM to meet additional required capacity than those utilities that were not required to plan ($p=.006$).[18] This suggests that utilities are encouraged by a clear PUC interest in integrated planning to add more DSM options to their traditional mix of supply-side resources. No significant relationship was found between a utility's regulatory requirements and the amount of new utility-owned generation or purchased power included in the long-term plan.

The above discussion focuses on utilities and the regulatory requirements under which they operate. Another way to organize these data is to focus on the states themselves, to see how planning-related regulations vary from one to the other. Table 3.1 does that, showing the requirements for 24 states (including the District of Columbia) as reported by the utilities.

Utilities reported 18 states as requiring preparation of an integrated plan, while only 8 states were listed as not requiring plan preparation. These numbers include two states (California and Florida) for which one or more utilities reported that plan preparation was required while one or more utilities reported that it was not. The seeming contradiction among responses by different utilities in those two states is probably due to differences in the number of customers served. Utilities that do a large share of their business in a particular state are likely to be held to more stringent standards than are utilities that serve a small number of customers there.

Eleven states were reported as formally approving the integrated plans prepared by utilities within their jurisdiction, while seven were reported as not having such requirements. These numbers include one state (California) that was reported by different utilities as both requiring and not requiring plan approval.[19] In addition to being attributable to the relative numbers of customers served, the differing regulatory requirements reported by utilities operating in California might be due to differing utility interpretations concerning the meaning of "plan approval."

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[18]Further testing indicated that the relationship between a utility's regulatory requirements and its need for future capacity made the relationship between regulation and the importance of DSM appear stronger than it actually was. Even after accounting for this, however, utilities that are required to prepare integrated resource plans still were found to rely more heavily on DSM than those utilities that were not required to plan ($p=.03$).

[19]No answer was given on this item for 7 of the 24 states in which the responding utilities do business, mainly because plan preparation was not mandated.

Table 3.1. State regulatory requirements

State	ORNL Survey Results: Require plan	Approve plan	Permission based on plan	NASUCA rating[1]
AL	no	NA[3]	NA	0
CA	yes/no[2]	yes/no	yes/no	4
CT	yes	yes	yes	4
DC	yes	yes	no	2
FL	yes/no	no	yes	4
GA	no	NA	NA	0
IA	yes	no	no	1
ID	yes	no	—[4]	0
IL	yes	yes	yes/no	3
MA	yes	yes	yes/no	4
MD	yes	—	no	3
ME	yes	yes	no	4
MO	no	NA	NA	0
MS	no	NA	NA	0
MT	no	NA	NA	0
NC	yes	yes	yes	1
NH	yes	yes	no	3
NV	yes	yes	yes	4
NY	yes	yes	—	4
OR	yes	no	—	3
RI	yes	no	no	0
VA	no	NA	NA	2
WA	yes	no	yes/no	4
WI	yes	yes	yes	4

[1]0 = Little or no progress in implementing a regulatory framework.
1 = Concrete proposals to implement a regulatory framework now before appropriate body, but proposals lack key elements.
2 = Concrete proposals to implement a complete regulatory framework now before appropriate body.
3 = A complete regulatory framework has been adopted.
4 = A complete regulatory framework has been adopted and implemented.

[2]"Yes/No" indicates that one or more utilities in state answered "yes" and one or more answered "no."

[3]"NA" indicates that item is not applicable because plan is not required.

[4]"—" indicates that item was not answered.

Nine states were said to base permission for proposed utility actions on inclusion of these items in an integrated plan, and ten were listed as not operating in this fashion. These numbers include four states (California, Illinois, Massachusetts, and Washington) that were variously reported as having and not having such a requirement. Once again, the reported differences can be explained by some combination of utility-specific regulation and varying utility interpretations of state requirements.

It should be noted that while nearly half the utilities reported operating under the most stringent regulatory requirements in at least one of their states (Fig. 3.3), only 9 of the 24 sample states were reported to have such a requirement. Similarly, very few utilities report that they operate under no state requirements regarding integrated planning, but a substantially larger fraction of the states were said to have no such requirements. These seeming inconsistencies are explained by the fact that many utilities operate in more than one state, at least one of which has stringent regulatory requirements.

A recent report prepared for the National Association of State Utility Consumer Advocates (NASUCA) rates all states in terms of their Integrated Resource Planning regulations (Mitchell, Wellinghoff, and Goldberg 1990). The rating given to each of the states represented in the ORNL survey, along with an explanation of those ratings, is shown in Table 3.1. In general, those states reported in the ORNL survey as not requiring plan preparation received the lowest NASUCA ratings, while those states that utilities reported as having the most stringent regulatory requirements got high ratings in the NASUCA study.

UTILITY DEPENDENCE ON GAS AND OIL

Data on the importance of gas- and oil-fired electric generating facilities for the sample utilities was obtained from Energy Information Administration reports for 1988 (EIA 1988a and b, 1989a and b). Use of gas and oil was considered important because of the greater uncertainty, relative to other fuels, concerning the cost and supply of these resources.[20] For half of the responding utilities, gas- and oil-fired generating plants accounted for less than 10% of their total energy use (Fig. 3.4). Most of the remaining utilities got less than half of their energy from gas- and oil-fired units. At the high end of the scale, one utility met over 80% of its energy requirements with gas- and oil-fired generating units. Overall, however, utility dependence on these fuels was minor.

Regression analysis revealed a strong relationship between a utility's current dependence on gas and oil for generating electricity and its planned reliance on DSM, as hypothesized. As a utility's dependence on gas and oil increased, so did the percent of its

[20]The Energy Information Administration (1990) estimates that, during the 1990s, gas and oil prices will increase much more rapidly than will coal prices.

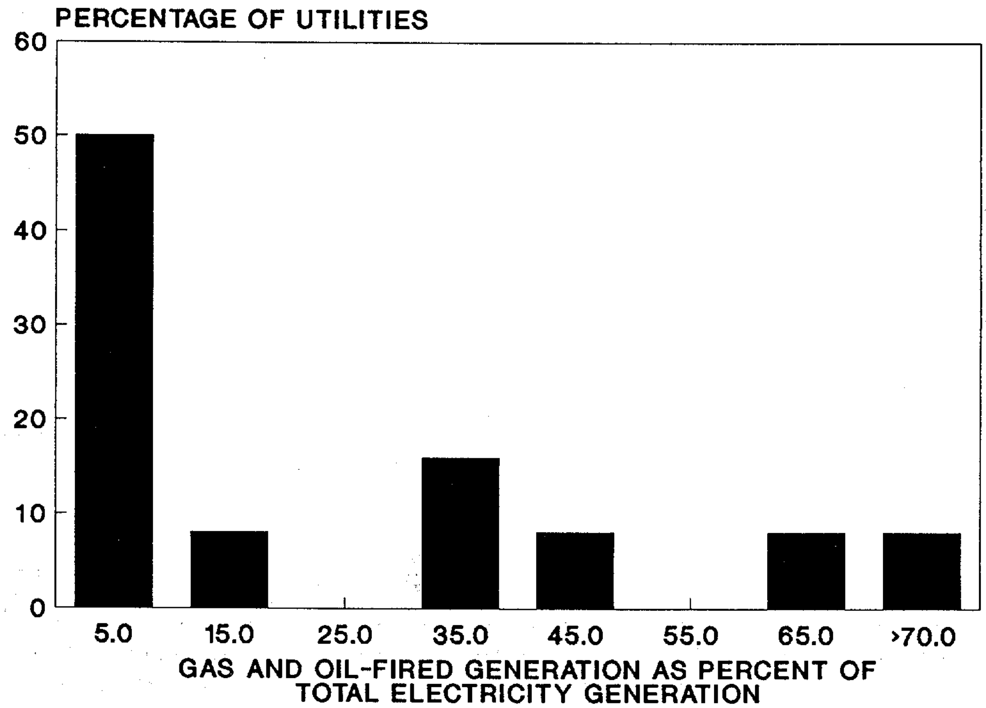

Fig. 3.4. Distribution of utilities on percent of total utility-owned generation fueled by gas and oil. Single numbers on horizontal axis represent midpoints of each grouping of responses.

projected total capacity requirement to be met by DSM (p=.0003) and the percent of its total electricity generation to be avoided through conservation programs (p=.03). Similarly, greater dependence on gas- and oil-fired generation is associated with greater use of purchased power as a share of total and additional electricity generation capacity requirement (p=.01 and .02, respectively) and as a share of total and additional electricity generation (p=.0005 and p=.03). Finally, a greater dependence on gas and oil is associated with less reliance on new utility-owned generation to meet additional capacity requirement. These findings suggest that a reliance on expensive, and potentially scarce, fossil fuels provides a strong incentive for utilities to avoid building new generating facilities and to focus instead on reducing peak generating requirements and overall generation and on buying power from other sources.[21]

[21]The aversion to gas and oil described here is probably focused more on oil than on gas, which may explain, in part, why many utilities plan to build new gas-fired combustion turbines to meet future peak demand. A more important factor, however, is that the very limited dependence on gas represented by the construction of a few peaking combustion turbines is not the same as a heavy dependence on gas and oil, which these findings indicate is being avoided by utilities.

GEOGRAPHIC LOCATION

Each responding utility was categorized according to the U.S. Census Bureau geographic division in which its headquarters is located. As shown in Fig. 1.1, the Pacific region had the greatest representation among our sample utilities, followed by the South Atlantic, New England, and Mountain regions. The West South Central and East South Central states were not represented at all, due primarily to the less advanced state of integrated resource planning in these regions.

Analysis of variance was performed to test for differences in the resource mix selected by utilities in different geographic regions. When the geographic divisions discussed above were used, no statistically significant differences were found. To accentuate observed differences among the sample utilities, all respondents were placed in one of two new categories: (1) Pacific Coast, Upper East Coast, and Wisconsin (referred to as "East-West-Wis"); and (2) everywhere else. Thirteen utilities from Washington, Oregon, California, Maine, Massachusetts, Connecticut, New York, and Wisconsin went into the first group. These were judged to be the states where utilities have historically placed the most emphasis on DSM resources. Eleven utilities from all other states represented in the sample went into the second group. Subsequent tests found several statistically significant differences among these two groups.

The "East-West-Wis" utilities were found to rely significantly more on DSM resources to meet total capacity requirements ($p=.005$), total electricity generation ($p=.0002$), and additional capacity requirements ($p=.0001$) than the group of other utilities. Conversely, the East-West-Wis group was significantly **less** dependent than the other group on new utility-owned generation to meet additional capacity requirements ($p=.007$). This indicates that the Pacific coast, upper east coast, and Wisconsin utilities are ahead of the rest of the nation in their reliance on DSM resources, and that their emphasis on DSM is associated with less dependence on new utility-owned generating facilities. The importance of DSM in those states can be explained, at least in part, by the greater emphasis placed on integrated planning by those state regulators (Table 3.1).

4. SCREENING OF POTENTIAL DSM RESOURCES

Early in the planning process, utilities "screen" potential DSM resources to determine which are suitable for more detailed consideration and which do not warrant further assessment. The screening process generally has three parts: (1) identification of potential DSM resources; (2) assessment of the various DSM options that are identified; and (3) selection of the most suitable DSM options for further consideration at subsequent stages of the planning process (Hill, Hirst, and Schweitzer 1991). This chapter describes the importance attributed by utilities to various sources of information used to identify and assess DSM resources and to the different criteria used to select those DSM options that warrant continued attention as the planning process progresses. In addition, any relationships that are discovered between utilities' screening procedures and the mix of resources chosen for their integrated resource plans will be discussed.

IDENTIFICATION OF POTENTIAL DSM RESOURCES

In the ORNL survey, utilities were asked to rate the importance of 11 possible sources of information (e.g., utility DSM planners, state PUCs) that could be used to help identify potential DSM resources during the screening stage of the integrated planning process. Figure 4.1 shows the range of responses as well as the mean score given for each item.

Clearly, utility DSM planners were the most important source of information for identifying potential DSM options. Not only was the mean response 4.4 (approximately halfway between great and very great importance) but the range of responses was very narrow, with no utility rating this item as less than 3 (moderate importance). Utility marketing staff also received high ratings, with a mean score of just under 4. Outside consultants, outside publications, and state PUCs were rated, on average, as being slightly less than moderately important. The lowest-rated sources were advisory groups, other utility staff, formal DSM planning networks, and state energy offices. Because respondents were instructed to assign a zero to a source if it was not used at all, a low mean score could mean that a large number of utilities did not use this source. Those that **did** use such a source, however, might give it high marks, as was the case with other utility planners (primarily corporate planners and power supply planners) and advisory groups.

The responses described above indicate that utilities rely most heavily on in-house expertise to identify potential DSM options. It is likely that those sources that are used the least or assigned the least importance are considered difficult to access, adversarial, or incapable of providing information that is new or useful.

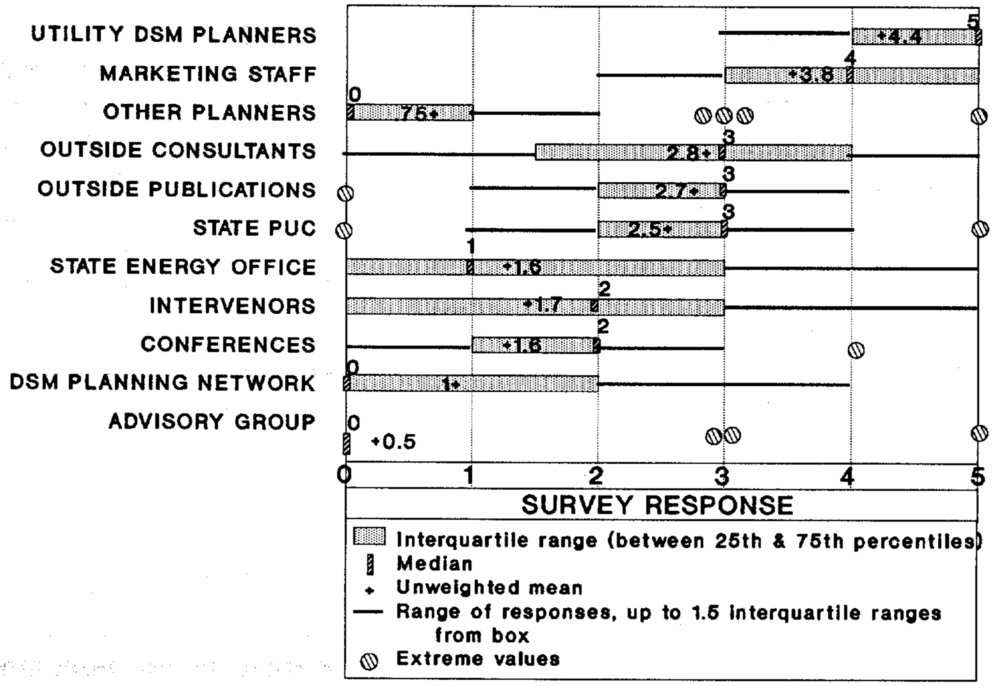

Fig. 4.1. Range of importance of sources used to identify DSM options during screening.

The results of multiple regression analysis suggest that, in the presence of the other key sources used to identify DSM options, only the importance placed on the use of advisory groups is significantly related to the amount of DSM included in the long-term plan (p=.05). Even this factor was found to be related to only one of the DSM measures (the percent of additional capacity requirement provided by DSM). This finding could mean that, after controlling for the effects of all other sources used to identify possible DSM options, input from technical advisory groups or consumer panels can encourage utilities to place more emphasis on DSM options.

INITIAL ASSESSMENT OF DSM RESOURCES

The utilities were asked to rate the importance of about 10 possible sources (e.g., utility marketing staff, state energy office) in providing information used to **assess** potential DSM options during the screening process. Many of the sources of information that could be used during this initial assessment of DSM options were similar to the sources that could be used in the previous step of DSM resource identification. Mean score and range for each item is shown in Fig. 4.2.

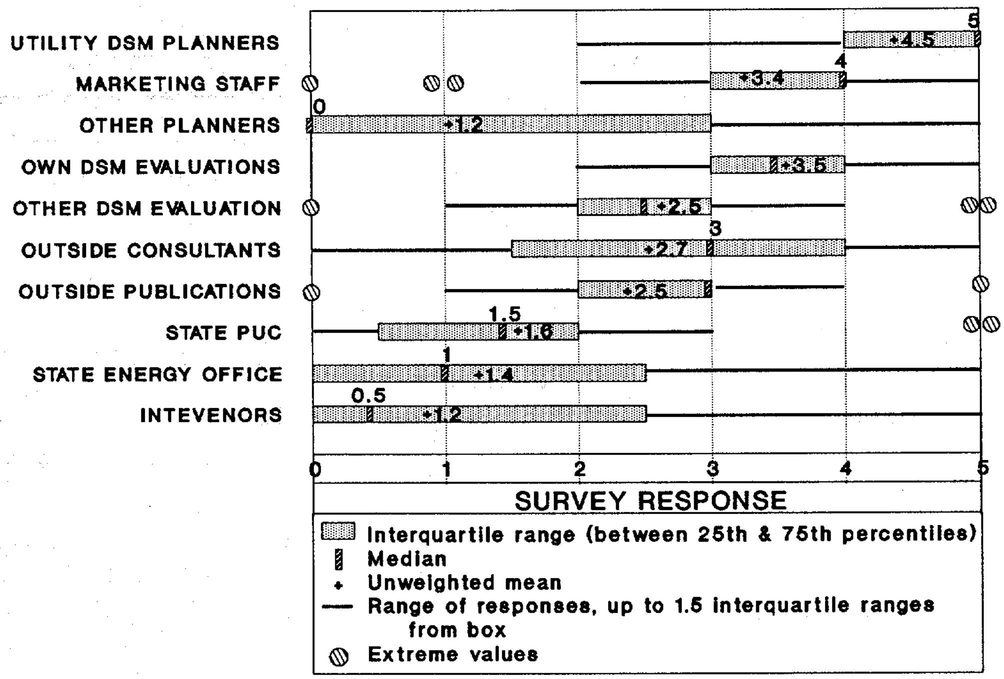

Fig. 4.2. Range of importance of sources used to assess DSM options during screening.

As with resource identification, utility DSM planners (with a mean score of 4.5) are the most important source of information used to assess DSM options during the screening stage. Once again, utilities' marketing staffs (with a mean score of 3.4) are quite important as well. A third important source, which was not used during the identification stage, is evaluations of prior DSM programs performed by the utility itself. Items rated as slightly less than moderately important, as during resource identification, are outside consultants and outside publications. These are joined by another new source, DSM program evaluations performed by other utilities. The least important or least-used sources are intervenors, other utility planners, state energy offices, and PUCs.

These responses indicate that utilities attach the most importance to in-house expertise to assess potential DSM options, just as they did when identifying potential resources. Again, those sources that are used the least or assigned the least importance are probably considered difficult to use or unhelpful.

Correlation analyses were run on pairs of similar items used during the screening process for both identification and assessment of DSM options. This was designed to show how closely the utilities resembled each other in terms of the importance they placed on input from a given source when identifying DSM resources relative to the importance they placed on that same source during resource assessment. For all pairs of similar items, the correlation was positive, meaning that a utility with a relatively low rating on a given item during the identification stage is likely to have a relatively low rating on that same item during the assessment stage. In most cases, the correlations were quite strong ($r > .70$). For utility DSM planners and for state PUCs, however, the observed correlations, while positive and statistically significant, were not as strong as for the other pairs of similar items. This indicates greater variability among utilities in the relative importance placed on these two items during the identification and assessment periods.

In the presence of the other key information sources used to assess options during screening, the importance placed on evaluations of prior DSM programs performed by other utilities was found to be negatively related to the amount of DSM included in the long-term plan. This relationship held for the percent of total capacity requirement provided by DSM ($p=.05$), the percent of total electricity generation avoided through the use of DSM ($p=.04$), and the percent of additional electricity generation avoided ($p=.02$). In other words, the attribution of greater importance to input from other utilities' DSM evaluations was associated with less emphasis on DSM options according to almost every measure of DSM used in this study.[22] It is possible that the emphasis placed on others' DSM evaluations is associated with less use of DSM because utilities having the least first-hand experience with planning and evaluating their own DSM programs are most inclined to rely on the experiences of other utilities.

SELECTION OF DSM RESOURCES FOR FURTHER STUDY

The final screening procedure addressed in the ORNL survey was the selection of DSM options for further consideration at later stages of the planning process. Respondents rated the importance of seven criteria, such as cost and electricity rates, that could be used to distinguish among potential resources. Fig. 4.3 displays the range of responses and the mean response on the importance of each criterion.

The most important criterion used for resource selection at this stage was cost, followed by technical feasibility and projected customer response. Only one item (effect on load) had a mean rating of less than 3 (moderate importance). This indicates that, on average, nearly every criterion suggested in the survey played at least a moderately important role in influencing the selection of DSM options during the screening stage. This is in marked contrast to Figs. 4.1 and 4.2, which indicate that a number of possible information sources had little effect on the identification and assessment of DSM resources

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[22]While the p-values reported here represent the significance found when controlling for the effects of all other assessment sources, the same negative relationships also were found through simple regression analysis where the importance of other utilities' evaluations was the only independent variable used.

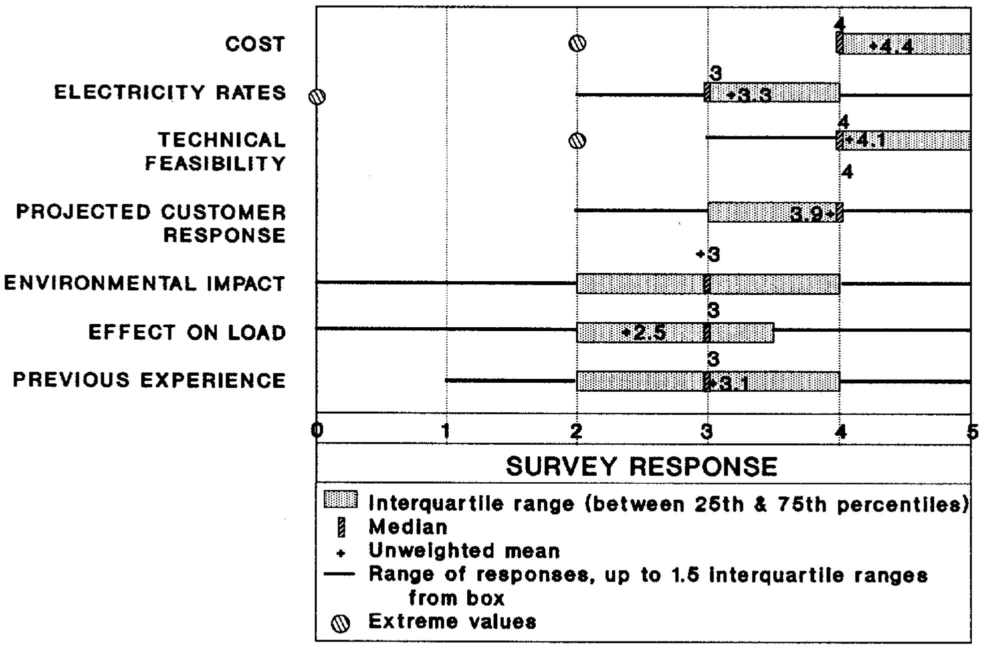

Fig. 4.3. Range of importance of criteria used to select DSM options during screening.

The implication of this finding is that, when selecting resources, utilities are likely to take the broadest approach possible, attaching substantial importance to a wide range of factors.

Three of the criteria used to select DSM resources during the screening stage were found, in the presence of all other criteria, to be significantly related to the percent of total electricity generation avoided through the use of DSM. The importance placed on projected customer response was negatively related ($p=.003$) to this measure of DSM importance, while environmental impact ($p=.01$) and previous experience with DSM programs ($p=.05$) both were positively related to the amount of DSM contained in a utility's plan. These findings indicate that utilities that are most concerned with how customers will respond to potential DSM programs are least likely to select these programs for further consideration for their integrated plan. In contrast, utilities that attribute substantial importance to potential environmental effects during the screening process are more likely to select DSM options, as are utilities that rely more heavily on their own previous experience with DSM programs.

5. INTEGRATION AND ANALYSIS

The long-term resource planning process performed by electric utilities involves the collection and analysis of a great deal of information pertaining to potential supply- and demand-side options, their prospective benefits, and their costs. This chapter focuses on two important elements of the analytical process: (1) the acquisition of input from non-utility interests; and (2) the techniques used to combine supply-side and DSM resources into an integrated plan.

PUBLIC INVOLVEMENT MECHANISMS

The ORNL survey asked utilities to rate the importance of six different mechanisms for obtaining input into the planning process from non-utility interests. These mechanisms are: collaborative planning with legally binding results; collaborative planning without legally binding results; use of an advisory group or task force; use of focus groups; use of workshops; and use of customer surveys (Ellis 1989; Cohen and Chaisson 1990; Prahl 1990). Figure 5.1 displays the range of utility responses for each item.

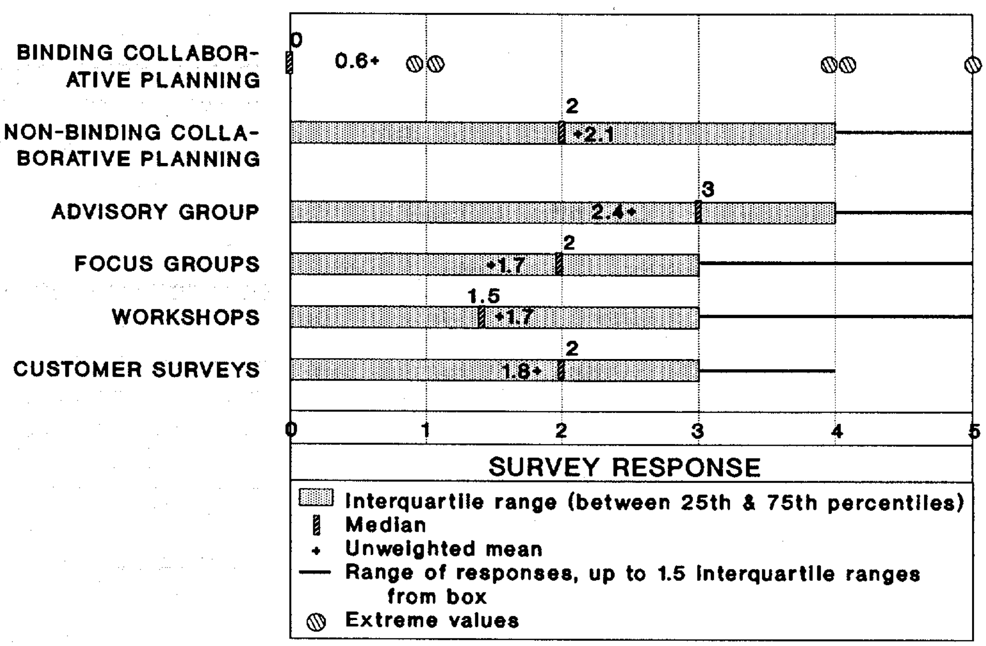

Fig. 5.1. Range of importance of various public input mechanisms.

On average, the responding utilities rated the use of an advisory group or task force as their most important source of public input. This was followed closely by the non-binding collaborative planning process, whereby representatives of various governmental agencies and non-governmental interest groups meet with utility representatives to jointly design a mutually acceptable plan. Because the results are non-binding, the final decision concerning the appropriate resource mix rests with the utility itself. Customer surveys, focus groups, and workshops were considered somewhat less important, and **binding** collaborative planning (where the utility is obligated to accept the resulting plan) was rarely used.

The importance attributed to advisory groups and non-binding collaborative planning efforts indicates that utilities are interested in obtaining the active involvement of non-utility interests in their plan development process. Focus groups, workshops, and customer surveys, which generally involve substantially less two-way communication, are less favored. However, the widespread avoidance of binding collaborative efforts indicates that utilities, while interested in active give-and-take with non-utility interests, are not prepared to share final authority concerning the contents of their long-term plans.

Through multiple regression analysis, a significant negative relationship was found between the importance attached to workshops and the percent of additional capacity requirement provided by DSM ($p=.009$). This means that, given similar emphasis on other public input mechanisms, utilities that consider the use of workshops more important have **fewer** DSM resources in their long-term plan. Conversely, utilities that attach more value to the use of workshops have a **greater** share of their total capacity requirement ($p=.01$), total electricity generation ($p=.004$), and additional electricity generation ($p=.05$) provided by new utility owned generation. This could be interpreted to mean that utilities that favor less interactive methods of public involvement are more inclined to favor new resources that allow firm utility control and less inclined to favor resources whose successful emplacement requires more interaction with customers.

A follow-up analysis was run to see if utilities for whom collaborative planning was important (a score of 4 or 5 on either collaborative planning item on the survey) differed from other utilities in terms of the amount of DSM, purchased power, and new utility-owned generation contained in their plans. No differences were found among the two types of utility in the amount of purchased power and new generation selected, but those utilities for whom collaboration was important were found to have a significantly higher percentage of their total capacity requirements provided by DSM ($p=.006$). This suggests that more intense interaction with non-utility interests could tend to encourage greater use of DSM.

Collaborative and non-collaborative utilities also were compared on the importance of the various information sources used to identify and assess DSM resources and on the criteria used to select DSM options during the screening process. Collaborative utilities were found to attach significantly greater importance to input from intervenors and PUCs when identifying ($p=.002$ and .03, respectively) and assessing DSM resources ($p=.01$ and .04, respectively). At the same time, collaborative utilities attached less importance to input from conferences when identifying resources (p=.05) and to evaluations performed by other utilities when assessing these resources (p=.04). No significant difference was found between the collaborative and non-collaborative utilities in terms of the importance attached to various selection criteria during the screening process nor in terms of the planning requirements imposed by their PUCs.

INTEGRATION OF SUPPLY- AND DEMAND-SIDE RESOURCES

Utilities were asked to specify which of three methods were used to integrate supply-side and DSM resources into their long-term integrated plan. Possible choices were: the simultaneous consideration of both types of resources based on cost or other utility criteria; subtraction of all cost-effective DSM options from the load forecast and subsequent filling of remaining need with supply-side resources; and initial preparation of an optimal supply-only plan, followed by the substitution of more cost-effective DSM programs (Hirst et al. 1990). Figure 5.2 shows the percentage of responding utilities giving each standardized answer as well as those listing multiple methods and writing in different approaches.

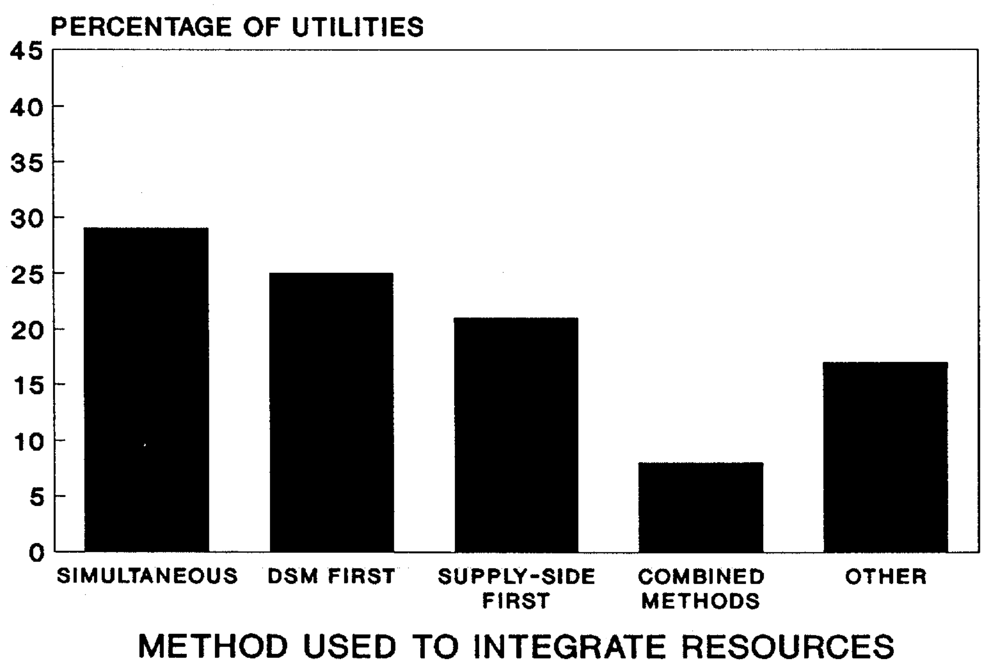

Fig. 5.2. Distribution of utilities on methods used to integrate supply-side and DSM resources.

The responding utilities were fairly evenly distributed in their use of the three specified methods of integrating resources, indicating that there is no predominant method of choice among electric utilities for combining supply- and demand-side resources into an integrated plan. The simultaneous consideration of both types of resources was favored slightly over the other two standard approaches. Several utilities used tailor-made approaches that differed from the three standard methods. Virginia Electric, for example, used an iterative technique it calls "margin analysis" to assess the effects of various DSM options on the need for supply-side resources and to compare different packages of DSM options. Northeast Utilities reported using its collaborative planning process to decide what and how much DSM to incorporate into the resource plan.

Multiple regression analysis showed that those utilities that simultaneously considered both supply-side and DSM resources had a significantly higher percent of additional capacity requirements provided by DSM ($p=.02$). A much different resource mix was found for those utilities that begin by reducing projected load through the selection of DSM options and then meet all remaining need with supply-side resources. These utilities meet a significantly greater portion of their total capacity requirements ($p=.0003$), total electricity generation ($p=.005$), and additional electricity generation ($p=.05$) with new utility-owned generation. A still different situation was found for utilities that begin by preparing an optimal supply-only plan and follow up with the substitution of cost-effective DSM programs. The use of this approach is associated with less reliance on purchased power to meet total required capacity ($p=.01$), total electricity generation ($p=.01$), and additional electricity generation ($p=.04$).

The findings presented above could mean that simultaneous and equal treatment of all types of resources leads to greater use of DSM, while the treatment of DSM options only at the time of the load forecast leads to more reliance on new utility-owned generating facilities. The first approach might encourage more emphasis on DSM by focusing attention on it throughout the planning process, while the second approach might favor the selection of new generation by limiting the time and attention paid to the DSM alternative. The lack of emphasis on purchased power by those utilities that begin by preparing a supply-only plan could be due to a tendency for utilities with more attractive supply-side options (and less need for purchased power) to favor this approach.

6. RESOURCE SELECTION

The final stage of the integrated planning process involves the selection of a mix of supply- and demand-side resources to meet projected needs for energy and peak capacity. The ORNL survey elicited responses on two key aspects of the resource selection task: (1) the cost-effectiveness tests used in this final assessment of DSM options; and (2) the overall criteria by which **all** types of potential resources are assessed.

DSM COST-EFFECTIVENESS TESTS

Respondents were asked to rate the importance of five widely-used cost-effectiveness tests in their final assessment of DSM resources that survived the earlier screening process (Krause and Eto 1988). The five tests are: (1) the **Participant Test**, which weighs the costs and benefits of DSM options from the perspective of participating customers; (2) The **Ratepayer Impact Test** (also known as the **Nonparticipant or No Losers Test**), which judges cost-effectiveness based on whether or not program implementation would result in an increase in electricity prices; (3) the **Total Resource Cost Test** (also known as the **All Ratepayers Test**), which looks at **all** costs and benefits, whether they accrue to utilities, participants, or nonparticipants; (4) the **Societal Test**, which is basically the same as the Total Resource Cost Test except that it also considers externalities; and (5) the **Utility Cost Test** (also known as the **Utility Revenue Requirements Test**), which focuses on the difference between utility avoided costs and the costs required for program implementation. The range of responses and the mean response for each item is presented in Fig. 6.1.

The Total Resource Cost Test was clearly considered most important by the responding utilities. Not only did it receive a mean score of 3.5 (halfway between moderate and great importance), but the responses also were concentrated at the high end of the scale, in contrast to all other items which had much broader interquartile ranges. The Utility Cost Test also was rated fairly high, with a mean score of 3. Least importance was attributed to the Societal Test, which received a mean score of just over 2 (slight importance).

The primacy of the Total Resource Cost Test indicates that, in general, utilities were most concerned with the **overall** effect of their DSM programs on all interested parties. Cost-effectiveness tests that focus on single-group interests were not given as much importance. Among the single-focus tests, however, the test that gauges the effect of programs on the utility itself was given more weight than the tests focusing on participants or nonparticipants. The relatively low importance given to the Societal Test (which examines externalities) implies that many utilities lack either the necessary tools or the interest to assess the external effects of their potential DSM programs.

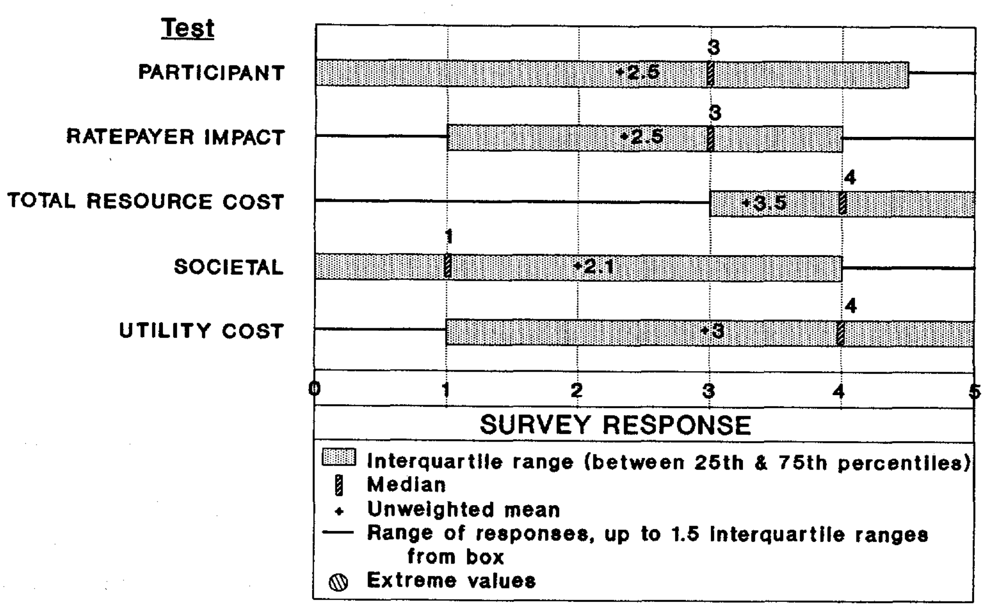

Fig. 6.1. Range of importance of various DSM cost-effectiveness tests.

No relationship was found between the importance attributed by utilities to the various cost-effectiveness tests and the amount of DSM selected for their long-term plans. A follow-up analysis was performed, whereby those utilities for whom the Ratepayer Impact Test was important were compared to all other utilities in terms of the amount of DSM selected. The Ratepayer Impact Test was judged to be important to a utility if it gave a score of 4 or 5 to this item on the survey. It was expected that those utilities that emphasize the Ratepayer Impact Test would have less DSM in their plans than other utilities, but no statistically significant difference was found between these two groups.

CRITERIA FOR ASSESSING ALL OPTIONS

The final item on the survey asked utilities to rate the importance of six different criteria in selecting options for their long-term resource plan. These criteria are: (1) cost; (2) environmental concerns; (3) flexibility; (4) reliability; (5) electric rates; and (6) capacity equivalence. The first five apply to the utility's assessment of **all** potential options, while the last one applies only to DSM resources. Figure 6.2 presents the utilities' responses to all six items.

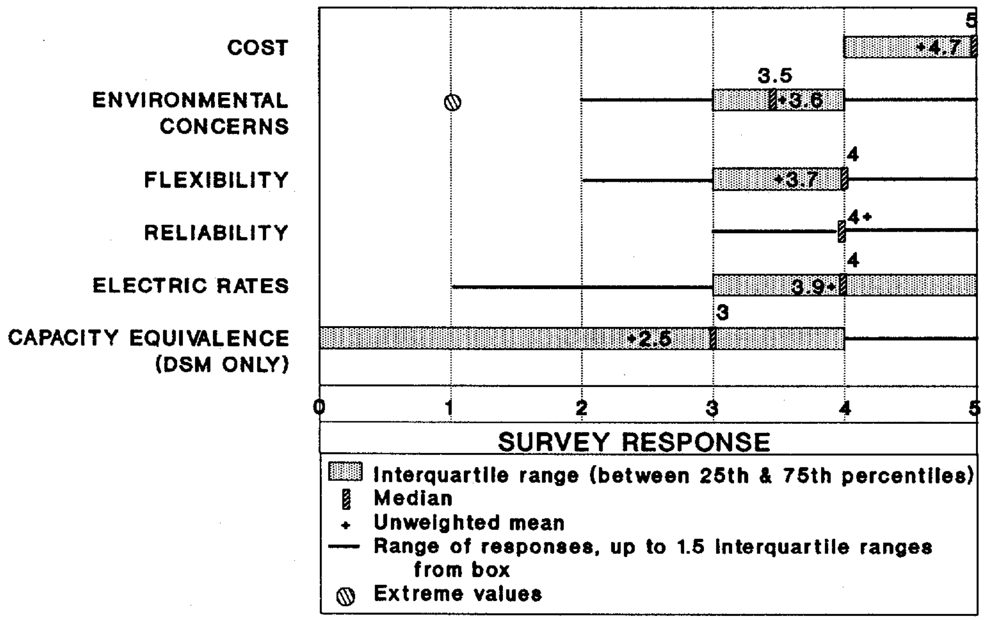

Fig. 6.2. Range of importance of various criteria in selecting options for plan.

Cost stands out as being the most important criterion for resource selection, with a mean response of 4.7 and no score below 4 (great importance). Nearly all the other items had mean scores between 3.6 and 4, with most responses clustered around the mean. The one exception is capacity equivalence, which is used for DSM resources only and which had a mean of only 2.5 and an extremely broad range. Almost 30% of the respondents did not consider capacity equivalence, in contrast to all the other criteria which were used by all responding utilities.

The responses shown in Fig. 6.2 indicate that there is a great deal of similarity among utilities in the importance they attach to those criteria that are suitable for the selection of both supply- and demand-side resources. And the importance attached to all those selection criteria is substantial. The clear implication is that, while cost is the single most important concern, utilities consider a broad range of factors when selecting options for their integrated resource plans. This is consistent with the finding (discussed in Chapter 4) that a similarly broad approach is taken when selecting DSM resources during the screening stage.

Through the use of multiple regression analysis, it was found that utilities that assign greater importance to cost as a resource selection criterion had a significantly lower percentage of total capacity requirements ($p=.02$), total electricity generation ($p=.05$), and additional capacity requirements ($p=.02$) provided by DSM. In contrast, utilities that assign greater importance to environmental concerns had a significantly **higher** percentage of their additional capacity requirements (p=.002) and additional electricity generation (p=.04) avoided through the use of DSM. No statistically significant relationship was found between the criteria used to select options for the integrated resource plan and the amount of purchased power or new utility-owned generation that was chosen.

The findings described above suggest that the resource selection criteria used have an effect on the amount of DSM chosen and that an emphasis on cost lessens the amount of DSM selected while an emphasis on environmental concerns increases it. It is possible to infer from this that utilities that currently base their resource acquisition decisions heavily on costs might increase their future reliance on DSM if they were to expand their definition of costs to include environmental externalities.

A correlation analysis was run on sets of similar items from the resource selection and screening stages of the planning process to see if there was a consistent, industry-wide relationship between the importance placed on a given factor (e.g., costs, rates) at one time and the importance assigned this same factor elsewhere in the planning process. The importance placed on electric rates during final resource selection was found to be strongly positively correlated with the importance assigned to the Ratepayer Impact Test as a means of assessing the cost-effectiveness of DSM options (r=.85). This means that if, relative to other utilities, a utility attached low importance to electric rates during final resource selection, then that same utility is very likely to attach low importance (again, relative to other utilities) to the Ratepayer Impact Test. The importance placed on rates during resource selection and the importance attached to the Ratepayer Impact Test both were positively correlated (r=.50 and r=.63, respectively) with the importance placed on rates during the screening process. The importance assigned to the Societal Test (which includes the cost of externalities) to assess DSM resources was positively correlated with the emphasis placed on environmental impact during screening (r=.52). Finally, the importance assigned to the use of the Utility Cost Test in assessing the cost-effectiveness of DSM resources was positively correlated with the emphasis placed on costs during screening (r=.47).

7. SUMMARY AND CONCLUSIONS

The preceding chapters contain a substantial amount of information concerning utilities and their resource portfolios, operating environments, and planning procedures. The most important findings from these chapters are summarized below, along with recommendations for ways to ensure that DSM technologies and programs receive full and fair consideration by utilities. While increased use of DSM options can provide benefits for utilities and customers under the proper conditions, the specific DSM resources selected and the emphasis placed on them relative to other types of resources must be determined based on the individual circumstances of the utilities and other parties that are affected by these decisions. Greater emphasis on DSM resources is recommended only when the options to be used are cost-effective and appropriate.

The findings and recommendations presented here are probably applicable to the entire U.S. utility industry and not just to the surveyed utilities, despite the fact that this sample was not selected randomly. Supporting this contention are the previously-stated facts that the 24 responding utilities account for approximately one-third of total national electric generating capacity, electricity sales, and DSM expenditures and that they are representative of all U.S. utilities in terms of projected growth rates and planned use of DSM resources.

RESOURCE MIX

DSM resources are projected to contribute much more heavily to meeting both required capacity and electricity generation in the year 2000 than is currently the case. However, DSM resources will continue to play a larger role in meeting capacity requirements than in contributing to electricity generation. This relatively greater importance of DSM in responding to capacity requirements makes sense in light of the finding from this survey that several utilities have substantial underutilized generating capacity that can be used to accommodate increased future sales, but that there is little surplus for meeting peak needs. Reduction of required capacity through DSM programs, therefore, is more attractive to utilities than reduction of sales, since the former can postpone the need to build new generating facilities while the latter does not necessarily have the same effect. An added attraction of peak reduction programs is that they avoid the loss in utility revenues typically associated with energy-efficiency programs.

Turning to the subject of new utility-owned generation, this study indicates that smaller utilities tend to rely more heavily on this resource for projected electricity generation (both total and incremental) than do larger utilities.

The findings discussed above suggest that, because the reduction of future sales does not offer utilities the same benefits that reduction of peak demand does, less is being done to reduce electricity generation through DSM programs than is technically possible. This presents state regulators with an opportunity to encourage greater use of DSM resources to reduce electricity sales, where this is judged to have important environmental benefits or other desirable effects. Such encouragement could involve the design and enactment of economic incentives that will give energy-savings programs some of the attractiveness now held by peak-reduction efforts. State regulators also could provide assistance to smaller utilities in the identification of appropriate DSM options and in the design of cost-effective programs. If some of the emphasis on new generation found among small utilities reflects a lack of familiarity or comfort with DSM, assistance of this kind from interested states or federal agencies could increase cost-effective DSM usage.

UTILITY ENVIRONMENT

Utilities with less immediate need for additional capacity and lower projected electricity generation growth rates placed more emphasis on DSM and less emphasis on new utility-owned generation and/or purchased power in their resource portfolio. This suggests that greater use of DSM resources can lead to less growth in electricity generation and postpone the date when new capacity will be needed. Conversely, utilities that do **not** reduce their growth rate and postpone the need for new capacity through the use of DSM will require more new utility-owned generation and/or purchased power.

Utilities that are required by state law or administrative order to prepare integrated resource plans placed more emphasis on DSM than did other utilities. Consistent with this, more emphasis on DSM resources was found among utilities located on the Pacific coast, upper east coast, and in Wisconsin, where regulatory requirements generally are more stringent. Utilities located in other areas were more dependent on new utility-owned generation.

Greater dependence on gas and oil as fuels for generating electricity was associated with more use of DSM and purchased power and less use of new utility-owned generation. This suggests that reliance on these fuels encourages utilities to reduce their electricity generation and capacity requirements and to buy power from other sources, while avoiding construction of new facilities.

Where utilities and other key parties find it desirable to postpone the need for additional capacity, the findings suggest that this can be accomplished by increasing the use of cost-effective DSM resources. Where regulators find the postponement of the need for new capacity to be in the public interest, they could possibly achieve this end by requiring utilities to prepare integrated resource plans. It also might be fruitful for state and federal agencies to offer information and/or assistance on DSM opportunities to those utilities that rely heavily on gas- and oil-fired generation, in light of the predisposition of this group to undertake DSM activities.

SCREENING

Utilities that attributed greater importance to input from technical advisory groups or consumer panels in identifying potential DSM options during the screening process placed more emphasis on DSM in their resource plans. When assessing potential options during the screening stage, utilities that placed greater importance on DSM program evaluations performed by **other** utilities produced plans that contained fewer DSM resources. When selecting DSM options for further consideration at later stages of the planning process, utilities that attributed more importance to potential environmental effects and utilities that relied more heavily on their own experience with DSM programs placed more emphasis on DSM. Conversely, less emphasis was placed on DSM by those utilities that attributed more importance to projected customer response.

To ensure that cost-effective DSM resources are not overlooked, state regulators could encourage utilities to use technical advisory groups or consumer panels during their screening process and to seriously consider the input from these sources when identifying potential DSM options. Where DSM resources appear to be beneficial but underutilized, regulators also could encourage utilities to consider potential environmental effects when selecting DSM options for further consideration and to perform more evaluations of their own DSM programs so they will have more first-hand experience on which to base their resource selection decisions. Assistance in designing and performing evaluations could come from state and federal energy agencies. As utilities gain more experience with DSM programs and become more familiar with customer response to different kinds of offerings, the use of cost-effective DSM is likely to increase.

INTEGRATION AND ANALYSIS

Utilities that attributed more importance to the use of workshops as a public involvement mechanism[23] have fewer DSM resources and more utility-owned generation in their long-term plans than do other utilities. This suggests that DSM resources are less attractive to utilities that favor less interactive methods of public involvement. Conversely, DSM resources played a larger role for those utilities for whom collaborative planning with non-utility interests was considered important. When combining supply- and demand-side resources into an integrated plan, simultaneous and equal treatment of both types of resources is associated with greater use of DSM, while subtracting projected savings due to DSM programs from the load forecast and then meeting remaining needs only with supply options is associated with more reliance on new utility-owned generation. Those utilities that begin their integration process with the preparation of a supply-only plan were found to use less purchased power than did other utilities.

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[23]As pointed out earlier, workshops tend to involve substantially less two-way communication than do advisory groups and collaborative planning efforts.

To ensure that cost-effective DSM resources are fully considered in the planning process, state regulators could encourage utilities to use more interactive public involvement mechanisms, like collaborative planning, and to pay serious attention to the input received from non-utility interests through these interactions. Another approach that could increase the likelihood that cost-effective DSM options are selected where they will be beneficial is for utilities to consider supply- and demand-side resources simultaneously and to give equal treatment to each type of resource.

RESOURCE SELECTION

Utilities that attributed greater importance to cost as a selection criterion when choosing options for their integrated resource plan produced plans with less DSM than did other utilities. In contrast, utilities that ascribed more importance to environmental concerns chose significantly more DSM than did utilities that attached less value to the environment.

Where a strong emphasis on narrowly-defined cost considerations is causing DSM options to be underutilized, state regulators could encourage utilities to attach more importance to environmental concerns when choosing resources for their integrated plans and to include environmental externalities in their cost calculations. Technical assistance from state and federal agencies concerning methods for internalizing environmental costs could prove helpful.

This study shows that electric utilities are developing and using improved planning methods. These methods consider a broad array of resources, as shown by the increasing attention to and implementation of DSM programs. These methods also include inputs from a variety of non-utility sources and a diverse set of criteria used in selecting individual resources and a suitable resource portfolio. Results from the ORNL survey of 24 electric utilities suggest that advances in integrated resource planning will likely lead to development of a balanced mix of demand and supply resources that satisfies customer energy-service needs at reasonable economic and social costs.

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APPENDIX A. QUESTIONNAIRE USED IN SURVEY OF UTILITIES

Questionnaire for Electric Utilities on Current and Projected Resources and Key Organizational/Environmental Characteristics

I. Projected Resource Mix and Current Demand-side Management Programs

Part A of this section asks about all those resources projected for use by your utility in the year 2000, while Part B addresses only those resources to be added between now and 2000. Part C asks for information on current demand-side management programs.

A. Total Resources for the Year 2000

Based on the forecast of most likely trends in load growth and the preferred mix of resources presented in your most recent long-term resource plan:

1(a). What is your utility's projected **total resource requirement**[a] to meet peak demand, losses, and reserves for the year 2000?__________MW.
Is this for **summer** or **winter**? (circle one)

(b). What percent of the above resource requirement will be met by the following resource-types:

Demand-side management (DSM)[b]__________
Purchased power[c]__________
New utility-owned generating facilities[d]__________
Existing utility-owned generating facilities__________
Other (please specify)____

2(a). What is your utility's projected **total energy sales plus losses**[e] for the year 2000?
__________GWh, MWh, or MWa. (Circle **one** of the preceding terms)

(b). What percent of the above energy sales plus losses will be met by the following resource-types:

DSM[b]__________
Purchased power[c]__________
New utility-owned generating facilities[d]__________
Existing utility-owned generating facilities__________
Other (please specify)____

---

[a]Total resource requirement includes all peak resources belonging to your utility and obtained from other sources, as well as peak resources that would have been needed in the absence of the load-reducing effects of all utility-sponsored DSM programs.

[b]DSM resources are defined as utility-sponsored activities that result in **reductions** in peak demand or overall energy sales. Do not include results of any load-**building** programs.

[c]Purchased power refers to purchases from both utility and non-utility sources.

[d]Includes repowering of existing facilities.

[e]This includes all electricity expected to be sold by your utility, plus losses, plus electricity that would have been sold in the absence of all utility-sponsored DSM programs.

B. <u>Additional Resources for the Year 2000</u>

Based on the preferred mix of resources presented in your most recent long-term resource plan:

3(a). What is your utility's projected **additional resource requirement**[f] to meet peak demand, losses, and reserves for the year 2000? ________MW.
Is this for **summer** or **winter**? (circle one)

(b). What percent of the above resource requirement will be met by the following resource-types:

DSM[b]________
Purchased power[c]________
New utility-owned generating facilities[d]________
Other (please specify)____

(c). Approximately what percent of the resource requirement described in 3(a) can be attributed to utility-sponsored load-building programs?________

The above numbers refer to additions to resources in existence in ________.
(year)

4(a). What is your utility's projected **additional energy sales plus losses**[g] for the year 2000? ________GWh, MWh, or MWa. (Circle **one** of the preceding terms)

(b). What percent of the above energy sales plus losses will be met by the following resource-types:

DSM[b]________
Purchased power[c]________
New utility-owned generating facilities[d]________
Other (please specify)____

(c). Approximately what percent of the energy sales plus losses described in 4(a) can be attributed to utility-sponsored load-building programs?________

The above numbers refer to additions to sales and losses in ________.
(year)

---

[f]Additional resource requirement is that portion of total resource requirement (defined in footnote a) to be added to the resources in existence at the time the most recent resource plan was prepared.

[g]Additional energy sales plus losses is that portion of total energy sales plus losses (defined in footnote e) that exceeds energy sales plus losses at the time the most recent resource plan was prepared.

C. <u>Current DSM Programs</u>

5(a). How much money did your utility spend on its DSM programs in the most recent year for which data are available[h]?_________

(b). To what year does the number given in 5(a) apply?_________

6(a). In the most recent year for which data are available, by how much did your utility's DSM programs reduce peak summer resource requirements[i], in MW_________, peak winter resource requirements[i], in MW_________, and total sales plus losses, in GWh, MWh, or MWa_________?

(b). To what year do the numbers given in 6(a) apply?_________

II. Organizational and Environmental Characteristics

A. <u>Utility Environment</u>

1(a). For the most recent year for which data are available, describe your utility's total resource requirement to meet peak demand, losses, and reserves, in MW_________ and total sales plus losses, in GWh, MWh, or MWa_________, weather-normalized if possible.
Are peak MWs for **summer** or **winter**? (circle one).
Are answers weather-normalized?______

(b). To what year do the numbers given in 1(a) apply?_________

2. Based on the forecast of most likely trends in load growth contained in your most recent long-term resource plan, in what year will your utility first need additional capacity[j]?_________

3(a). Does the state or states that your utility operates in currently have legislation or an administrative order requiring utilities to prepare long-term resource plans that integrate demand- and supply-side resources?_____________ ______
Name of State Yes/No

_____________ ______ _____________ ______ _____________ ______
Name of State Yes/No Name of State Yes/No Name of State Yes/No

---

[h]This includes all expenditures made in the most recent year for which data are available, whether these expenditures were capitalized or expensed.

[i]To be consistant with the data you provided in Sections I.A. and B., reduction in peak resource requirements should include reductions in peak demand plus losses and reserves.

[j]For this question, do not count facilities that are currently committed (i.e., contracted or under construction) as additional capacity.

3(b). If the answer to 3(a) is "yes", is the plan formally approved by state regulators?

Name of State	Yes/No	Name of State	Yes/No	Name of State	Yes/No

(c). If the answer to 3(a) is "yes", does state permission for proposed utility resource acquistions depend on inclusion of those activities in the long-term resource plan?

Name of State	Yes/No	Name of State	Yes/No	Name of State	Yes/No

B. Screening of Potential Resources

4. On a scale of 1 to 5 (below), rate the importance of the following sources in helping to **identify** potential DSM resources to be considered during the screening stage of your planning process[k]? **[If a source was not used at all, mark it with a zero.]**

1 (Very Slight) 2 (Slight) 3 (Moderate) 4 (Great) 5 (Very Great)

Utility DSM planners_____
Utility marketing staff (those who implement DSM programs)_____
Other utility staff (please indicate from which departments)______________
____
Outside consultants_____
Outside publications on DSM and related matters_____
State PUC_____
State energy office_____
Intervenors (please indicate what interests they represent)______________
____
Conferences_____
Formal DSM planning network_____
Other (please specify)______________

5. On a scale of 1 to 5 (below), rate the importance of the following sources in providing information used to **assess** potential DSM resources during the screening stage of your planning process.[k] **[If a source was not used at all, mark it with a zero]**

1 (Very Slight) 2 (Slight) 3 (Moderate) 4 (Great) 5 (Very Great)

Utility DSM planners_____
Utility marketing staff (those who implement DSM programs)_____
Other utility staff (please indicate from which departments)______________
____
Evaluations of prior DSM programs performed by your utility_____
Evaluations of prior DSM programs performed by other utilities_____
Outside consultants_____
Outside publications on DSM and related matters_____
State PUC_____
State energy office_____
Intervenors (please indicate what interests they represent)______________
____
Other (please specify)______________

[k] "Your planning process" refers to the procedures used to produce your most recent long-term resource plan.

6. Rate the importance of the following criteria in **selecting** DSM options during the screening stage, for further consideration at later stages of your planning process. **[If a criterion was not used, mark it with a zero]**

1 (Very Slight) 2 (Slight) 3 (Moderate) 4 (Great) 5 (Very Great)

Cost____
Electricity rates______
Technical feasibility_____
Projected customer response_____
Environmental impact_____
Effect on load factor_____
Previous experience with this type of program_____
Other (please specify)____

C. <u>Integration and Analysis</u>

7. Rate the importance of the following mechanisms in obtaining input into your planning process from non-utility interests[1]. **[If a mechanism was not used, mark it with a zero]**

1 (Very Slight) 2 (Slight) 3 (Moderate) 4 (Great) 5 (Very Great)

Collaborative planning, with legally binding results_____
Collaborative planning, **without** legally binding results_____
Advisory group or task force_____
Focus groups_____
Workshops_____
Customer surveys (by utility or other interested parties)_____

8. Which of the following methods were used to integrate supply-side and DSM resources into your most recent long-term resource plan?

Rank all supply and DSM resources by levelized cost and/or other criteria. Starting with the load forecast and existing resources, add new resources to fill the gap between load and resources using the least-cost resources or those that best meet utility criteria_____

Develop estimate of DSM potential relative to a specified avoided cost. Subtract all cost-effective DSM from the load forecast and then use the "net" load forecast in a traditional supply-only planning framework_____

Develop an optimal supply-only plan. Then test promising DSM options against this plan, looking for options that lower total revenue requirements. Combine DSM options that pass this revenue requirements test into aggregate DSM packages, again looking for those that lower revenue requirements_____

Other (please specify on back of page)______________________________

---

[1]Non-utility interests can include environmental groups, state regulators, independent power producers, and a host of other organizations and individuals.

D. Resource Selection

9. Rate the importance of the following cost-effectiveness tests in assessing DSM options for your most recent long-term resource plan. **[If a test was not used, mark it with a zero]**

1 (Very Slight) 2 (Slight) 3 (Moderate) 4 (Great) 5 (Very Great)

Participant Test____
Ratepayer Impact (Non-participant, No Losers) Test____
Total Resource Cost (All Ratepayers) Test____
Societal Test (Total Resource Cost + externalities)____
Utility Cost (Utility Revenue Requirements) Test____
Other (please specify)________________________________

10. Rate the importance of the following criteria in assessing options for your most recent long-term resource plan. Criteria apply to **all** types of options, unless otherwise specified. **[If a criterion was not used, mark it with a zero]**

1 (Very Slight) 2 (Slight) 3 (Moderate) 4 (Great) 5 (Very Great)

Cost____
Environmental Concerns____
Flexibility____
Reliability____
Electric Rates____
Capacity Equivalence (for DSM options)_____
Other (please specify)________________________________

____

____

Please provide the following information concerning the person with primary responsibility for completing this questionnaire:

Name________________________________
Position________________________________
Utility________________________________
Address________________________________
____
Phone Number____________________________

APPENDIX B. HYPOTHESIZED RELATIONSHIPS

HYPOTHESIZED RELATIONSHIPS

Utility Environment

1. Utility size is related to the amount of DSM, purchased power and new utility-owned generation selected.

2. A utility's need for capacity is positively related to the amount of DSM and purchased power selected, and is related in an unspecified manner to the amount of new utility-owned generation selected.

3. A utility's growth rate is positively related to the amount of DSM and purchased power selected, and is related in an unspecified manner to the amount of new utility-owned generation selected.

4. The stringency of PUC regulation is related to the amount of DSM, purchased power, and new utility-owned generation selected.

5. Utility dependence on gas and oil is positively related to the amount of DSM and purchased power selected, and is related in an unspecified manner to the amount of new utility-owned generation selected.

6. A utility's geographic location is related to the amount of DSM, purchased power, and new generation selected.

Screening

7. The sources used to identify potential DSM resources to be considered during the screening stage are related to the amount of DSM selected.

8. The sources used to provide information for assessing potential DSM resources during the screening stage are related to the amount of DSM selected.

9. The criteria used to select DSM options during the screening stage (for further consideration later) are related to the amount of DSM selected.

Integration and Analysis

10. The methods used to obtain public input into the planning process are related to the amount of DSM, purchased power, and new utility-owned generation selected.

11. The method used to integrate supply- and demand-side resources is related to the amount of DSM, purchased power, and new utility-owned generation selected.

Resource Selection

12. The economic test used to assess DSM options is related to the amount of DSM, purchased power, and new utility-owned generation selected.

13. The resource selection criteria used are related to the amount of DSM, purchased power, and new utility-owned generation selected.

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