ACHIEVABLE ELECTRICITY CONSERVATION POTENTIAL: THE ROLE OF UTILITY AND NON-UTILITY PROGRAMS

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ABSTRACT

In recent years there has been extensive debate among utilities, regulators, and intervenors on the amount of electricity and peak demand savings demand-side management (DSM) efforts can actually achieve. For the most part, this debate has been marked by extensive rhetoric, but only limited objective data. In an attempt to narrow the range of this debate, this paper summarizes recent objective data related to the question of achievable conservation potential, including: (a) actual DSM results achieved by utilities with particularly aggressive DSM programs; (b) long-range resource plans recently filed by several major utilities; (c) an in-depth study on the amount of conservation New York State's three largest utilities can achieve over a 10-18 year period; and (d) a study on the amount of electricity that can be saved in New York as a result of market forces, codes, and minimum efficiency standards.

Two major findings emerge from this analysis: (1) Through utility-operated DSM programs, the average utility can likely reduce its annual electricity sales by approximately 1% per year, for a period of at least ten years (i.e., 10% savings after ten years), and probably longer. Slightly higher reductions in peak demand are often possible. (2) Substantial additional savings (of the same order of magnitude as savings from utility programs) can be achieved as a result of other mechanisms besides utility sponsored programs, including market forces, equipment efficiency standards, and building codes. However, in order to achieve these additional savings, utilities will need to take a pro-active role, including support of efforts to strengthen codes and standards, coordination with government agencies on training and enforcement issues, and work with manufacturers to promote the development of high efficiency equipment.

INTRODUCTION

In recent years a number of studies have been conducted which estimate the technical potential for electricity savings from DSM measures. For example, a recent study by the Electric Power Research Institute (EPRI) found that use of energy saving technologies could reduce U.S. electricity consumption in the year 2000 by 24-44% (Faruqui et. al., 1990). Similarly, a recent study on the technical DSM potential in New York State estimated that if all conservation measures which are cost-effective to society are implemented, electricity sales would be reduced by 34% (Miller et. al., 1989). However, while technical potential studies are useful for determining the size of the available DSM resource, such studies ignore the many barriers to successful adoption of DSM measures by end-users. In order to address this limitation, this paper examines how much DSM savings can actually be achieved by reviewing four types of data: (a) actual DSM results achieved by utilities with particularly aggressive DSM programs; (b) long-range resource plans recently filed by several major utilities; (c) an in-depth study prepared for the State of New York on the amount of conservation the state's three largest utilities can achieve over a 10-18 year period, and (d) a study on the amount of electricity that can be saved in New York as a result of market forces, codes, and minimum efficiency standards.

ACTUAL DSM RESULTS OF UTILITIES WITH AGGRESSIVE DSM EFFORTS

Several electric utilities have been aggressively pursuing DSM programs for several years including Central Maine Power, the New England Electric System, Northeast Utilities, Pacific Gas and Electric, Southern California Edison, and Wisconsin Electric Power Company. Table 1 summarizes the results of these DSM efforts. In this table DSM peak kW and kWh savings are presented as a percent of the peak demand and total kWh sales for each utility. Results are summarized in three ways: (a) on a cumulative basis; (b) as an annual average over the period of analysis; and (c) for measures installed during the most recent year for which data are available.

As can be seen from the data, average savings for these utilities increase by 0.5-1.7% of peak demand and 0.4-1.4% of kWh sales each year (median of 0.8% and 0.7% respectively). Efforts of this level have been sustained for up to ten years. Several of the utilities have been increasing their DSM efforts in recent years. For the most recent year, median savings from measures installed during the year are 1.35% of peak demand and 0.8% of kWh sales. In the most recent year, percentage kW savings were greater than percentage kWh savings for every utility but one. On a cumulative basis, percentage kW savings are greater than percentage kWh savings for two-thirds of the utilities examined.

REVIEW OF LONG-RANGE UTILITY PLANS

In addition to the utilities examined above, a number of other utilities are planning aggressive DSM programs over the next 10-20 years. Table 2 summarizes planned kW and kWh savings for 18 of these utilities. Results are summarized for 2000 and 2008 (or the nearest year for which data are available). Savings are reported as a percent of predicted 2000 and 2008 peak demand and kWh sales <u>before</u> DSM savings are subtracted.

As can be seen in this table, projected incremental DSM savings during each year of the 1990-2000 period range from 0.22-1.35% of electricity sales in 2000 and 0.47-1.56% of peak demand in 2000 (median values of 0.55% and 0.96% respectively). Over the 1990-2008 period, projected DSM savings increase each year by 0.12-1.36% of 2008 electricity sales and 0.28-1.44% of 2008 peak demand (median values of 0.4% and 0.67% respectively). Thus, over the 1990-2000 period, many utilities are planning incremental peak demand savings of approximately 1% per year. Projected kWh savings over the 1990-2000 period, and projected incremental kW and kWh savings over the 1990-2008 period average approximately 0.5% per year.

STUDY OF ACHIEVABLE DSM POTENTIAL FOR THREE N.Y. UTILITIES

In 1990, ACEEE and the New York State Energy Office (NYSEO) conducted a study to see how much DSM savings could be cost-effectively achieved by the state's major electric utilities. For this study, utility DSM programs around the country were examined, and based on the results of the most successful of these programs (where success meant high participation and high savings, while remaining cost-effective to the sponsoring utility), 21 conservation programs were

Table 1. DSM Savings of Selected Utilities as a Percent of 1989 Sales and Peak Demand

Utility	Period	Cumulative kW	Cumulative kWh	Avg. Year kW	Avg. Year kWh	Last Year kW	Last Year kWh
Central Maine Power	1984-90	4.3%	3.6%	0.6%	0.5%	2.1%	1.6%
New England Electric	7/87-90	5.8	2.1	1.7	0.6	1.4	0.9
Northeast Utilities	1987-90	1.8	1.8	0.5	0.4	0.7	0.7
Pacific Gas & Electric	1980-89	6.9	8.5	0.7	0.8	0.4	0.3
Southern Calif. Edison	1980-89	9.5	13.5	0.9	1.4	1.3	0.5
Wisconsin Electric Power	4/87-90	4.0	3.3	1.1	0.9	1.5	1.2

Notes:
Data were obtained from the individual utilities. Data for the California utilities generally include free riders and are not adjusted for coincidence with the system peak. Data for other utilities are generally adjusted to exclude free riders and are adjusted for the effects of diversity at the time of the system peak. PG&E figures include many low- and no-cost measures which are probably no longer in place; So. Cal. Edison figures exclude many measures which have passed their useful life. Figures for 1990 are preliminary.

Table 2. Role of C&LM in the Long-Range Resource Plans of Selected Utilities

	Annual C&LM Svgs as % of Sales or Demand at End of Period					
	1990-2000 Period			1990-2008 Period		
Utility	GWh	Winter MW	Summer MW	GWh	Winter MW	Summer MW
Boston Edison	0.61%	1.13%	1.42%	0.37%	0.63%	0.80%
Central Hudson	0.40	0.68	0.76	0.26	0.37	0.49
Central Maine Power (2006)	0.22	1.18	0.63	0.12	0.66	0.34
Consolidated Edison	0.80	0.81	1.26	0.82	0.83	1.25
Green Mountain Power (2010)	0.31	0.96		0.18	0.46	
Long Island Lighting	0.88	1.07	1.06	0.56	0.70	0.63
New England Electric	0.42	1.10	1.37			0.85
NY State Electric & Gas	0.92	1.45	1.46	0.68	0.95	1.05
Niagara Mohawk	0.50	0.81	0.96	0.33	0.51	0.67
Northeast Utilities (1999)	0.67	0.93	0.92		0.44	0.52
Northern States Power	0.37	1.03	1.56	0.25	0.68	0.96
NW Power Planning Council #	0.65					
Orange & Rockland	0.36	0.47	1.05	0.21	0.28	0.63
Pacific Gas & Elec. (2009)	0.64		1.22	0.47		0.86
Puget Sound Power & Light	0.35			0.31		
Rochester Gas & Electric	0.73	0.79	0.82	0.52	0.61	0.60
Sacramento MUD (2010) #	1.35		1.55	1.36		1.42
Wisconsin Electric Power	0.43	0.52	0.56			

Notes:
Data derived from forecasts and long-range resource plans of each utility. Savings are reported as a percent of forecasted sales and demand before subtracting DSM savings. Where utilities report a range of estimates, the midpoint of the range is reported here. To the extent C&LM has occurred prior to the base year of the forecast, these C&LM savings are incorporated into the forecast and not into the savings estimates.
("date") indicates a period end-year other than 2000 or 2008.
= preliminary figure from planning process now underway.

developed for application by the three largest electric utilities in New York State (Consolidated Edison, Long Island Lighting, and Niagara Mohawk Power Corporation). Each program was subjected to a detailed screening process, including cost-benefit analyses from multiple perspectives. Programs which passed the screening process were combined into a DSM plan for each utility (a detailed description of the study can be found in Nadel and Tress, 1990).

The programs included in the study targeted all major sectors, end-uses, and market types (e.g., new construction and retrofit). The study examined only conservation programs; other types of utility programs such as load management, fuel switching, and cogeneration programs were not examined. The study examined only conservation measures which were commercially available in 1990 (with one exception, super-efficient refrigerators, which are now at the prototype stage). A further conservatism was that the study assumed that building codes and equipment efficiency standards will be strengthened during the 1990's, hence programs included in the analysis begin where the strengthened standards end.

The analysis began in 1991, with traditional audit and rebate programs of the type that are now being implemented by many utilities in New York and other states. However, unlike the traditional rebate program, the programs featured high rebate levels (typically 80% of measure cost), extensive personal marketing, and an emphasis on new technologies which receive only limited use at present. Beginning in 1992-1994, comprehensive direct installation programs were introduced into the analysis -- programs which package measure identification, installation, and financing into a single service. These programs are designed to make it as easy as possible for customers to participate -- in many cases, all the customer has to do is say "yes."

Results of the analysis are summarized in Figure 1. For Niagara Mohawk and Long Island Lighting, energy and demand savings in 2000 and 2008 range from 9-12% of projected electricity sales and peak demand. For Consolidated Edison, savings range from 14-19%. Savings are higher for Consolidated Edison because two-thirds of Con Edison's load is in the commercial sector, the sector with the highest conservation potential (Miller et. al., 1989).

For all three utilities, savings, as a percent of projected sales and demand, averaged 0.9-1.9% per year over the first ten years, but less than 0.5% per year thereafter. This is the case for several reasons. First, as sales grow, more and more conservation is needed just to keep the conservation percentage constant. Second, measures installed before 2000 begin wearing out in the 2000-2008 period. While some of these measures are replaced, others are not, and some measures have become standard practice, so no credit for savings can be taken. Third, this analysis is limited to existing technologies. After 10-20 years, much of the savings from these technologies are realized, and additional savings are primarily available from new technologies that were not included in the analysis.

SAVINGS FROM MARKET FORCES, CODES AND STANDARDS

In addition to examining achievable savings from utility DSM programs, the ACEEE/NYSEO study (Nadel and Tress, 1990) also examined savings achievable from other mechanisms, including market forces (what would likely happen in the market, even if increased utility programs were not offered), strengthened building codes, and new and improved equipment efficiency standards.

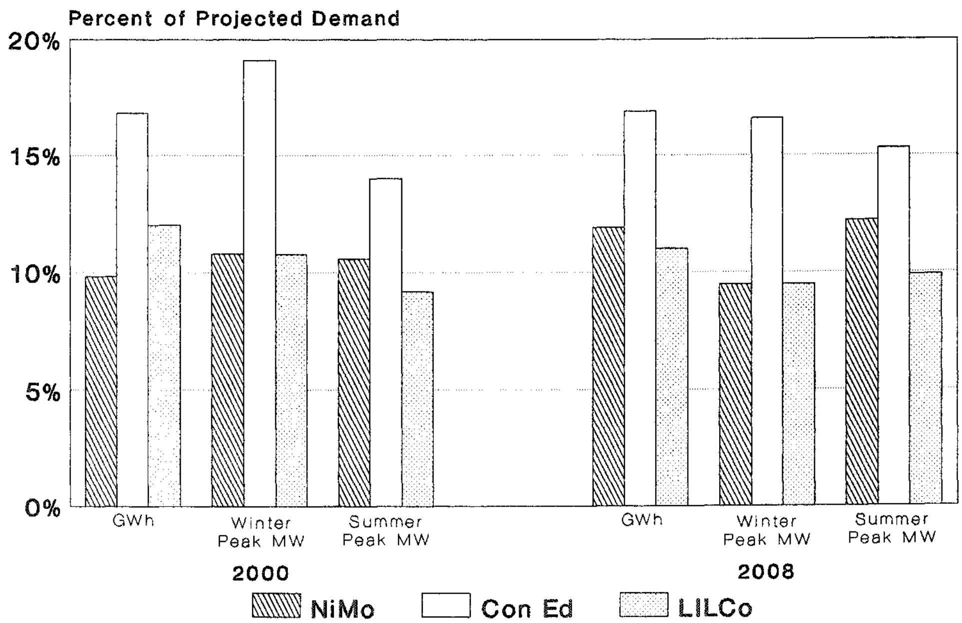

Figure 1. Conservation savings due to utility DSM programs as a percent of projected demand for three New York utilities.

Savings from market forces were estimated for each of the 73 measures examined in Miller et. al. (1989), based on published research and ACEEE's professional judgement. Savings from pending amendments to the New York building code were estimated by NYSEO (average savings in new commercial buildings of approximately 14%). In addition, a second set of amendments, saving an additional 15% effective 2001, were assumed. Savings from revised federal appliance and fluorescent ballast standards were estimated by ACEEE for each of the products now subject to DOE regulation. Standard levels and effective dates were based on published research by DOE and other organizations, and on the requirements of federal legislation. Finally, savings from efficiency standards for lamps, luminaires (lighting fixtures), motors, and commercial packaged air conditioners and heat pumps were estimated by ACEEE based on legislation presently pending in Massachusetts and New York. Savings due to strengthened residential building codes, or to efficiency standards on other products (such as chillers, distribution transformers, and office equipment) were not included in the analysis.

Results of these analyses are summarized in Table 3. These analyses found that achievable savings due to other mechanisms average 13.6% of projected New York GWh sales in 2008. These savings are approximately equal to achievable savings in New York State from utility programs (as discussed in the previous section of this paper).

DISCUSSION AND CONCLUSION

DSM results achieved by six major utilities over the past decade, future DSM plans prepared by 18 utilities for the next two decades, and a detailed study on potential DSM programs in New York State generally indicate that DSM programs can reduce electricity sales and peak demand by approximately 1% per year for a ten year period (i.e., 10% savings after ten years). Results and plans of several utilities indicate that due to the impact of load management programs, somewhat higher savings in peak demand are often possible. Beyond a ten year period, data is much more limited, but indicates that annual DSM savings will drop off, unless new technologies (e.g., lighting systems up to twice as efficient as those currently on the market -- Piette et. al., 1989) or new programs (e.g., fuel switching or cogeneration programs) are introduced.

In addition to savings achievable with utility DSM programs, savings due to market forces, codes, and minimum efficiency standards can approximately double the amount of DSM savings achieved. While savings due to market forces will likely happen if utilities take no action, utilities can dramatically increase the likelihood of achieving savings from codes and standards by taking proactive action including: (a) support of efforts to strengthen codes and standards at the state and local level (for example, New England Electric was an important player in successful efforts to adopt appliance and lamp efficiency standards in Massachusetts); (b) coordination with government agencies on code training and enforcement issues (for example California and New York utilities are both active in efforts to set up training centers for improved lighting design); and (c) work with manufacturers to promote the development of equipment of increased efficiency (for example, a consortium of utilities in now developing a program to encourage refrigerator manufacturers to develop and commercialize new refrigerators that use approximately half the electricity of units on the market in 1991 -- Fernstrom et. al., 1991).

Table 3. Estimated Conservation Savings in New York State Resulting from Market-Forces, Codes, and Standards

	GWh Savings in 2008	% of Projected Sales in 2008
Market forces and first-tier standards: (included in forecast)	8,941	4.6%
Revised codes and standards (for equipment that is currently regulated)		
Refrigerators and freezers	2,655	1.4%
Other residential appliances	2,588	1.3
Lamp ballasts	1,046	0.5
Comm'l building code changes	5,638	2.9
Total - revised codes & standards	11,927	6.2%
New efficiency standards (for regulations now under consideration)		
Lamps	4,420	2.3%
Luminaires (lighting fixtures)	910	0.5
Motors	1,020	0.5
Commercial packaged HVAC equipment	140	0.1
Subtotal	6,490	3.4%
Overlap between new stds. & utility programs	-1,095	-0.6
Total - new standards	5,395	2.8%
GRAND TOTAL	26,263	13.6%

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