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REVIEW OF THE DEMAND-SIDE MANAGEMENT PLANS OF FOUR NEW YORK UTILITIES.

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EXECUTIVE SUMMARY

In April 1988, New York's seven investor-owned utilities filed their first long-term Demand Side Management (DSM) Plans in response to a Public Service Commission (PSC) order. This order represents an important step in implementing the PSC's goal of a more balanced long-term planning process which included appropriate emphasis on DSM. The PSC invited the Lawrence Berkeley Laboratory to assist Commission staff in reviewing the plans. In this study, we compare the DSM plans of four utilities: Consolidated Edison (Con Ed), Niagara Mohawk (NMPC), New York State Electric and Gas (NYSEG), and Rochester Gas and Electric (RG&E). For each utility, we discuss the technical and market potential for DSM, DSM programs proposed for full-scale implementation, the impact of DSM on future load growth, and major opportunities on the demand-side that should be included in future plans. We also comment on the strengths and limitations of current utility plans, offer some suggestions for improving the DSM plans, and identify several key methodological issues that the PSC and utilities will need to resolve in order to assure that demand-side options are given comparable treatment with respect to supply-side resources.

Table ES-1 summarizes the cumulative impact of DSM programs estimated by the utilities in the year 2000. The initial DSM plans of all four utilities are modest in terms of the contribution of DSM options to reducing total system peak load in the year 2000 (3-8%). These values are lower than the market potential for DSM identified in other recent studies (e.g., the Michigan Electricity Options Study concluded that aggressive DSM programs could reduce summer peak loads by about 9-11% during the next 15-20 years). Of the four utilities, Con Ed's DSM programs are probably the most ambitious because they are expected to reduce summer peak loads by 742 MW in the year 2000, which represents about 60% of the utility's projected load growth. Programs proposed by the utilities may not actually be implemented.

The quantitative indicators are most meaningfully interpreted in the context of an assessment of the utility's commitment to actually implement large-scale DSM programs. The indicator, "utility commitment," is qualitative and admittedly subjective; however, at the present time, we believe that it is the key factor. We have defined it as the utility's stated willingness or actual commitment of dollars to implement new full-scale DSM programs in the near-term. Using this standard, only Con Ed and NYSEG actually propose to implement new full-scale DSM programs. RG&E and NMPC's willingness to commit to major expenditures is contingent on satisfactory resolution of the "lost revenues" problem. DSM programs, particularly those that promote higher end-use efficiency, can cause revenue shortfalls or "lost revenues" because utility rates are calculated on the basis of a specific demand forecast and, in some cases, on both sunk and planned supply investments to meet that demand. RG&E believes that the uncertainties associated with DSM programs are too high to justify major investments.

DSM measures targeted to commercial buildings account for about 52% of Con Ed's total peak load reduction. RG&E expects that DSM options for commercial and residential buildings will produce comparable reductions in peak loads, while NYSEG's and NMPC's programs focus primarily on reducing peak demand in the residential sector. Of the four utilities, only NMPC proposes a DSM program targeted at industrial customers, an energy management information service.

Three of the four utilities identify commercial lighting as an end-use with cost-effective DSM options. Con Edison identifies other DSM options applicable to commercial buildings (e.g., motors, thermal cool storage, efficient air conditioning replacement, curtailable electric service). In the residential sector, the summer peaking utilities (Con Ed and RG&E) found that replacing existing room air conditioners with high-efficiency equipment and peak clipping measures (e.g., direct control of room air conditioners and pool motors) were cost-effective DSM options. Winter-peaking utilities (NYSEG) favored load-shifting and valley-filling DSM options (e.g., direct control of water heating and residential thermal storage).

In terms of improving future DSM plans, the most important data and analysis needs are: improved stock characterization, explicit treatment of Qualifying Facilities (QFs) in resource mix, comprehensive assessment of the achievable potential for DSM options for all end uses and sectors, research on customer response and other information relevant to DSM options (load shape impacts, incentives required to achieve certain penetration rates), and projections of avoided costs. More reliable data are available on DSM options for the residential sector than for the commercial and industrial sectors.

The PSC and utilities must also resolve several thorny analytical and methodological problems that hinder DSM program implementation. For example, the utilities used varying economic tests for initial screening and final selection of DSM options. The PSC may need to develop a more explicit treatment of the role of various economic tests in DSM program evaluation. In addition, the utilities were particularly concerned that DSM programs would lead to substantial near-term revenue losses. Thus, the timing of DSM programs is a critical issue: programs and incentives should be selected that meet the twin goals of minimizing short-run negative rate impacts while preparing for long-run expansion of DSM programs. Finally, because New York utilities are members of a centrally-dispatched power pool, DSM options should be evaluated from the perspective of optimizing benefits for the New York Power Pool. Several utilities are assessing the costs and benefits of DSM options from their individual perspectives only; for winter-peaking utilities, this approach understates the benefits of DSM measures that could reduce the Power Pool's summer peak load.

In summary, the initial DSM plans of the four utilities provide a useful foundation upon which future efforts can build. The plans highlight the principal near-term load shape objectives of the utilities (e.g., peak-clipping and valley filling) and their concern about the rate impacts of lost sales associated with conservation programs. In many cases, conservation options either were not thought to match the load shape objectives of the utilities and therefore were eliminated or were not cost-effective from the utility's perspective (particularly in the residential sector). Thus, conservation options are a relatively small component of the DSM programs proposed by the utilities. However, given that the plans involve limited reductions in electricity sales, it is likely that the PSC will be frustrated by the utilities' reluctance to identify and implement customer conservation programs. DSM planning in the long-run requires a convergence of perspectives. At the present time, there are still substantial differences among the utilities and between utilities and regulators. The PSC may well have to develop mechanisms that alter current ratemaking practices which act as disincentives for conservation investments or devise additional incentives for the utilities to encourage them to implement conservation programs more aggressively.

Table ES-1. Potential impact of utility DSM programs.

	(1) 1987 Peak Load (MW)		(2) Projected Load Growth to 2000 without DSM		(3) DSM Impact Indicators: Peak Load Reduction due to DSM (MW)		(4) % of Peak Load Growth†	(5) % of Peak Load‡	Utility Commitment§
	S	W	S	W	S	W			
Con Ed	**7964**	5655	**1216**	680	**742**	---	61%	8.1%	A
RG&E	**1205**	1105	**255**	325	**0-115**	0-85	0-45%	0-7.8%	P
NYSEG	2055	**2530**	667	**802**	62	**130**	16%	3.9%	A
NMPC	5565	**6124**	359	**752**	0-99	**0-198**	0-26%	0-2.9%	P

Sources: DSM Plans of individual utilities; New York Power Pool, "Electric Power Outlook: 1988-2004," April 1988.

† Col.(4) = Col.(3)/Col.(2); calculated based on system peak of each utility (in bold).

‡ Col.(5) = Col.(3)/Col.(1)+(2); calculated based on system peak of each utility (in bold).

§ P = planned; A = action on some programs.

● Con Ed and RG&E are summer peaking; NYSEG and NMPC are winter peaking.

INTRODUCTION

In April 1988, New York's seven investor-owned utilities filed their first long-term Demand Side Management (DSM) Plans as a result of a Public Service Commission (PSC) order which directed each utility to assess the potential for DSM in its service territory and identify cost-effective programs to capture that potential (NYPSC, 1987). The PSC's long-term goal is a planning process in which DSM competes with supply-side resources to meet future needs. Prior to this decision, the utilities had spent about $60 million on demand-side activities, principally on research and development projects, as a result of a 1984 decision that required the state's utilities to devote up to 0.25 percent of annual revenues towards investments in end-use efficiency through an Electricity Conservation Investment Program (Swanson, 1988; NYPSC, 1984). The New York PSC invited Lawrence Berkeley Laboratory (LBL) to assist Commission staff in reviewing the plans. In issuing its final order on the long-range demand-side management plans of the utilities, the New York PSC considered the comments of ten other interested parties in addition to PSC staff (New York Public Service Commission, 1988). Because these plans represented the utility's initial effort, the PSC was particularly interested in suggestions for improving future plans.

In this study, we review the DSM plans of four utilities: Consolidated Edison (Con Ed), Rochester Gas & Electric (RG&E), New York State Electric and Gas (NYSEG), and Niagara Mohawk Power Company (NMPC).[1] The study begins with an overview of the evaluation framework for DSM planning and a summary of the current load/resource balance of the NY utilities in order to provide a yardstick and a context for our review of the four utility plans. We then examine the DSM plans of the individual utilities in some detail: the technical and market potential for conservation, cost-effective programs in each sector, relative impact on future load growth, and efficiency options that are not included in the plans. Finally, we offer some suggestions for improving DSM plans in the areas of data reporting, data quality, and analysis/methodology.

EVALUATION FRAMEWORK FOR DSM PLANNING

The central issue in evaluating DSM proposals is the place this activity occupies in the larger planning environment. Perspectives often differ on this question. It is common for utilities to begin their analysis by defining a load shape objective, and then shaping DSM programs to meet that goal. EPRI has played a leading role in developing the conceptual framework for demand-side management (see Table 1) and documented case studies of utilities that have implemented a DSM planning process and programs (EPRI, 1984; EPRI, 1985).[2] This approach has

[1] We did not review the DSM plans of two smaller investor-owned utilities, Central Hudson Gas and Electric and Orange and Rockland Utilities, as well as the Long Island Lighting Company, which is in a unique position because it needs capacity immediately.

[2] Demand-side management options include strategic conservation, load management, customer generation, new uses of electricity, electrification, and variable levels of customer service.

gained broad acceptance in the utility industry (EPRI, 1988). Regulators commonly approach DSM in the context of broad policy objectives that include social issues such as environmental quality and equity among interested parties. Moreover, there is often a difference in time horizon between the regulator's perspective and the utility's. The regulator's perspective, which includes this broader social agenda, is often described in the literature as least-cost utility planning (NARUC, 1988).

Table 1. Framework for demand-side planning.

	Elements	*Approach*
1)	Define Program Objectives	• DSM as part of utility's formal strategic planning • Hierarchy of planning objectives (broad utility, operational actions, & load shape)
2)	Identify Alternatives	• Achieve load shape objectives by examining combination of end uses, technology alternatives, & market implementation methods
3)	Evaluate Alternatives	• Initial screening ("intuitive selection") • Aggregate analysis (cost/benefit analysis) • Detailed evaluation
4)	Customer Acceptance and Response	• Estimating future market demand customer participation rates • Consumer & market research • Customer adoption techniques
5)	Market Implementation	• Program design, management, marketing strategy
6)	Monitoring	• Program evaluation • Cost-effectiveness • Process and impact evaluation

Sources: Adapted from Electric Power Research Institute (EPRI) and Edison Electric Institute, "Demand-Side Management Volume 1: Overview of Key Issues," EPRI EA/EM-3597, August 1984.

EPRI, "Demand-side Planning: Sierra Pacific Power Case Study," EPRI EA-4314, November 1985.

The issue of appropriate time horizon can be critical in situations where utilities have excess generating capacity during the near term. In this case, the utility's load shape objectives often focus on valley filling and load growth, and not on long-term improvements in end-use efficiency (i.e., strategic conservation). As we will see, this issue arises with several of the New York utilities. The issue of differing time horizons is also reflected in the language of economic evaluation tests that are used to measure DSM programs. Some of these tests emphasize near-term rate effects (e.g., non-participants test); other tests attempt to capture long-term social costs. Without a common perspective on goals, the discussion of DSM programs and their economics can become a hopelessly diffuse exercise involving parties talking past each other, without much real contact and communication.

In the long run, DSM programs will only find a useful place in the utility environment if a convergence of perspectives can be achieved between the utilities and the regulators. Hirst, among others, has emphasized the importance of establishing consensus on goals and methods (Hirst, 1988a). The example of collaborative planning between utilities and government agencies in the Pacific Northwest is an instructive model of how DSM can achieve a significant role in the planning and resource acquisition process that is satisfactory to all parties (NPPC, 1986; Cherniack and Gardner, 1988). However, the particular circumstances which led to the convergence of perspectives in that case is not general. We find that the environment in New York does not support consensus at this time. Nonetheless, the dialogue among utilities, regulators, and interested parties initiated by the filing and review of these initial DSM plans provided an opportunity for the articulation of differences and creates the pre-conditions for their possible resolution. In this study, we review the current state of this dialogue in New York and assess the extent to which perspectives differ among the utilities and between their goals and those articulated by the PSC.

CURRENT SITUATION OF NY UTILITIES

New York's seven major investor-owned utilities, along with the New York Power Authority are members of the New York Power Pool (NYPP). Member utilities engage in coordinated planning as part of the Pool. The Pool's integrated planning strategy has three principal objectives: 1) defer the need for new utility sources of generating capacity, 2) reduce the lead time requirements for new capacity additions, and 3) encourage technologies for fuel diversification over the long term (NYPP, 1987). Average electricity rates (in 1986) were between 6-7 cents/kWh for the three upstate utilities, while average rates for Con Ed's customers were significantly higher (about 12.5 cents/kWh).

In 1987, the NYPP's summer electric load peaked at 24,570 MW, while the Pool's summertime capability was 30,733 MW (NYPP, 1988). The Pool's reserve margin in 1988 was projected to increase to about 32%, principally because of the completion of a 1080-MW nuclear plant at Nine Mile Point. Current reserve margins are significantly higher than the Pool's required reserve margin target (22%). The Pool's summer peak load is projected to increase at an annual rate of 1.2% during the forecast period (1988-2004). To meet increased load growth during this period, the NYPP plans to rely primarily on life extension of existing power plants (5790 MW), energy savings from additional utility-sponsored DSM programs (1300 MW), and electric generation from independent power producers (2550 MW).

Currently, most of the state's utilities have excess generating capacity, with the notable exception of LILCO (Table 2). Among the four utilities, Con Ed and RG&E are summer peaking, while NYSEG and NMPC experience peak loads during the winter. Forecasts of peak load growth range from 0.9% per year for NMPC to 2.3% per year for NYSEG. Con Ed's summer peak loads are dominated by electricity use in commercial buildings, which accounts for about 70% of the total system peak. In contrast, residential buildings are the largest contributor to RG&E and NYSEG's peak loads (40%), while the industrial sector contributes about 25% of the total system peak.

Table 2. Current situation of the New York utilities.

	Con Ed	RG&E	NYSEG	NMPC	NY Power Pool
1988 Reserve Margin (%)	34%	40%	20%	37%	32%
Peak Load Growth (%/year)	1.0%	1.5%	2.3%	0.9%	1.2%
(1987-2000 Projected)					
Peak Season†	S	S	W	W	S
Estimated Class Peak or Sales (%)‡					
- Residential	30%	40%	41%		
- Commercial/Govt	70%	33%	34%		
- Industrial	-	27%	25%		
1986 Avg. Electricity Rates (¢/kWh)§	12.5	7.2	7.1	6.1	
- Residential	14.9	8.8	9.5	7.6	
- Commercial	12.1	15.3	8.5	7.4	
- Industrial	11.9	-	6.5	4.2	

Sources: DSM Plans of individual utilities; New York Power Pool, "Electric Power Outlook:1988-2004," April 1988.

† S = Summer; W = Winter

‡ Summer peak for Con Ed and RG&E; sales for NYSEG; Con Ed's industrial customers are grouped with commercial class, although contribution to peak demand is quite small.

§ Energy Information Administration, "Financial Statistics of Selected Electric Utilities 1986" DOE/EIA-0437(86), February 1988, Table 41.

COMPARATIVE ASSESSMENT OF UTILITY DSM PLANS

The Public Service Commission (PSC) provided the utilities with substantial latitude in developing initial long-range DSM plans. The PSC established broad topics that had to be addressed by each utility (e.g., estimates of DSM potential within each sector, costs and benefits of prospective DSM programs, schedule for moving programs to full implementation), however it did not specify information requirements in detail. As a result, the information and data provided by the utilities varied significantly in terms of format, quality (e.g., reliance on empirical data vs. estimates), and level of detail, which complicates efforts to evaluate and compare the plans. With these caveats, we offer our assessment of the initial DSM plans of the utilities.

Quantification of DSM Technical Potential

The identification of large-scale demand side resources is strongly influenced by the range of DSM options considered as well as the approach taken to the initial screening process. Of the four utilities, Con Ed's plan provided the most comprehensive assessment of the technical potential for DSM. Con Ed developed a large menu of DSM options for the residential and commercial sectors, including operating strategies and rate design (about 75 measures). Con Ed estimated that these DSM options had the technical potential for reducing its summer peak in the year 2000 by about 2800 MW (compared to a market potential of 742 MW; see Table 3). Con Ed defined technical potential for DSM as the maximum attainable savings without considering cost-effectiveness or ability to physically install the measure; the market potential for DSM will be significantly lower.

NMPC argued that it was not worthwhile to devote substantial resources to quantifying the technical potential for demand-side options and thus restricted its effort to a qualitative assessment of various end uses (e.g., residential space and water heating, refrigerators, and commercial lighting). NMPC stated that there were significant aggregation problems in estimating total potential based on individual options (e.g., double-counting of savings) and that there were conceptual problems in defining the potential for certain types of measures (e.g., load-shifting options that could ultimately create a new peak in formerly off-peak hours).

RG&E and NYSEG did not attempt to quantify the technical potential for DSM. Instead, each utility evaluated the market potential for a relatively limited range of DSM options (about eight programs). Many promising options were deferred for future analysis, and neither utility attempted to identify the full technical potential of DSM programs.

Options for the industrial sector were not examined in detail by the utilities, although NMPC's Plan recognized the potential opportunities in this sector. The industrial sector probably poses the most difficult challenge for estimating the technical and market potential of DSM because of the heterogeneous nature of the sector, the diversity of firms within the same industry, as well as difficulties in forecasting energy savings from technical improvements in process-related loads. Thus, given the gaps in coverage of certain sectors, the initial plans of the utilities should not be viewed as comprehensive assessments of DSM potential.

Table 3. Potential impact of utility DSM programs.

	(1) 1987 Peak Load (MW)		(2) Projected Load Growth to 2000 without DSM		(3) DSM Impact Indicators: Peak Load Reduction due to DSM (MW)		(4) % of Peak Load Growth†	(5) % of Peak Load‡	Utility Commitment§
	S	W	S	W	S	W			
Con Ed	**7964**	5655	**1216**	680	**742**	---	61%	8.1%	A
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Sources: DSM Plans of individual utilities; New York Power Pool, "Electric Power Outlook: 1988-2004," April 1988.

† Col.(4) = Col.(3)/Col.(2); calculated based on system peak of each utility (in bold).

‡ Col.(5) = Col.(3)/Col.(1)+(2); calculated based on system peak of each utility (in bold).

§ P = planned; A = action on some programs.

● Con Ed and RG&E are summer peaking; NYSEG and NMPC are winter peaking.

Impact of Proposed DSM Programs

Table 3 presents several indicators that show the impact of DSM programs proposed by the four utilities: the cumulative reduction in peak load (MW) by the year 2000, savings from DSM programs as a fraction of projected peak load growth and as a fraction of total peak load (in the year 2000 without DSM). The initial DSM plans of all four utilities are modest in terms of the contribution of DSM options to reducing total system peak load (3-8%). Moreover, the various indicators are calculated based on the optimistic assumption that *all* proposed programs will be implemented. These values are lower than the market potential for DSM identified in other recent studies. For example, the Michigan Electricity Options Study (MEOS) concluded that aggressive implementation of conservation and load management options could reduce summer peak loads by 1500 and 650 MW respectively over the next 15-20 years (MEOS, 1987a). These DSM options would reduce total system peak load by about 9-11%, depending on assumptions regarding load growth. The estimates in the MEOS study were based on 36 DSM measures; these measures covered end uses representing 70% of residential and only 30% of commercial sector electricity use (MEOS, 1987b). Similarly, the Northwest Power Planning Council concluded that conservation resources could reduce Bonneville Power Administration's (BPA) overall demand for electricity by 14% over the next 20 years and could meet virtually all of the system's load growth for the next ten years except in the high load growth scenario (NPPC, 1986).[3]

Table 4 highlights the fact that the DSM programs proposed by the utilities will have only a minimal impact on reducing their energy requirements. Among the four utilities, the combined impact of all DSM programs typically reduces the annual sales of each utility in the year 2000 by less than one percent.

Table 4. Impact of proposed DSM programs on energy requirements (GWh).

	1987 Energy Requirement	Projected Energy Requirements in year 2000	Reduction in year 2000 Energy Requirements due to DSM
Con Ed	34,938	42,020	56†
RG&E	6,418	7,977	0-445
NYSEG	13,734	18,688	34
NMPC	34,871	40,582	135‡

Sources: New York Power Pool, "Electric Power Outlook, 1988-2004," April 1988; DSM Plans of each utility.

† Note that Con Ed projects that greatest reduction in annual energy requirements occurs in 1996 (about 138 GWh).

‡ Note that NMPC projects that greatest reduction in annual energy requirements occurs in 1995 (about 250 GWh), principally because low-cost water heating measures program ends in mid-1990s.

3 The percent savings are for reductions in average megawatts (27,063 average MW in basecase; 23,372 average MW with conservation). Average megawatts are defined as a unit of energy output over a year, which is equivalent to the energy produced by the continuous operation of one megawatt of capacity over a year period (e.g., 8760 MWh). The units are particular to the conditions in the Northwest - BPA's system is hydro-based and typically energy-constrained (not capacity).

The quantitative indicators are most meaningfully interpreted in the context of an assessment of the utility's commitment to actually implement large-scale DSM programs. The PSC directive to develop DSM plans is only a first step toward comprehensive integrated resource planning. There is clearly lacking the shared and uniform perspective on this process that Hirst, for example, has identified as a key element in its success (Hirst, 1988a). The contrasting attitudes of the utilities can best be seen by a measure of their interest in realizing DSM options over the next decade. The indicator, "utility commitment," is qualitative and subjective; however, at the present time, we believe that it is the key factor. We have defined it as the utility's stated willingness or actual commitment of dollars to implement new full-scale DSM programs in the near-term. Using this standard, only Con Ed and NYSEG actually propose to implement new full-scale DSM programs. RG&E and NMPC's willingness to commit to major expenditures is contingent on satisfactory resolution of the "lost revenues" problem.[4]

Of the four utilities, Con Ed's DSM programs are probably the most ambitious. Con Ed projects that its proposed DSM programs could reduce summer peak loads by 742 MW in the year 2000, which represents about 60% of its projected load growth. Con Ed proposes full-scale implementation of five programs in the near-term and intends to expand seven pilot programs to full-scale if ongoing pilot projects prove them to be viable. However, some of the programs may not prove to be cost-effective from the utility's perspective or the technologies are not completely developed. For example, direct control of room air conditioners and swimming pool motors programs, representing about 140 MW, are just in the development stage, because the load management hardware has not been successfully tested (Con Ed, 1988).

NYSEG proposes to implement several DSM programs, principally load-shifting measures (e.g., residential thermal storage and demand-controlled water heating), which are expected to reduce its winter peak by 132 MW in the year 2000 (NYSEG, 1988). The company's commitment to these programs appears strong and is in line with corporate objectives to improve system load factor. Most of the benefits from NYSEG's DSM programs occur far in the future (e.g., 130 MW reduction in peak load in the year 2000; 220 MW by the year 2006) and also result in only a minimal reduction in electric sales (e.g., 34 GWh out of 18,688 GWh in the year 2000).

Rochester Gas and Electric (RG&E) and Niagara Mohawk Power Company (NMPC) identify significant DSM opportunities, although both utilities are very concerned about the impacts of lost sales associated with conservation programs. RG&E projects that three large-scale DSM programs could reduce its summer peak by 115 MW in the year 2000, about 45% of projected peak load growth. However, RG&E claims that DSM program uncertainties are much too high to justify major investments at this time (RG&E, 1988). The DSM programs proposed by Niagara Mohawk Power Company (NMPC) represent about 26% of the utility's projected peak

[4] DSM programs, particularly those that promote higher end-use efficiency, can cause revenue shortfalls or lost revenues because utility rates are calculated on the basis of a specific demand forecast and, in some cases, on both sunk and planned supply investments to meet that demand. In cases where the utility has excess capacity and slow or stagnant load growth, DSM programs that reduce sales (and revenues) adversely impact the utility's ability to recover sunk investments, without either raising average rates or reducing shareholder earnings.

load growth. NMPC will initiate the DSM programs "provided that procedures for recovering lost revenue can be developed that are mutually acceptable to NMPC and the Commission." (NMPC, 1988a) In general, NMPC is reluctant to propose full-scale DSM programs at this time, because of major uncertainties regarding the cost-effectiveness of almost all DSM strategies (NMPC, 1988b). Because the two utilities have attached major contingencies to full-scale implementation of DSM programs, peak load reductions are shown as ranges in Table 3.

Table 5. Demand-side programs proposed by NY utilities.

		Cumulative Peak Savings by year 2000 (in MW)			
Sector	DSM Strategy	Con Ed	RG&E	NYSEG	NMPC
Commercial					
Lighting Repl.	C	168	52	25	
Eff. Motors	C	5			
Thermal Cool Storage	LS	41			
Energy Mgmt Systems	C	9			
Eff. A/C Repl.	PC	81			10
Curtailable Elec. Service	FLS	80			
Residential					
Replace existing room A/C	C	41	49		
Water heaters	C		4		14[†]
High efficiency refrigerators	C			5	
Room A/C - direct control	PC	119			
Pool Motors - direct control	PC	21			
Water Htg. - direct control	LS			49	42
Thermal storage - new	LS/VF			25	82[‡]
- existing	LS/VF			26	
Time of Use Rates	LS				50
Industrial					
Energy Mgmt. information					NA[§]
Other (gas/steam A/C)		177			
Total Peak Load Reduction (MW)			742	115	130

C = Conservation;
LS = Load-shifting
PC = Peak-clipping
FLS = Flexible load shape
VF = Valley filling

† Low-cost water heating measures program will reduce peak load by 42 MW by mid-1990s.

‡ NMPC estimate for residential thermal energy storage includes existing and new homes.

§ NA = not available at this time.

Where are the Large-Scale Demand-Side Resources?

Table 5 presents the cumulative peak load savings by the year 2000 for DSM programs/measures identified by each utility as potentially cost-effective. DSM measures targeted to commercial buildings account for about 75% of Con Ed's total peak load reduction. RG&E expects that DSM options for commercial and residential buildings will produce comparable reductions in peak loads, while NYSEG's and NMPC's programs focus primarily on reducing peak demand in the residential sector. Of the four utilities, only NMPC proposes a DSM program targeted at industrial customers, an energy management information service.

Commercial Sector Lighting

Three of the four utilities identify commercial lighting as an end-use for which there are cost-effective DSM options. For example, Con Ed proposes three commercial lighting programs (incandescent to fluorescents, relamping of fluorescents, and high-efficiency ballasts) which have installed costs that range between $400-900/kW. By the year 2000, Con Ed estimates that its programs can reduce peak loads by 168 MW, about 40% of the technical potential, which it estimates at about 400 MW. High-efficiency ballasts have the largest market potential (90 MW). Based on pilot studies, Con Ed also attempts to account for the effect of free riders, which reduces the market potential by about 13%. NMPC found that the penetration of efficient lighting technologies was quite low in most commercial building types (<10%) with the exception of hospitals. Thus, NMPC estimated that fluorescent relamping and conversion of incandescents to fluorescents had the technical potential to reduce peak loads by about 107 MW, although it did not propose these programs in its DSM plan. These studies suggest that the technical potential for reducing lighting electricity use is quite large; the challenge is to fully exploit the identified potential. Thus, differences in program design (rebate levels, delivery mechanism, marketing strategies) and key input assumptions (problem of free riders) need to be examined in more detail.

Commercial Sector: Other End Uses

Con Ed identifies several other DSM options that are applicable to commercial buildings (e.g., motors, thermal cool storage, efficient air conditioning replacement, curtailable electric service), while NMPC proposes a program to promote the installation of energy-efficient HVAC equipment in new commercial construction. We suspect that these other DSM options identified by Con Ed could also represent significant cost-effective opportunities for the three upstate utilities. Their potential reduction in system peak load may be relatively smaller because the commercial sector accounts for a smaller share of total system peak for the three upstate utilities (e.g., 56% for Con Ed vs. 20-25% for NYSEG and RG&E). In fact, NYSEG's plan included a preliminary study of possible new DSM programs, which found that curtailable electric service could reduce winter peaks by about 43 MW in 1990, while commercial HVAC rebates could reduce winter peaks by 12 MW.

Recent studies conducted by the Electric Power Research Institute and Lawrence Berkeley Laboratory also document the tremendous opportunities that exist for improving the energy efficiency of commercial buildings. For example, EPRI (1987a) developed technical briefs on over

20 commercially-available DSM options for commercial sector buildings. LBL reviewed and evaluated the technical potential of selected conservation technologies for California's commercial sector in the following end uses: space cooling, ventilation, refrigeration, motors, lighting, and windows (Usibelli et al, 1985). Utilities, such as Texas Utilities and Southern California Edison, estimate that they have each shifted about 30 MW of peak load because of cool storage installations in commercial buildings (Piette, 1988). The three upstate utilities should examine these additional commercial sector DSM options in future plans.

Residential Sector

In the residential sector, the summer peaking utilities (Con Ed and RG&E) found that replacing existing room air conditioners with high-efficiency equipment along with several peak clipping measures (e.g., direct control of room air conditioners and pool motors) were cost-effective DSM options. Utilities with winter peaks (NYSEG and NMPC) favored load-shifting and valley-filling DSM options (e.g., direct control of water heating and residential thermal storage). In addition, several utilities proposed conservation programs for water heating, either installation of low-cost measures (NMPC) or replacement of existing water heaters with high efficiency units (RG&E).

Results from other studies suggest that residential DSM conservation options can be particularly attractive to customers. For example, in the MEOS study, residential lighting programs accounted for 33% of the electricity savings, and were particularly effective in reducing winter peak loads (Krause et al, 1988). These type of programs should be explored by New York's winter-peaking utilities, NYSEG and NMPC. In their plans, residential conservation options either were not thought to match the load shape objectives of the utilities and therefore were eliminated or were not cost-effective from the utility's perspective. Thus, conservation options are a relatively small component of the DSM programs proposed by the utilities.

In looking at residential DSM options, it is important to account for the impact of the National Appliance Energy Conservation Act (NAECA) of 1987, which mandates minimum levels of energy efficiency for selected new residential appliances (refrigerators, freezers, central and room air conditioners, heat pump, electric and gas water heaters, and gas furnaces). For example, a recent study by Geller (1988) concluded that utility-funded rebates may still be a cost-effective strategy for several products, including highly-efficient air conditioners and heat pumps; appliances in which there are significant efficiency differences between the top-rated models and the initial standards (i.e., about 30-50%). Program design of future utility appliance rebate programs may focus more on accelerating the turnover of inefficient existing stock, rather than stimulating purchase of high-efficiency new equipment.

High-Efficiency Refrigerator Programs

All four utilities considered various types of refrigerator rebate programs. Only NYSEG actually proposed a rebate program, while the other three utilities concluded that it was not cost-effective. The differences among the utilities appear to be primarily related to differing views on program design and costs, although there are significant gaps in data reporting which make it difficult to draw definitive conclusions (Table 6). For example, RG&E's program would stimulate customers to replace existing refrigerators before the end of their useful lifetime and includes very high penetration rates. The other three utilities designed their programs toward influencing the decisions of those customers purchasing new refrigerators or replacing existing refrigerators and used much lower penetration rates over a longer time period than RG&E (although overall penetration levels are comparable). RG&E's proposed rebate levels are more than an order of magnitude greater than those proposed by NYSEG and NMPC and are out of line with the estimates of other studies. Eto et al (1988) examined market discount rates for refrigerators by looking at historic appliance purchase decisions in conjunction with historic energy prices and found that market discount rates are high (80-100%). They concluded that rebates must essentially offset the entire increase in *first* cost of each successive level of efficiency; not the entire cost of the appliance. At such levels, the programs can not be cost-effective.

Table 6. High-efficiency refrigerator programs: Key assumptions.

	Con Ed	RG&E	NYSEG	NMPC
Program Design	New/Repl.	All Existing	New/Repl.	New/Repl.
Target Market (homes)	NA	170,000	600,000	NA
Penetration Level (%)	NA	50%	41%	NA
Penetration Rate (%/yr)	NA	100%/yr in 1 yr.	3.5%/yr over 12 yrs	NA
Cost ($/unit)				
- Administrative	NA	15	20†	NA
- Field labor	NC	10	NC	NC
- Incentive/Rebate	NA	900	62	29
Total Cost ($/unit)	NA	925	82	NA
Electricity Savings (kWh/unit-yr)	NA	NA	180	104

Sources: DSM Plans of individual utilities. Con Ed, p. 94-95; RG&E, p. 42; NYSEG, p. V-A-11,23,24; NMPC, p. 6-5,7.

† Based on administrative and promotional costs of $240,000 and $150,000/year, respectively which was divided by average number of rebates for refrigerators over study period.

NA = information not provided in DSM plan

NC = not considered

Fuel-switching: Direct Load Control vs. Gas-fired Water Heating

It is not surprising that electric utilities typically impose a fuel choice constraint on the range of DSM options; they only consider DSM measures that preserve customers. However, omission of fuel switching measures is not necessarily appropriate for regulators that want to consider the societal perspective in evaluating resource options. We have developed an illustrative example for electric water heating which compares a DSM option that electric utilities often propose to reduce winter peak load (i.e., direct control of water heaters) with an alternative approach that promotes conversion to gas water heating (Table 7). We consider both the utility and customer perspectives.

NYSEG proposes to install controlled electric water heating in about 87,500 homes (of which approximately 27% are new construction) by the year 2003 by offering a customer rebate of $200/unit. This produces total winter peak load savings of about 61 MW, based on their estimate of 0.7 kW savings per unit.

An alternative option is for the utility to promote installation of gas-fired hot water equipment in the new home market. Fuel choice decisions in new construction are dependent on the first costs of the heating/hot water equipment for the builder, access to gas service, and hook-up and metering costs. NYSEG forecasts that 70-80% of the new homes in its service territory are expected to have electric hot water. We estimate that a program to promote gas-water heating in new homes could reduce NYSEG's peak load by about 17 MW in the year 2000, assuming peak load reduction per unit is comparable to that obtained from water heater control (0.7 kW/unit), and comparable market penetration rates as the utility projects for controlled electric water heating. This assumes of course that the homes have access to gas hook-ups. This example is quite simplified and ignores revenue losses from reduced electric sales as well as revenue from increased gas sales. In addition, going from individual end uses and DSM options to system-wide impacts requires explicit analysis of diversity and coincidence effects.

>From the customer's perspective, we assume that it costs between $200-300 extra to convert to gas water heating (includes cost of extending gas line and installing necessary venting). At current rate schedules and typical hot water usage, annual expenditures per household are about $430 for an uncontrolled electric hot water compared to $195/year for a controlled water heater on a special day/night rate schedule and $138/year for a gas-fired water heater. If customers pay the additional costs for gas service, the investment has a payback time of about one year compared to conventional electric water heating and between 3-5 years compared to the controlled water heating option (excluding utility incentives). This example suggests that the fuel-switching issue should be looked at in a more rigorous fashion.

Table 7. Controlled electric water heating vs. gas water heating.

	Conv. Elect. Water Heating	Controlled Elect Water Heating	Efficient Gas-fired Water Heaters
Utility Impacts			
Program Costs			
- Customer Rebates		$200/unit	?
- Builder Incentives		$37/unit	?
- Admin/Marketing		$55/unit[a]	?
Installed Load	4.5 kW		
Peak Savings (Winter)		0.7 kW/unit	0.7 kW/unit(?)[b]
Target Market		175,000	47,200[c]
50% Market Penetration		87,500	23,600
Total Peak Load Savings (MW)		61 MW	17 MW(?)
Customer Impacts			
Usage	4300 kWh/yr	4300 kWh/yr[d]	230 therms/yr[e]
Energy Price	$0.098/kWh	$0.108/0.042/kWh[f]	$0.60/therm
Annual Energy Expenditures ($)	$430/yr	$195/yr	$138/yr
Gas Conversion Cost			$200-300

Sources: DSM Plans of individual utilities. NYSEG, p. V-A-10,11,17,18. NMPC, p. 3-9,A-8.

Notes: [a] Administration and promotional costs of $300,000 and $100,000 per year respectively were divided by average number of rebates (i.e., about 7333/year) to derive per unit costs.

[b] We have assumed peak savings of 0.7 kW/unit, which needs to be verified in order to account for system diversity and coincidence factors. Revenue losses from reduced electric sales are ignored; increased gas sales are also not included.

[c] 90% of potential new home market identified by NYSEG.

[d] Annual electricity use for water heating based on and engineering estimates from NMPC.

[e] Assumed efficiency of 65% based on typical efficient gas water heater and similar usage pattern as typical customer. (ACEEE, "The Most Energy-Efficient Appliances," 1985.)

[f] SC-1 rates is regular tariff for all time periods; SC-8 rate is time of use rate (used by customers with controlled water heating). For customers with controlled water heating, we assumed that 95% of the hot water use occurred during the off-peak period (K. Fuller, NYSEG, personal communication).

DSM Options for New Construction: Capturing Lost Opportunity Resources

The utilities should emphasize DSM programs that attempt to improve the efficiency of new construction, given their current situation (i.e., excess generating capacity). The timing of these type of programs coincides well with utility revenue and capacity needs: minimal lost sales in the near-term combined with development of a long-term DSM resource that can be acquired more cost-effectively by promoting energy-efficient new construction compared to the future costs of retrofitting additional measures. Facing a similar near-term resource glut, the Northwest Power Planning Council (NPPC) and Bonneville Power Administration (BPA) have established several innovative programs, including building performance standards for new residential and commercial construction and design assistance programs for builders, to ensure energy-efficient construction of the new stock. Developing a comprehensive approach will require cooperation from the appropriate institutions within the State that have jurisdiction over building performance standards.[5]

Weatherization Programs for Existing Stock

The utilities in New York conduct home energy audits and offer loans at below-market rates for several weatherization measures (e.g., insulation, storm windows, and infiltration reduction measures) as part of a mandated program called Home Insulation and Energy Conservation Act (HIECA). These envelope measures were generally not included as part of the DSM plans of each utility because they have been administered and evaluated as part of the HIECA program. NMPC considered evaluating these measures but was hampered by the lack of adequate information; NMPC is currently sponsoring a pilot project to collect this data. Two obvious factors that affect the cost-effectiveness and technical potential of weatherization programs are the thermal integrity of the existing stock and the fraction of homes that heat with electricity. NYSEG reports that about 15% of the homes in its service territory heat with electricity, while NMPC estimates that about 11% of its homes are electrically-heated. In future plans, it makes sense for the utilities to evaluate the technical and market potential for improving the thermal integrity of the existing residential stock as part of their DSM programs.

Strengths and Limitations of Utility DSM Plans

Regulators that are evaluating utility DSM plans probably will find it useful to establish broad guidelines that can serve as an independent yardstick against which individual plans can be assessed. We developed such criteria and used them to evaluate the strengths and limitations of the DSM plans of the four utilities. The areas considered were:

(i) Comprehensiveness of DSM Options - How comprehensive was the assessment of potential DSM options (e.g., extent to which the plan considered all end uses, sectors, and options that included different load shape objectives)?

[5] In California, the California Energy Commission has a legislative mandate to promulgate energy performance standards for new construction as part of its long-term resource planning functions.

(ii) Assessment of DSM Technical and Market Potential - How well did the utility assess the technical and market potential of DSM options (e.g., scope, approach to screening DSM options and estimating energy and demand impacts)?

(iii) Program Costs - Are DSM program costs reasonable and well-documented (e.g., are incentive levels for programs based on pilot studies or estimated, relation between participation rates and program costs, utility administrative costs)?

(iv) Program Design and Implementation - Are the programs logical given the utility's assessment of the DSM potential and the costs and benefits of the program? To what extent has the utility paid attention to how individual DSM options (end-use technologies) are combined into programs (the utility's delivery system)? Did the utility evaluate alternative program designs and strategies?

(v) Economic assessment of DSM - What economic tests were used by each utility to evaluate costs and benefits of DSM programs? Were they appropriate? Did the utility consider other factors in screening and selecting DSM programs (e.g., customer service, ability to avoid lost opportunities, equity issues - availability to low-income customers)?

(vi) To what extent did the utility's economic analysis incorporate transactions with the Power Pool (e.g., were avoided costs estimated from the perspective of the utility as an island)?

(vii) Commitment of utility resources to assure development of DSM resources - How much effort is the utility devoting to DSM data collection/analysis, research and development, and pilot programs? Is the utility's program evaluation effort adequate?

Not surprisingly, the initial DSM plans of the utilities tend to be uneven. Several utilities were particularly strong in some areas, but could benefit from additional efforts in other areas (see Table 8). For example, Con Ed's DSM plan provided a fairly comprehensive assessment of the technical and market potential of a wide-range of DSM options, including an estimate of "free rider" effects for each program. However, its documentation of program costs was quite sketchy. Con Ed did not explicitly include the utility's administrative and incentive costs in its economic analysis. Initially, these cost elements were arbitrarily set at zero in the non-participant test; the amount by which the option passed the test established a cost guideline for utility expenditures. While this may be a useful analysis technique, it tends to lower confidence in the projected savings for various DSM programs. Achievement of the market potential of a utility DSM program is closely linked to the program's design and required incentive levels; Con Ed's approach masks this key feature.

Conversely, NYSEG's DSM plan considered a rather limited number of DSM programs/measures. However, programs that were evaluated by the utility had a detailed assessment of energy and peak demand impacts, the target market for each program, and components of program costs. Assumptions were clearly stated and typically based on experience in pilot programs, which tends to increase confidence in the reliability of the savings and cost estimates. In addition, NYSEG's DSM plan had a particularly strong link between the utility's Action Plan (e.g., strategic marketing action plan endorsed by top management) and its longer-term DSM objectives. NYSEG's challenge is to broaden its menu of DSM options to include additional strategic conservation programs. This issue is related to the relatively short time horizon that the company uses to define its current load shape objectives (e.g., load-shifting and valley-filling). In the longer run, strategic conservation may play a much larger role.

Table 8. Strengths and limitations of utility efforts.

	Con Ed	RG&E
DSM Options		
- Comprehensiveness	Excellent (75 measures)	Limited (7 programs)
- Assess Tech. Potential	Thorough	No
- Market Potential	Well-developed (quantified free-rider effects)	Exogenous penetration rates; not based on pilot studies
- Program Cost Data	Poor documentation	Incentive levels are excessive
- Program Design & Implementation	Transition to full-scale programs linked to pilot program results & cost-effectiveness	Blitz programs primarily; no timing strategy; penetration levels and time allowed to achieve them are unrealistic
Economic Tests/Analysis		
Screening	Total resource cost; participant	
Selection	Non-participant†	Rev. Requirements
Program Start Date	Non-participant†	
- Interaction with Power Pool	No	Yes
Commitment of Utility Resources to Development of DSM Options	Strong pilot programs, particularly commercial sector	Accelerating R&D and pilot program efforts; program evaluation needs additional emphasis

† DSM program costs, both administrative & incentives, set equal to zero.

Table 8. Strengths and limitations of utility efforts (cont.).

	NYSEG	NMPC
DSM Options		
- Comprehensiveness	Limited (6 programs; building standards)	Good (~50 options initially; 20 measures for further screening)
- Assess Tech. Potential	No	Illustrative; Qualitative only
- Market Potential	Driven by load shape objective; good data on energy demand impacts by measure.	Bundle measures by load shape impact; aggregate impact tested only
- Program Cost Data	Well-documented; reasonable & well-adjusted incentive levels	Well-documented; based on pilot program results
- Program Design & Implementation	Penetration level bounded by system peak impacts; pilot study on alt. program design	Long range timing drives implementation level
Economic Tests/Analysis		
Screening		Participants test
Selection	Rev. requirements	Non-participant
Program Start Date		
- Interaction with Power Pool	No	Yes
Commitment of Utility Resources to Development of DSM Options	Strong link between action plan and long-term DSM plan; good R&D program on load-shifting measures and DSM information exchange (NORDAX)	Very strong R&D program; good experimental design on pilot programs, particularly real-time pricing

RG&E's DSM plan was a useful exercise for the utility because it highlighted the commitment of utility resources that are required in order to develop full-scale DSM programs. However, the plan is primarily illustrative and focuses on the development of a planning methodology that can be used to evaluate DSM options and identify key uncertainties. The initial plan does not provide a basis to guide implementation of large-scale DSM programs. RG&E needs to address a broader range of DSM options and assess alternative implementation strategies and program designs based on pilot studies or the experience of other utilities. RG&E's program design focused too much on "blitz" programs that required very high incentive levels to induce high participation rates. RG&E's economic analysis of the costs and benefits of DSM was relatively sophisticated; their analysis included the impact of DSM options on the sale or purchase of economy energy from the Power Pool.

NMPC's economic analysis also attempted to account for interactions with the Power Pool. In addition, NMPC's Plan reflects its strong commitment to demand-side R&D activities - the Company's market research and stock characterization are quite developed, and its pilot programs include strong monitoring and evaluation components. In terms of limitations, NMPC's analysis bundles several programs by load shape, which makes it impossible to evaluate the merits of individual programs. For example, NMPC's combined conservation program is an aggregation of several individual programs, including residential low-cost water heating measures, residential refrigerator rebate program, commercial sector efficient exit lighting, and commercial sector efficient motors. In addition, NMPC's approach to implementing DSM programs is so cautious that, in some cases, the utility appears to miss some obvious opportunities, which could be identified based on the experience of other utilities. For example, NMPC identifies commercial lighting efficiency options as having significant technical and market potential for DSM, yet it was the only utility that did not propose a DSM program in this area (although the company is currently conducting a pilot study).

Finally, we note that all four NY utilities have a reasonably strong commitment to developing the infrastructure to conduct, monitor, and evaluate demand-side programs. In particular, R&D and pilot program efforts are accelerating; the challenge is to make an effective transition to full-scale implementation of DSM programs.

SUGGESTIONS FOR IMPROVING DSM PLANS

Data Reporting Issues

In most cases, it was quite difficult to track down the pertinent information on proposed DSM options in order to independently evaluate the proposals. To some extent, this is a by-product of the approach adopted by the New York PSC, which allowed the utilities substantial flexibility in developing their long-term DSM plan. The New York approach is probably less burdensome on the utilities from a reporting standpoint, however it does not lend itself to independent confirmation or evaluation by commission staff or third-party intervenors. It may well have the perverse effect of fostering an adversarial environment between utilities and intervenors. Intervenors are likely to be distrustful of the utility's evaluation of DSM options, particularly if key input data are either omitted, incomplete, or difficult to check because sources for assumptions are not included.

It is interesting to contrast this approach with the process that has evolved in California. The California Energy Commission, Public Utilities Commission, and utilities have developed a standardized approach that is used in DSM and integrated resource plans. Typically, this involves: 1) reporting requirements, established through public workshops in which all parties participate, and 2) end-use and sector data, DSM plans, and supply-side resource activities, reported on standard forms (e.g., the California utilities report inputs in their Common Forecasting Methodology filing). The standard forms for DSM programs include information on program design, targeted end uses, committed funding, scope, net impacts on peak, intermediate, and baseload capacity, and data sources. This type of the process can be expensive and time-consuming and increases the regulatory burden on utilities, although it greatly facilitates independent assessment of plans by regulators and intervenors. Proponents of a standardized approach also argue that the additional public scrutiny may help parties develop consensus on resource requirements and avoid expensive mistakes.

We believe the merits of the California approach outweigh its disadvantages and urge the PSC to solicit utility input to develop common reporting formats for key assumptions and input data used in evaluating DSM options. One could imagine incorporating elements of each utility's current reporting format to produce a consensus approach that would make it much easier to assess the DSM plans of each utility.

Data Requirements/Quality

Table 9 summarizes our assessment of the data and analysis needs for improving future DSM plans. Items that in our opinion are highest priority are indicated by an asterisk. These include: improved stock characterization, explicit treatment of qualifying facilities (QFs) in resource mix, a comprehensive assessment of the market potential for DSM options for all end uses and sectors, research on customer response and other information relevant to DSM options (load shape impacts, incentives required to achieve certain penetration rates), and avoided cost projections. In general, more reliable data are available on DSM options for the residential sector. The commercial and industrial sectors are less well characterized, particularly in terms of peak impacts by end use and achievable DSM potential.

The avoided supply costs are one critical element in the evaluation of the benefits of DSM options. The utilities projections of avoided costs should be based on their long-term resource outlook and include sensitivity analyses of varying fuel prices and levels of independent power production. We also believe that additional work needs to be done in terms of quantifying the impact of various DSM options on avoided transmission and distribution losses and costs.

Table 9. Data/analysis needs for improving DSM plans.

	Current Situation	Priorities for Future
Electricity Demand Forecast		
Sales Forecasts by Sector	Type of Model	
- Residential	Appliance End Use	Best characterized
- Commercial	Econometric	Incorporate engr. end use approach
- Industrial	Econometric or typical customers	Needs improvement; address heterogeneity, market conditions, cogeneration and bypass
Peak Load Models	HELM	Focus on commercial & industrial load shapes
*Peak Impacts by End Use	Incomplete	Key area; needs improvement (esp. comm./ind.)
Appliance Saturation	2 of 4 utilities report	Comm'l office equipment (computer loads, internal heat gains)
*Stock Characterization (EUIs)		Focus on commercial sector
Thermal Integrity	Not included	Impt. for assessing weatherization pgms.
Generating Resources		
Resource Mix		Include in future plan for reference
Reserve Margin		Include in future plan for reference
*Treatment of QFs	Inconsistent among util.	Include in load/resource balance

* Indicates high priority needs

Table 9. Data/analysis needs for improving DSM plans (cont.).

	Current Situation	Priorities for Future
DSM Options		
Assess Tech. Potential	1 of 4 utilities	Useful for targeting DSM opportunities
*Achievable Potential	Few end uses, mostly resid.	High priority; focus on comm. & ind. sector
Elect. Savings	Engr. estimates	Measured data needed to confirm engineering estimates
Load Shape Impacts	Engr. estimates	High priority although metered data is expensive
DSM Costs		
- Installed Cost	Pilot pgms; other utilities	
* - Incentive/Rebate	Pilot programs	Experience from full-scale implementation
- Administration	Pilot programs	
Penetration Level	Estimates	Establish targets for full-scale pgms
* Penetration Rates	Pilot pgms.	High priority; based on experience with full-scale pgms.
Cost/Benefit Analysis		
*Avoided Costs	Key for assessing DSM benefits	Use long-run avoided costs
- Energy	Information available but not always included in Plan	Include fuel price sensitivity analysis
- Generation	Used combustion turbine or combined cycle proxy	Agree on allocation of capital-related costs and reliability discounting factor
- Trans.& Dist. (T&D)		Quantify DSM impacts on T&D costs; area needs additional work
- Add'l Time differentiation		Standardize and define costing periods

* Indicates high priority needs

Analytical/Methodological Issues

The PSC and utilities must also resolve several thorny analytical and methodological problems. We briefly discuss several of these issues: 1) economic tests for DSM measures, 2) timing of DSM programs, 3) DSM uncertainties vs. supply-side uncertainties, 4) key factors to assess in sensitivity analysis, and 5) evaluating DSM options: individual utility vs. power pool.

Economic Tests for DSM Measures

The four utilities used varying economic tests for initial screening and final selection of DSM options. There is a large literature on the economic tests associated with DSM (EPRI, 1987b; CPUC, 1987; Krause and Eto, 1988). For example, Con Ed and Niagara Mohawk argued strongly that the unit cost test (i.e., the non-participants or ''no-losers test) should be used in selecting DSM options and in determining appropriate start dates (Hartnett et al, 1988). The non-participants test measures the distribution equity impacts of demand-side programs on non-participating utility ratepayers. Benefits include changes in utility production costs (i.e., avoided generation, T&D capital costs, and avoided fuel costs); costs include program administrative costs, incentives paid to participants, and "lost revenues", which are just the aggregate impact of savings by individual participants on the utility. RG&E and NYSEG point out that all DSM options failed the non-participants test. Both RG&E and NYSEG selected DSM options based on the utility revenue requirements test. The utility revenue requirements test represents total discounted benefits and costs for the entire study period. Benefits include transactions, capacity and production cost benefits. Costs include costs of the program to the utility but exclude revenue impacts. It is clear that reliance upon the non-participants test will severely limit the amount of resources available from DSM options. From our perspective, the PSC needs to develop a more explicit treatment of the various economic tests and their role in program evaluation. For example, the total resource cost test has a plausible claim to priority among the several tests because it addresses the resource allocation issue directly from a broad social perspective. This test includes both utility and consumer costs balanced against avoided cost benefits. Institutional constraints dictate the use of other tests as well. In fact, after the utilities filed their initial DSM plans, the NYPSC issued an Order which stated that the unit cost test was too restrictive and concluded that a variety of factors should be considered in evaluating DSM programs (e.g., ability to avoid lost opportunities, environmental benefits or costs of substituting DSM, equity concerns, customer service, and potential for enhancing the economic competitiveness of local industry (NYPSC, 1988b).

Timing of DSM Programs

The utilities were particularly concerned that DSM programs would lead to substantial near-term revenue losses. In the long-run, the avoidable costs associated with new supply-side resources should offset future revenue losses of many DSM options. It may be advisable to start implementation of DSM programs now at a modest scale to realize the long-term benefits of such resources. Such efforts could be expanded as the resource balance becomes tighter. Thus, the timing of DSM programs is a particularly critical issue: programs and incentives should be selected that meet the twin goals of minimizing short-run negative rate impacts while preparing for long-run expansion of DSM programs. It would also be useful to integrate this planning with the identification of long-run avoided costs.

DSM uncertainties vs. supply-side uncertainties

The utilities expressed significant concerns about key aspects of DSM programs (e.g., customer response, marketing and administrative costs, and load shape impacts). One utility claims that the uncertainties are so great that it is not feasible to implement large-scale DSM programs. We make two observations: 1) several utilities failed to adequately distinguish between sources of uncertainty, and 2) the utility's analysis seemed to implicitly downplay the uncertainties associated with supply-side resources. With respect to the first point, one or two of the utilities lumped exogenous factors (e.g., regulatory treatment, load growth, independent power production, and relative gas and electric prices) with uncertainties that are specific to DSM programs (e.g., program costs and load shape impacts). The exogenous factors listed are obviously not unique to demand-side options and would affect the costs and benefits of supply-side resources as well (Hirst and Schweitzer, 1988).

Key factors to assess in sensitivity analysis

Most of the utilities incorporated sensitivity analysis in their DSM plans in order to evaluate the cost-effectiveness of DSM options under different scenarios. This approach is now standard practice in utility resource planning. The key factors that should be included in a sensitivity analysis in future DSM plans are: differing assumptions about load growth, fuel prices and avoided costs, the level of independent power production, and varying assumptions in the estimates of the costs, savings, and customer response to DSM programs. The range in uncertainties associated with implementing DSM programs can be reduced as utilities gain experience with conducting pilot programs or incorporate lessons learned from utilities in other regions.

Evaluating DSM options: Individual Utility vs. Power Pool

Two utilities (NYSEG and Con Ed) evaluated the costs and benefits of DSM options from their individual perspective only and did not consider interactions with the Power Pool. This approach is clearly a simplified representation of the actual operating environment of the utilities. The key question for regulators is what bias does this approach introduce in terms of evaluating the cost-effectiveness of DSM programs. For example, does a utility with a winter peak understate the benefits of DSM measures that can reduce summer peak load (which is the peak period for the Pool) if it evaluates those options solely from its own avoided costs of supply? DSM options that are economic from the perspective of the Power Pool (i.e., reduce summer peak) may not be economic from the perspective of a winter-peaking utility. The PSC will likely have to address both modeling and policy issues related to the Power Pool in order to give individual utilities proper signals and adequate incentives with regard to assessing the costs and benefits of DSM options.

CONCLUSION

The initial DSM plans of the four utilities provide a useful foundation upon which future efforts can build. The plans highlight the principal near-term load shape objectives of the utilities (e.g., peak-clipping and valley filling) and their concern about the rate impacts of lost sales associated with conservation programs. In many cases, conservation options either were not thought to match the load shape objectives of the utilities and therefore were eliminated or were not cost-effective from the utility's perspective (particularly in the residential sector). Thus, conservation options are a relatively small component of the DSM programs proposed by the utilities. However, given that the plans involve limited reductions in electricity sales, it is likely that the PSC will be frustrated by the utilities reluctance to identify and implement customer conservation programs. DSM planning in the long-run requires a convergence of perspectives. At the present time, there are still substantial differences among the utilities and between utilities and regulators. The PSC may well have to develop mechanisms that alter current ratemaking practices which act as disincentives for conservation investments or devise additional incentives for the utilities to encourage them to implement conservation programs more aggressively.

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REFERENCES

California Public Utilities Commission (CPUC) and California Energy Commission, "Standard Practice Manual: Economic Analysis of Demand-side Management Programs," December 1987.

M. Cherniack and M. Gardner, "A Review of Conservation Experience in the Pacific Northwest and some Policy Issues Raised," *Proc. of the 1988 ACEEE Summer Study on Energy Efficiency in Buildings,* Vol. 8, Washington DC, August 1988.

Consolidated Edison (Con Ed), "1988 Demand-Side Management Plan," New York NY, April 1988.

Electric Power Research Institute (EPRI) and Edison Electric Institute, "Demand-Side Management, Volume 1: Overview of Key Issues," EPRI EA/EM-3597, August 1984.

Electric Power Research Institute (EPRI), "Demand-side Planning: Sierra Pacific Power Case Study," EPRI EA-4314, November 1985.

Electric Power Research Institute (EPRI), ''Demand-Side Management, Volume 4: Commercial Markets and Programs,'' EPRI EA/EM-3597, September 1987a.

Electric Power Research Institute (EPRI), ''TAG Technical Assessment Guide, Volume 4, Fundamentals and Methods, End Use,'' EPRI P-4463-SR, August 1987b.

Electric Power Research Institute (EPRI), ''DSM Regulatory Impacts,'' EPRI P/EM-5631, March 1988.

J. Eto, J. McMahon, J. Koomey, P. Chan, and M. Levine, ''The Regional Energy and Economic Impacts of The National Appliance Energy Conservation Act of 1987,'' Lawrence Berkeley Laboratory, LBL-25471, June 1988.

H. Geller, ''Prospects for Residential Incentive Programs in light of the National Appliance Efficiency Standards,'' A Symposium on Demand-Side Management, Albany NY, May 3-5, 1988.

J. W. Hartnett, T. Flaim, and S. C. Molodetz, ''Assessing Demand-side Program Strategies'' *Proc. of the 1988 ACEEE Summer Study on Energy Efficiency in Buildings,* Vol. 8, Washington DC, August 1988.

E. Hirst, ''Integrated Resource Planning: The Role of Regulatory Commissions,'' *Public Utilities Fortnightly, 122:6*, September 15, 1988a.

E. Hirst, ''Creating Viable Utility Conservation/Load Management Programs,'' *Energy: The International Journal, 13:33* (1988b).

E. Hirst and M. Schweitzer, ''Uncertainty in Long-term Resource Planning for Electric Utilities,'' ORNL/CON-272, Oak Ridge, TN, December 1988.

F. Krause et al., ''Analysis of Michigan's Demand-Side Electricity Resources in the Residential Sector'' Lawrence Berkeley Laboratory, LBL-23025, April 1988.

F. Krause and J. Eto, ''Least-Cost Utility Handbook for Public Utility Commissioners: Volume 2, The Demand-Side: Conceptual'' and Methodological Issues, NARUC, December 1988.

Michigan Electricity Options Study (MEOS), ''Integrated Analysis: Issues, Assumptions, and Methodologies'' Work Group #6 Report, October 1987a.

Michigan Electricity Options Study (MEOS), ''Demand-Side Resource Options'' Work Group #2 Report, October 1987b.

National Association of Regulatory Utility Commissioners (NARUC), ''Least-Cost Utility Planning Handbook for Public Utility Commissioners,'' Washington, DC, July 1988 (draft).

New York Power Pool (NYPP), "Integrated Planning Strategy of the New York Power Pool" April 1987.

New York Power Pool (NYPP), "Electric Power Outlook: 1988-2004" April 1988.

New York Public Service Commission (NYPSC), "Opinion and Order Requiring the Development of Conservation Programs," Opinion 84-15, May 21, 1984.

New York Public Service Commission (NYPSC), "Order Directing the Submittal of Annual Demand-Side Management Plans," Case 28223, September 22, 1987.

New York Public Service Commission (NYPSC), "Order Concerning Long Range Demand Side Management Plans," Case 28223, December 23, 1988.

New York Public Service Commission (NYPSC), Opinion and Order Concerning Integrated Planning and Ratemaking Issues, Opinion No. 88-20, July 26, 1988.

New York State Electric and Gas Corporation (NYSEG), "Long-Range Demand Side Management Strategy," Binghampton, NY, April 1988.

Niagara Mohawk Power Corporation (NMPC), "Demand Side Management Plan 1988," Syracuse, NY, April 1988a.

Niagara Mohawk Power Corporation (NMPC), "Amendment to the 1988 Long-range Demand Side Management Plan," Syracuse, NY, August 1988b.

Northwest Power Planning Council (NPPC), "Northwest Conservation and Electric Power Plan," Portland, OR, 1986.

M. A. Piette, "Technology Assessment: Thermal Cool Storage in Commercial Buildings," Lawrence Berkeley Laboratory, LBL-25521, January 1988.

Rochester Gas & Electric, "1988 Demand-Side Management Plan," April 13, 1988.

S. Swanson, "Results of the Electricity Conservation Investment Program," Proceedings of A Symposium on Demand-Side Management: Managing the Shape of Tomorrow, Albany NY, May 1988.

A. Usibelli et al, "Commercial Sector Conservation Technologies, Lawrence Berkeley Laboratory, LBL-18543, February 1985.