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ENERGY DIVISION

ELECTRIC-UTILITY DSM-PROGRAM COSTS AND EFFECTS: 1991 TO 2001

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SUMMARY

For the past three years (1989, 1990, and 1991), all U.S. electric utilities that sell more than 120 GWh/year have been required to report to the Energy Information Administration data on their demand-side management (DSM) programs. These data provide a rich and uniquely comprehensive picture of electric-utility DSM programs in the United States.

Altogether, 890 utilities (of about 3250 in the United States) ran DSM programs in 1991; of these, 439 sold more than 120 GWh and reported details on their DSM programs. These 439 utilities represent more than 80% of total U.S. electricity sales and revenues. Altogether, these utilities spent almost $1.8 billion on DSM programs in 1991, equal to 1.0% of total utility revenues that year. In return for these (and prior-year) expenditures, utility DSM programs cut potential peak demand by 26,700 MW (4.8% of the national total) and cut annual electricity use by 23,300 GWh (0.9% of the national total); see Fig. S-1.

These 1991 numbers represent substantial increases over the 1989 and 1990 numbers on utility DSM programs. Specifically, utility DSM expenditures doubled, energy savings increased by almost 50%, and demand reductions increased by one-third between 1989 and 1991.

Utilities differed enormously in their DSM-program expenditures and effects. Almost 12% of the reporting utilities spent more than 2% of total revenues on DSM programs in 1991, while almost 60% spent less than 0.5% of revenues on DSM. In six states (Massachusetts, Rhode Island, Connecticut, Wisconsin, Washington, and California), utilities spent more than 2% of their revenues on DSM. Utilities in another ten states (Maine, Vermont, New York, Delaware, the District of Columbia, North Carolina, South Carolina, Florida, Nevada, and Oregon) spent 1 to 2% of revenues on DSM.

Utility estimates of future DSM-program expenditures and benefits show continuing growth. By the year 2000, U.S. utilities expect to spend 1.2% of revenues on DSM and to cut demand by 8.8% and annual sales by 2.7%. Here, too, expectations vary by region. Utilities in the North Central, West and Northwest plan to spend more than 2% of revenues on DSM that year, while utilities in the South Atlantic, Midwest, Southwest, and Central regions plan to spend less than 1% of revenues on DSM.

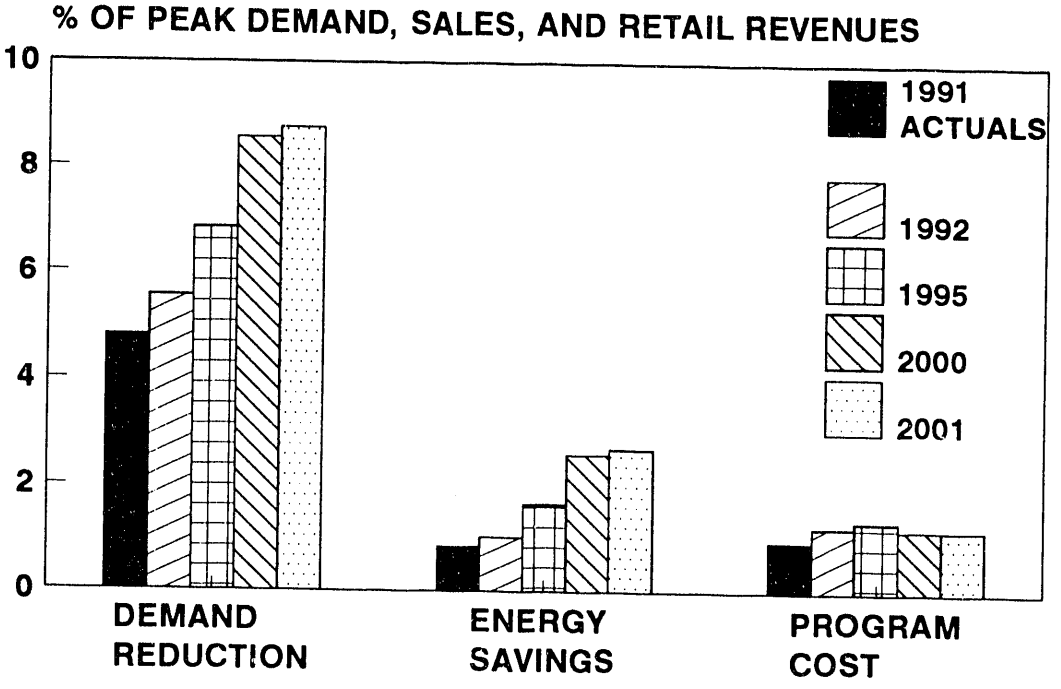

Fig. S-1. Utility data for 1991 and forecasts to the year 2001 of DSM-program costs, energy savings, and potential peak-demand reductions relative to national totals.

INTRODUCTION

BACKGROUND

> Conservation is our resource of choice. Energy conservation best satisfies the twin goals of being cost-effective and environmentally benign. Over the next decade Bonneville will spend about $2.8 billion on conservation, all of it at or below the cost of adding large new power plants.

This statement, from the head of the Bonneville Power Administration, is similar to declarations made by other utilities about the importance of demand-side management (DSM) programs as a resource (Hardy 1993). The growing knowledge that DSM programs can defer or displace new power plants is reflected in the *Energy Policy Act of 1992* (U.S. Congress 1992). Several provisions in "Title I—Energy Efficiency" require state regulatory commissions and federal utilities to consider fully the potential for energy-efficiency and load-management programs to provide energy and capacity resources for utilities.

Clearly, utility interest and activity in DSM is increasing. Until recently, however, virtually no data were available on a national scale to identify the scope, performance, and costs of such programs. In April 1992, the Energy Information Administration (EIA) (Prete, Gordon, and Bromley 1992) published a summary of DSM data for 1990 from all U.S. electric utilities. Schedule V of EIA-861 is used to collect data on DSM-program peak demand reductions, energy savings, and costs for the prior year and estimates for the next ten years.

This report presents data reported to EIA for 1991 on the EIA-861 forms. Results are presented for the "leading" DSM utilities, states, ten federal regions, and the U.S. as a whole for the period 1991 through 2001. In addition, the 1989, 1990, and 1991 results are compared with each other, based on EIA revisions to the 1989 and 1990 data (EIA 1993b). The present report updates a similar report I wrote last year (Hirst 1992). This report includes regional data and projections, improved state-level estimates, and an extra year of data.

In 1991, utilities spent almost $1.8 billion on DSM programs, cut demand by 26,700 MW, and cut annual electricity use by 23,300 GWh. Compared to totals for the U.S. electric-utility industry, DSM accounted for 1.0% of retail revenues, 4.8% of summer peak demand, and 0.9% of retail sales (Table 1).

Table 1. Effects and costs of electric-utility DSM programs, 1989 to 1991

	Potential peak-demand reduction[a] (MW and %[b])		Energy savings (GWh/year and %[b])		Program cost (million $ and %[b])	
1989	20,100	3.8	16,300	0.6	870	0.5
1990						
Totals[c]	23,300	4.3	18,700	0.7	1,180	0.7
Investor-owned utilities	17,500	4.3	13,200	0.7	1,060	0.8
Consumer-owned utilities	5,800	4.7	5,500	0.9	120	0.3
1991						
Totals[d]	26,700	4.8	23,300	0.9	1,750	1.0
Investor-owned utilities	19,500	4.5	17,600	0.8	1,510	1.0
Consumer-owned utilities	7,200	6.1	5,700	0.9	240	0.6

[a]Utilities report to EIA estimates of actual and potential peak-demand reductions (16,700 MW vs 26,700 MW for 1991). The actual figures are the amount of load shed during system peaks. The potential figures represent the amount of load that the utility could have shed. The difference between the two numbers represents, as examples, interruptible contracts that were not exercised and load-control devices that were not activated. All the numbers presented in this report are potential estimates.

[b]These percentages reflect, respectively, total U.S. summer peak demand, retail electricity sales, and retail electric revenues for 1989, 1990, or 1991.

[c]These totals are based on the 363 utilities with annual sales greater than 120 GWh that reported running a DSM program in 1990. Of these 363 utilities, 127 are investor-owned, and the remaining 236 are consumer-owned.

[d]These totals are based on the 439 utilities with annual sales greater than 120 GWh that reported running a DSM program in 1990. Of these 439 utilities, 133 are investor-owned, and the remaining 306 are consumer-owned.

Source: EIA (1993b).

On average, the investor-owned utilities (IOUs) spent a larger percentage of their revenues on DSM than did the consumer-owned utilities (which include federal, state, municipal, and cooperative utilities). On the other hand, the consumer-owned utilities reported larger percentage reductions in demand and energy than did the IOUs (Table 1).

Utility DSM expenditures and effects increased — in both absolute and relative terms — from 1989 to 1990 and again from 1990 to 1991 (Table 1 and Fig. 1). For example, the percentage of retail revenues spent on DSM increased from 0.5% in 1989 to 0.7% in 1990 and to 1.0% in 1991.

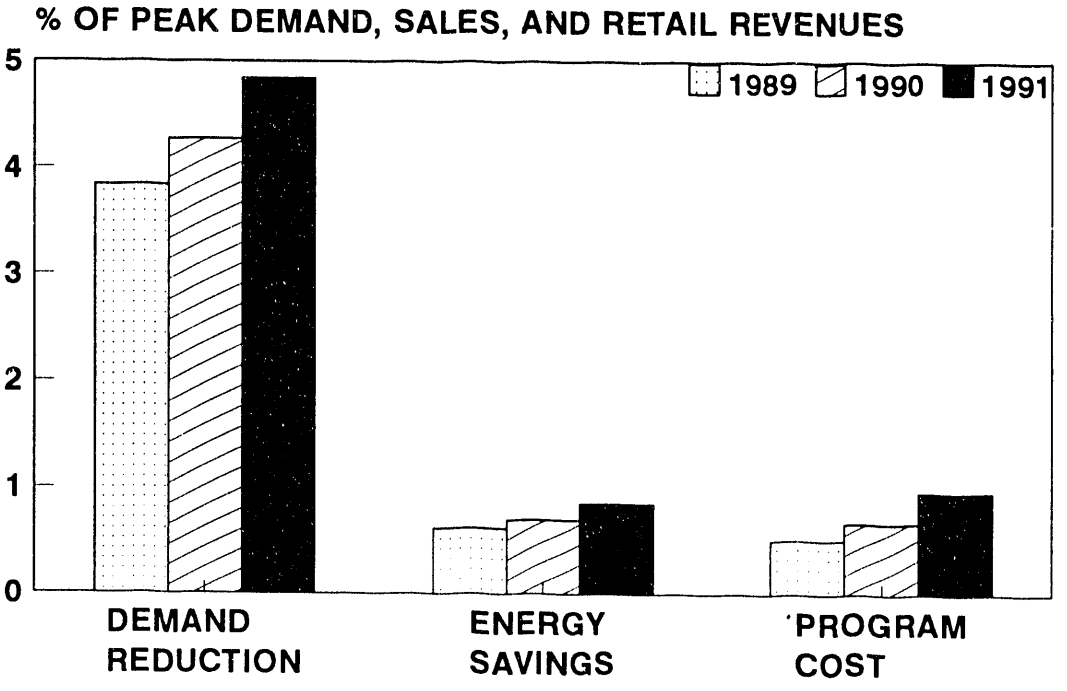

Fig. 1. Costs and effects of electric-utility DSM programs in 1989, 1990, and 1991.

The remainder of this chapter describes the DSM data elements in EIA-861 and the data-quality issues surrounding these utility estimates. The next three chapters present data on DSM expenditures, energy savings, and peak-demand reductions, respectively. Chapter 5 presents forecasts of these costs and effects to the year 2001. And Chapter 6 summarizes and interprets the results presented here. The Appendix explains the key limitations in the data and the assumptions made to produce the results presented here.

EIA-861

Of the roughly 3250 U.S. utilities that submitted EIA-861 forms, 890 reported operation of a DSM program in 1991. Only those utilities with annual sales greater than 120 GWh were required to complete Schedule V and to report data on their DSM programs; 439 utilities did so. These 439 utilities account for 83% of all the electricity sold to retail customers and for 86% of all the retail revenues collected by U.S. utilities. (The 451 utilities that reported running a DSM program in 1991 but did not report data on those programs accounted for only 1% of U.S. retail sales and revenues.) Thus, the vast majority of U.S. electricity customers are served by utilities that offer DSM programs. All the utility, state, regional, and national results presented here are based on aggregations of information provided by these 439 utilities.

Schedule V included several questions about the costs and effects of utility DSM programs in 1991. These questions asked for utility estimates of actual and potential peak-

demand reductions caused by direct-load-control, interruptible-load, and conservation and other programs. The form also asked for 1991 energy savings caused by DSM programs as well as the 1991 utility expenditure on these programs. In addition, Schedule V asked for utility projections of DSM program effects (MW of peak-load reductions and MWh of energy savings) and of utility program costs for each year from 1992 through 2001.

DATA QUALITY

The data that utilities report to EIA provide a rich and valuable source of information on current DSM programs and their likely direction for the coming decade. Because DSM is, compared to the construction and operation of power plants, a new activity for most utilities, they (either explicitly or implicitly) use different definitions for savings and costs, and they measure these factors in different ways [Hirst and Sabo (1991) and Hirst and Reed (1991)]. As a result, readers should view the results presented here cautiously. As the Northwest Power Planning Council (1993) noted:

> [M]any facets of utility conservation activities are not standardized. There can be great variance between utilities in program purposes and features; internal program and customer tracking systems; practices in estimating and evaluating savings; and practices to account for costs and savings.

As one aggregates the data from utilities to states to regions to the nation as a whole, the accuracy of the data improves.

This report provides more detail on the program-expenditure data because they are more accurate than the data on energy and demand savings. However, utilities may include different costs within the numbers reported to EIA. For example, utilities differ on whether and how overhead costs are treated; on the inclusion of the costs for DSM-personnel training, program evaluation, load research, and other activities that support DSM programs; and on the timing of costs (actual expenditures vs obligations).

Utility reports on energy savings and demand reductions reflect different definitions (e.g., net vs total energy savings) and the methods used to produce these estimates (e.g., engineering calculations vs use of metered data). The cautions I offered last year concerning utility estimates of DSM-induced energy savings and load reductions are still valid (Hirst 1992):

> The results presented [on energy and demand reductions] should be viewed cautiously for several reasons. First, utilities may use different definitions for DSM programs. For example, Carolina Power and Light and Florida Power Corporation include the energy provided by cogenerators in their DSM-program totals; most other utilities do not. Some utilities might have included the effects of their load-building programs even though the EIA instructions clearly stated that they should not.

Second, utilities use different methods to estimate the effects of their DSM programs; in general, engineering estimates are higher than estimates based on billing data or load-research data.

Third, utilities might report estimates at the customer meter or at the generator busbar; these estimates differ by roughly 5 to 15% because of losses in the transmission and distribution system.

Fourth, some utilities might report total savings rather than net savings. Net savings are the reductions in electricity use and demand that can be attributed directly to the program, whereas total savings are the reductions in electricity use and demand experienced by program participants.

Finally, some utilities might have reported annual savings [the current-year savings produced by the program's activities in the current year] instead of the cumulative savings [the current-year savings produced by all of a program's participants from the program's inception through the current year] requested by EIA.

In spite of these caveats, the EIA-861 data are a unique and comprehensive source of information and insights into the past and likely future costs and performance of electric-utility DSM programs. No other data base contains such detailed information on so many utilities. And these data are probably as accurate as those in any other DSM data base.

DSM-PROGRAM COSTS

As was true in 1990, the distribution among utilities in DSM expenditures is skewed. Two California utilities (Pacific Gas & Electric and Southern California Edison) alone account for 15% of the national total (Table 2). The top five utilities account for more than 25% of the total, and the top thirteen account for fully 50% of the total utility expenditures on DSM. At the other end of the spectrum, one-fourth of the utilities with DSM programs spent less than 0.1% of revenues on these programs (Fig. 2). Altogether, only 49 (11% of the 439) utilities spent more than 2% of their revenues on DSM in 1991.

All but three of the top 25 DSM-expenditure utilities are investor owned. The three consumer-owned utilities are all large municipalities on the west coast. All but four of these 25 utilities are multibillion dollar companies. The top 25 utilities in 1991 are, with few exceptions, the same utilities that spent the most on DSM in 1990 (Hirst 1992).

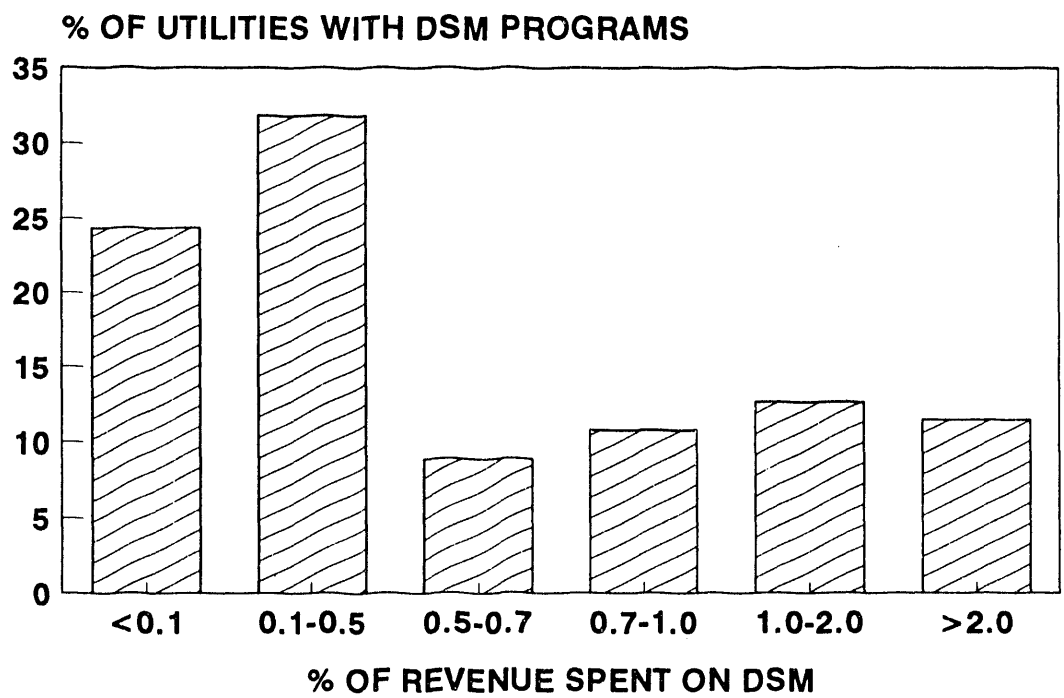

Fig. 2. Distribution of the 439 utilities with DSM programs by percentage of 1991 revenues spent on those programs. On a national-average basis, 1.0% of revenues was spent on DSM.

Table 2. The 25 utilities with the greatest 1991 expenditures on DSM[a]

Utility name	State	IOU (Yes/No)	Generation (GWh)	Revenue (M$)	1991 DSM programs Demand (MW)	Energy (GWh)	Cost (M$)	1991 DSM as percentage of Peak	Sales	Revenue
Pacific Gas & Electric Co	CA	Y	80427	7378	700	620	150.4	4.9	0.8	2.0
Southern California Edison Co	CA	Y	78643	7292	2358	585	107.4	14.1	0.7	1.5
Connecticut Light & Power Co	CT	Y	26386	2276	260	811	81.6	6.1	3.1	3.6
Consolidated Edison Co-NY	NY	Y	39227	4910	161	266	76.6	1.7	0.7	1.6
Florida Power & Light Co	FL	Y	74331	5159	1132	2625	72.0	8.0	3.5	1.4
Florida Power Corp	FL	Y	29149	1719	998	408	58.6	16.8	1.4	3.4
Niagara Mohawk Power Corp	NY	Y	39371	2883	67	345	55.3	1.1	0.9	1.9
Massachusetts Electric Co	MA	Y	15985	1364	108	341	53.7	3.7	2.1	3.9
Carolina Power & Light Co	NC	Y	42771	2686	1318	4418	52.9	15.6	10.3	2.0
Duke Power Co	NC	Y	74167	3817	1089	4	48.1	7.7	0.0	1.3
Puget Sound Power & Light Co	WA	Y	21451	957	69	154	42.1	2.6	0.7	4.4
Wisconsin Electric Power Co	WI	Y	26498	1293	290	853	40.3	6.1	3.2	3.1
Sacramento Municipal Util Dist	CA	N	8746	644	277	60	38.0	12.8	0.7	5.9
Boston Edison Co	MA	Y	15517	1315	92	275	37.0	3.5	1.8	2.8
San Diego Gas & Electric Co	CA	Y	15862	1356	81	150	36.5	2.8	0.9	2.7
Long Island Lighting Co	NY	Y	17806	2198	209	309	27.9	5.4	1.7	1.3
Virginia Electric & Power Co	VA	Y	62166	3688	228	147	27.2	1.8	0.2	0.7
Potomac Electric Power Co	DC	Y	26379	1552	331	174	26.8	5.7	0.7	1.7
New York State Elec & Gas Co	NY	Y	19605	1368	34	79	24.6	1.5	0.4	1.8
Public Service Electric & Gas	NJ	Y	41651	3500	89	137	24.0	1.0	0.3	0.7
Los Angeles, City of	CA	N	23853	1771	136	12	22.0	2.7	0.0	1.2
Seattle, City of	WA	N	9371	283	27	238	18.7	2.2	2.5	6.6
Narragansett Electric Co	RI	Y	4865	458	37	118	18.6	1.5	2.4	4.1
Texas Utilities Electric Co	TX	Y	87354	4892	392	55	18.1	2.3	0.1	0.4
Union Electric Co	MO	Y	38305	2089	215	17	18.0	3.1	0.0	0.9
Totals and averages		22	919886	66845	10698	13200	1177	5.4	1.6	2.4

[a]Two holding companies (Northeast Utilities and New England Electric) would rank higher if their totals were shown. Northeast Utilities, which owns Connecticut Light and Power and Western Massachusetts Electric, spent $99.4 million on its DSM programs in 1991; New England Electric, which owns Massachusetts Electric, Narragansett Electric, and Granite State Electric, spent $74.5 million.

Because consumer-owned utilities are, on average, much smaller than IOUs, a display of the percentage of revenues spent on DSM (Table 3) shows a different picture than that for absolute expenditures. Consumer-owned utilities account for 15 of the top 25 utilities in terms of percentage of revenues spent on DSM. These 25 utilities spent, on average, 4.3% of revenues on DSM. The municipal utilities in Seattle, Tacoma, and Sacramento spent roughly 6% or more on DSM.

On average, the utilities in California, Connecticut, Massachusetts, Rhode Island, Washington, and Wisconsin spent more than 2% of retail revenues on their DSM programs (Fig. 3). Ten other states along or near the east and west coasts devoted between 1 and 2% of retail revenues to DSM programs. Again, a comparison between the 1990 and 1991 data shows few changes. The utilities in Washington state, Nevada, California, and New York increased their DSM expenditures. On the other hand, Maine, Virginia, and Missouri showed declines in the percentage of revenues devoted to DSM.

Table 3. The 25 utilities with the greatest 1991 percentage expenditures on DSM

Utility name	State	IOU (Yes/No)	Generation (GWh)	Revenue (M$)	1991 DSM programs Demand (MW)	Energy (GWh)	Cost (M$)	1991 DSM as a percentage of Peak	Sales	Revenue
Seattle, City of	WA	N	9371	283	27	238	18.7	2.2	2.5	6.6
Tacoma, City of	WA	N	6578	193	6	52	12.3	0.7	0.8	6.3
Sacramento Municipal Util Dist	CA	N	8746	644	277	60	38.0	12.8	0.7	5.9
Runestone Electric Assoc	MN	N	149	9	8	0	0.5	29.0	0.2	5.5
PUD No 1 of Snohomish County	WA	N	5951	248	44	184	12.6	7.1	3.1	5.1
Grant Electric Coop	WA	N	162	10	5	0	0.5	15.2	0.3	4.8
Carteret-Craven El Member Corp	NC	N	360	31	7	0	1.4	2.2	0.0	4.7
Coop Power Assoc	--	N	5680	165	69	0	7.5	9.6	0.0	4.5
Puget Sound Power & Light Co	WA	Y	21451	957	69	154	42.1	2.6	0.7	4.4
Western Massachusetts Elec Co	MA	Y	4154	410	45	139	17.8	6.5	3.4	4.4
Cambridge Electric Light Co	MA	Y	1429	115	15	23	4.8	5.2	1.6	4.2
Narragansett Electric Co	RI	Y	4865	458	37	118	18.6	1.5	2.4	4.1
Commonwealth Electric Co	MA	Y	3467	403	20	70	16.4	3.2	2.0	4.1
Massachusetts Electric Co	MA	Y	15985	1364	108	341	53.7	3.7	2.1	3.9
Granite State Electric Co	NH	Y	663	59	4	14	2.2	3.4	2.1	3.8
Wisconsin Public Service Corp	WI	Y	10174	471	29	0	17.3	1.8	0.0	3.7
Connecticut Light & Power Co	CT	Y	26386	2276	260	811	81.6	6.1	3.1	3.6
Wabash Valley Power Assoc	--	N	3895	168	41	0	6.0	5.8	0.0	3.6
Taunton, City of	MA	N	519	37	1	6	1.3	25.4	1.1	3.5
Northern Electric Coop Assoc	MN	N	186	14	10	1	0.5	43.1	0.7	3.4
Florida Power Corp	FL	Y	29149	1719	998	408	58.6	16.8	1.4	3.4
Choptank Electric Coop	MD	N	553	43	2	0	1.5	1.6	0.0	3.4
Polk-Burnett Electric Coop	WI	N	141	10	6	0	0.4	25.2	0.0	3.4
Davidson Electric Member Corp	NC	N	452	34	10	0	1.2	--	0.0	3.4
Eugene, City of	OR	N	2484	91	28	140	3.0	8.1	5.6	3.3
Totals and averages		10	162948	10212	2126	2762	418	9.6	1.4	4.3

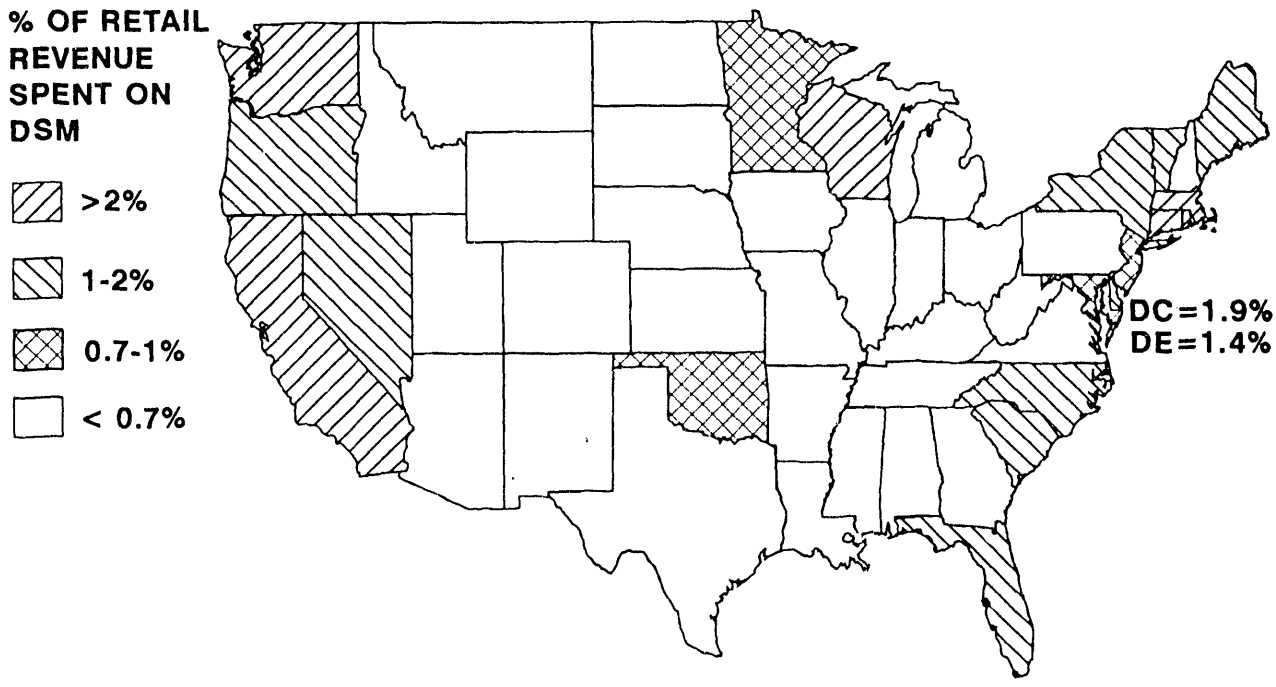

Fig. 3. The percentage of retail revenues spent on utility DSM programs by state.

DSM-PROGRAM ENERGY SAVINGS

The distribution across utilities in DSM-induced energy savings is even more skewed than the distribution of DSM-program costs, as was true for 1990 (compare Figs. 2 and 4). About 60% of the utilities cut energy use by less than 0.1%. At the other end of the spectrum, only 7% of the utilities cut energy use by more than 2% in 1991.

Interpretation of the utility reports of energy savings is complicated (Table 4). Two of the top utilities (Carolina Power and Light and Florida Power and Light) included cogeneration in their energy-saving estimates; cogeneration accounted for more than half of the totals for both utilities. The savings claimed by these utilities would have been much lower had they reported DSM energy savings as did most other utilities. The Tennessee Valley Authority (TVA) currently runs no DSM programs; its energy-saving estimate is based on the continuing effects of its past programs.

As was true for DSM-program costs, the IOUs dominate the energy-savings list. Two of the four public utilities (Bonneville and TVA) are federal agencies, and the other two are distributors in Washington state. Comparison of Tables 2 and 4 shows, not surprisingly, many of the same utilities; 60% of the utilities listed in Table 2 are also shown in Table 4.

The utilities in Connecticut, Maine, Massachusetts, Rhode Island, Wisconsin, and Tennessee saved more than 2% of their annual energy use in 1991 (Fig. 5). Vermont, North Carolina, Florida, Washington, Oregon, and Hawaii saved between 1 and 2%. Comparison of the maps in Figs. 3 and 5 shows considerable similarity. States in which utilities devote substantial fractions of their revenues to DSM are much the same states in which high energy savings occur.

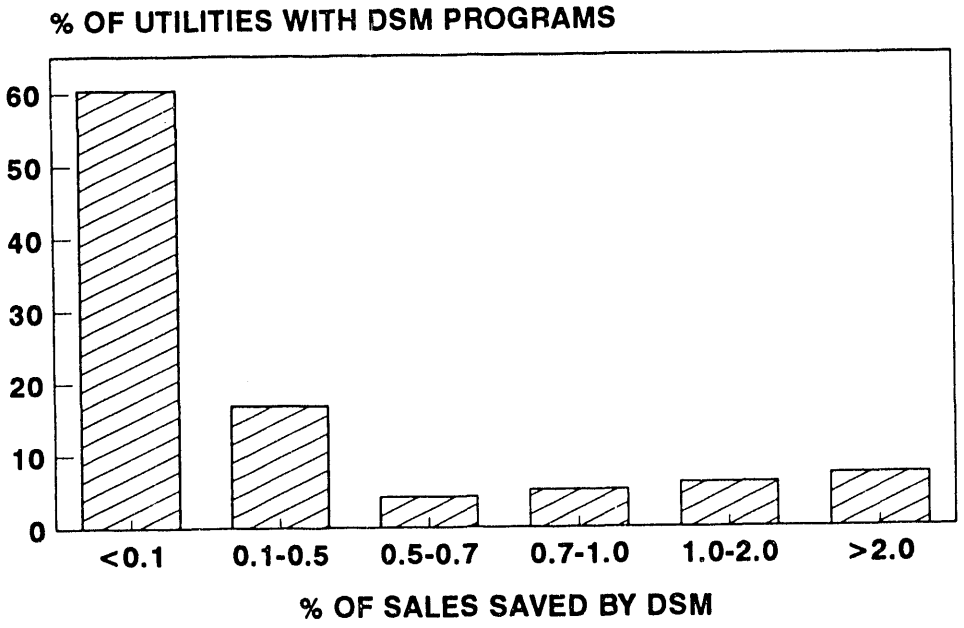

Fig. 4. Distribution of the 439 utilities with DSM programs by percentage of 1991 generation saved by those programs. On a national-average basis, utilities cut annual energy use by 0.9%.

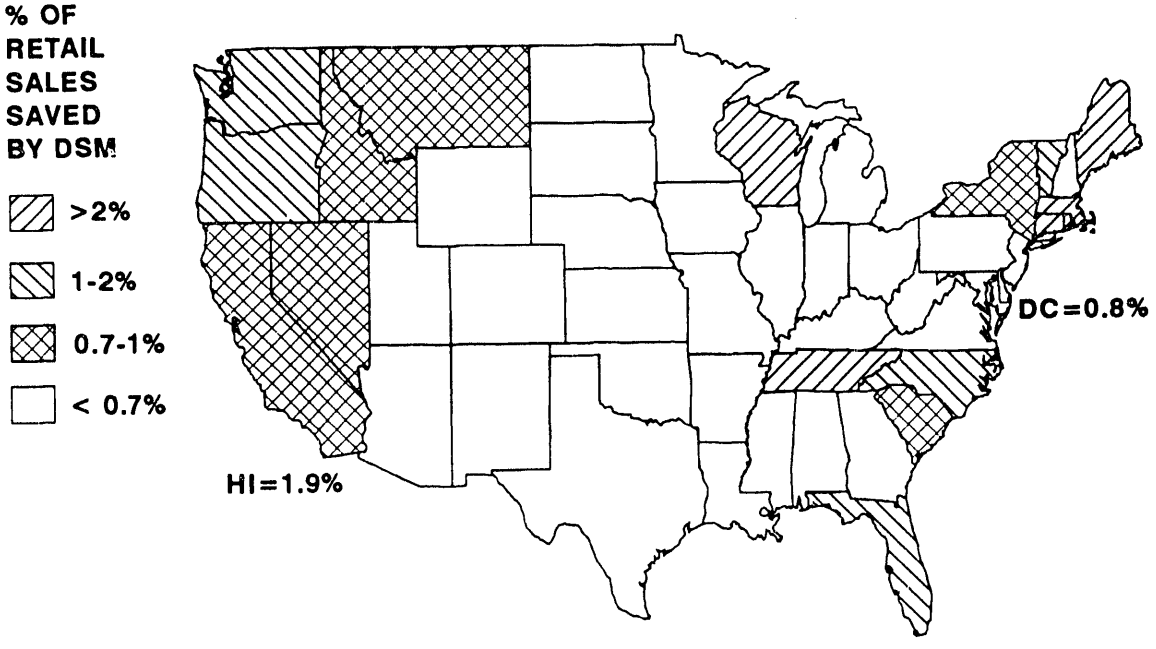

Fig. 5. The percentage reduction in retail sales attributed to utility DSM programs by state. (These estimates include downward adjustments for Florida, North Carolina, and South Carolina because of the inclusion of cogeneration estimates in the utility reports. South Dakota is not shown because the energy-saving numbers are too high and are inconsistent with the DSM-expenditure numbers.)

Table 4. The 25 utilities with the largest 1991 energy savings caused by DSM

Utility name	State	IOU (Yes/No)	Generation (GWh)	Revenue (M$)	1991 DSM programs			1991 DSM as a percentage of		
					Demand (MW)	Energy (GWh)	Cost (M$)	Peak	Sales	Revenue
Tennessee Valley Authority	TN	N	121189	5174	1182	3228	0.0	5.4	2.7	0.0
Carolina Power & Light Co[a]	NC	Y	42771	2686	1318	1767	52.9	15.6	10.3	2.0
Bonneville Power Admin	MT	N	91268	1997	787	867	5.8	5.0	1.0	0.3
Wisconsin Electric Power Co	WI	Y	26498	1293	290	853	40.3	6.1	3.2	3.1
Connecticut Light & Power Co	CT	Y	26386	2276	260	811	81.6	6.1	3.1	3.6
Florida Power & Light Co[a]	FL	Y	74331	5159	1132	630	72.0	8.0	3.5	1.4
Pacific Gas & Electric Co	CA	Y	80427	7378	700	620	150.4	4.9	0.8	2.0
Southern California Edison Co	CA	Y	78643	7292	2358	585	107.4	14.1	0.7	1.5
Gulf Power Co	FL	Y	11210	565	175	424	2.1	10.0	3.8	0.4
Florida Power Corp	FL	Y	29149	1719	998	408	58.6	16.8	1.4	3.4
Niagara Mohawk Power Corp	NY	Y	39371	2883	67	345	55.3	1.1	0.9	1.9
Massachusetts Electric Co	MA	Y	15985	1364	108	341	53.7	3.7	2.1	3.9
Central Maine Power Co	ME	Y	10297	856	74	334	17.5	6.3	3.2	2.0
Kentucky Utilities Co	KY	Y	15638	588	113	320	1.8	3.9	2.0	0.3
Long Island Lighting Co	NY	Y	17806	2198	209	309	27.9	5.4	1.7	1.3
Northern States Power Co	MN	Y	33717	1759	520	301	16.5	7.3	0.9	0.9
Boston Edison Co	MA	Y	15517	1315	92	275	37.0	3.5	1.8	2.8
Consolidated Edison Co-NY	NY	Y	39227	4910	161	266	76.6	1.7	0.7	1.6
Potomac Edison Co	MD	Y	17618	674	136	252	0.6	7.4	1.4	0.1
West Penn Power Co	PA	Y	26914	1071	137	239	1.7	4.8	0.9	0.2
Seattle, City of	WA	N	9371	283	27	238	18.7	2.2	2.5	6.6
PUD No 1 of Snohomish County	WA	N	5951	248	44	184	12.6	7.1	3.1	5.1
Monongahela Power Co	WV	Y	15382	625	97	175	0.3	5.9	1.1	0.1
Potomac Electric Power Co	DC	Y	26379	1552	331	174	26.8	5.7	0.7	1.7
Hawaiian Electric Co Inc	HI	Y	6877	536	22	160	0.0	2.0	2.3	0.0
Totals and averages		21	877923	56400	11338	14107	918	6.4	2.2	1.8

[a]The numbers from Florida Power and Light and from Carolina Power and Light were adjusted downward to reflect their inclusion of cogeneration. About 76% of Florida Power and Light's and 60% of Carolina Power and Light's reported 1991 energy savings were from cogeneration.

DSM-PROGRAM DEMAND REDUCTIONS

On average, U.S. utility DSM programs cut potential peak demand by 4.8% in 1991, more than five times the percentage reduction in energy use. This difference is reflected in the utilities' conservation load factor (CLF), which is the ratio of DSM-program-induced average demand reduction to peak reduction. Analogous to a utility's system load factor, it represents the fraction of the year that the utility's DSM programs save energy. The CLF for all U.S. DSM programs was 0.10 in 1991. This CLF is far lower than the U.S. system load factor of 0.56 [Edison Electric Institute (EEI) 1992], which shows that utility DSM programs focus much more on cutting peak demands than on saving energy.

Consistent with the much larger percentage reduction in peak demand is the broader distribution of demand reduction across utilities (compare Figs. 4 and 6). Only 18% of the utilities report cutting peak demand by *less* than 1%. On the other hand, 8% of the utilities report peak-demand reductions of more than 25%, and half of those utilities claim to have cut peak demand by 50% or more. These numbers strike me as implausible. They probably result from incorrect reports of peak demands from some small utilities. Therefore, I do not show the leading utilities in terms of *percentage* reduction in peak demand, although Table 5 shows the absolute DSM-induced demand reductions reported by the utilities. Because data on peak demand by state are not available, a map that shows the percentage reduction in 1991 peak demand caused by DSM programs by state is not shown.

Once again, the top 25 utilities are dominated by IOUs. Altogether, these 25 utilities account for almost 60% of the national reduction in potential peak demand.

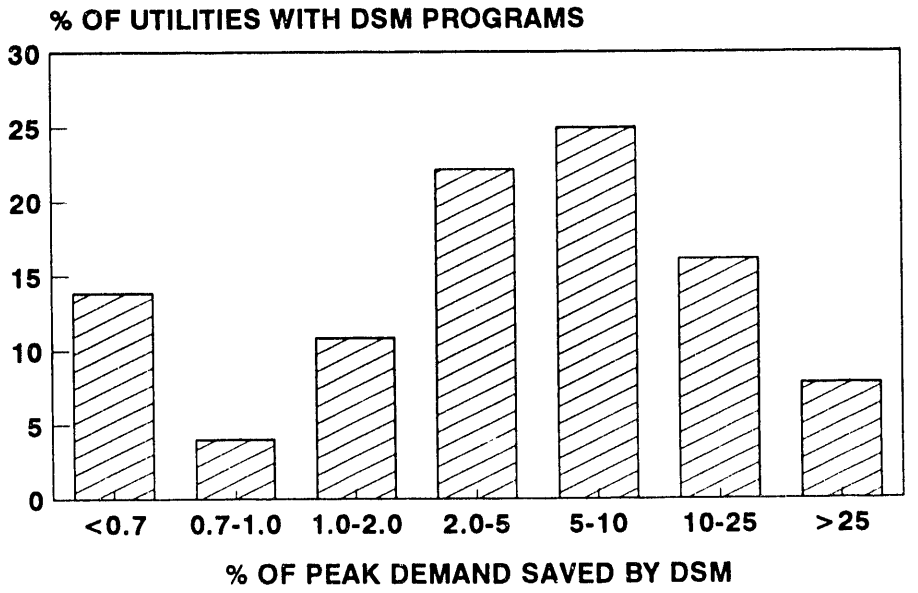

Fig. 6. Distribution of the 439 utilities with DSM programs by percentage of 1991 potential peak demand saved by those programs. On a national-average basis, utilities cut peak demand by 4.8%.

Table 5. The 25 utilities with the largest 1991 potential peak-demand reductions caused by DSM

Utility name	State	IOU (Yes/No)	Generation (GWh)	Revenue (M$)	1991 DSM programs Demand (MW)	Energy (GWh)	Cost (M$)	1991 DSM as a percentage of Peak	Sales	Revenue
Southern California Edison Co	CA	Y	78643	7292	2358	585	107.4	14.1	0.7	1.5
Carolina Power & Light Co	NC	Y	42771	2686	1318	1767	52.9	15.6	10.3	2.0
Tennessee Valley Authority	TN	N	121189	5174	1182	3228	0.0	5.4	2.7	0.0
Florida Power & Light Co	FL	Y	74331	5159	1132	630	72.0	8.0	3.5	1.4
Duke Power Co	NC	Y	74167	3817	1089	4	48.1	7.7	0.0	1.3
Florida Power Corp	FL	Y	29149	1719	998	408	58.6	16.8	1.4	3.4
Bonneville Power Admin	OR	N	91268	1997	787	867	5.8	5.0	1.0	0.3
Houston Lighting & Power Co	TX	Y	62865	3675	711	13	15.0	6.1	0.0	0.4
Pacific Gas & Electric Co	CA	Y	80427	7378	700	620	150.4	4.9	0.8	2.0
Alabama Power Co	AL	Y	58550	2847	618	0	4.6	7.2	0.0	0.2
Northern States Power Co	MN	Y	33717	1759	520	301	16.5	7.3	0.9	0.9
Oklahoma Gas & Electric Co	OK	Y	23420	1211	402	8	14.0	8.6	0.0	1.2
Texas Utilities Electric Co	TX	Y	87354	4892	392	55	18.1	2.3	0.1	0.4
Tampa Electric Co	FL	Y	16760	988	356	157	14.4	13.1	0.9	1.5
Oglethorpe Power Corp	GA	N	19602	1064	350	21	0.3	10.7	0.1	0.0
Potomac Electric Power Co	DC	Y	26379	1552	331	174	26.8	5.7	0.7	1.7
Baltimore Gas & Electric Co	MD	Y	28289	1995	309	15	16.2	5.2	0.1	0.8
PacifiCorp	OR	Y	55603	2251	295	46	13.3	4.4	0.1	0.6
Wisconsin Electric Power Co	WI	Y	26498	1293	290	853	40.3	6.1	3.2	3.1
Sacramento Municipal Util Dist	CA	N	8746	644	277	60	38.0	12.8	0.7	5.9
Philadelphia Electric Co	PA	Y	40741	3598	275	3	10.9	3.9	0.0	0.3
Minnkota Power Coop Inc	ND	N	3779	91	270	0	0.5	67.8	0.0	0.6
Connecticut Light & Power Co	CT	Y	26386	2276	260	811	81.6	6.1	3.1	3.6
Arkansas Power & Light Co	AR	Y	32816	1528	240	0	0.3	6.0	0.0	0.0
Pennsylvania Power & Light Co	PA	Y	38539	2558	234	59	12.6	4.3	0.2	0.5
Totals and averages		20	1181988	69442	15694	10686	819	10.2	1.2	1.3

UTILITY FORECASTS TO 2001

So far, this report presented and discussed utility data on past (1989, 1990, and especially 1991) DSM programs. EIA-861 also requested estimates of program costs and effects for 1992 through 2001. I normalized these forecasts with EIA's "Reference" forecasts of electricity sales and revenues to the year 2000 for each of the ten federal regions (EIA 1991); see the Appendix for details.

NATIONAL FORECASTS

Utilities expect their expenditures on DSM programs to increase, from 1.0% of retail revenues in 1991 to almost 1.4% in 1995 (Fig. 7). Utility DSM expenditures are then expected to decrease to 1.2% in 2000 and 2001. Forecast reductions in peak demand and in energy use increase steadily during this decade; peak-demand reductions nearly double from 4.8% in 1991 to 8.8% in 2001, while energy reductions triple from 0.9% to 2.7%.

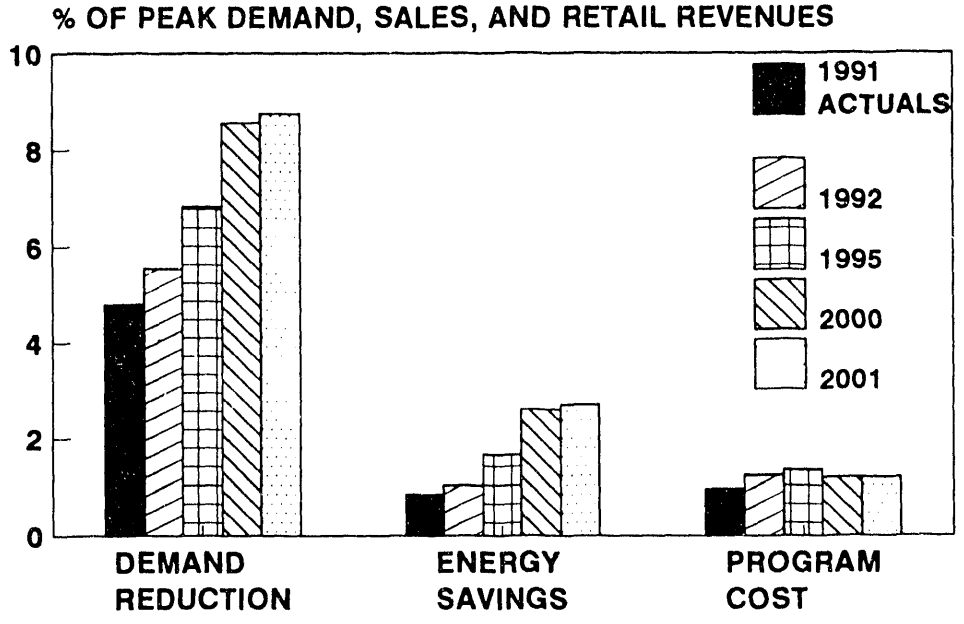

Fig. 7. Utility forecasts of annual DSM-program costs, energy savings, and peak-demand reductions to the year 2001 relative to national totals.

In absolute terms, DSM-program budgets increase from 1991 to 1995, although at a slower rate than from 1989 to 1991 (Fig. 8). Between 1995 and 2001, DSM budgets decrease slightly. Energy savings increase steadily throughout this decade at a rate slightly faster than the 1989—1991 growth rate. Peak-demand reductions also grow steadily during this period. The more rapid growth in energy savings and demand reductions than in program costs suggests that DSM programs will become more cost-effective in the future.

The 1991 forecasts for the year 2000 are higher than the comparable forecasts made in 1990. For example, the 1990 reports to EIA forecast reductions in peak demand and annual energy use of 55,800 MW and 78,500 GWh. The 1991 forecasts were for 56,500 MW and 83,000 GWh, 1% and 6% higher, respectively. The 1990 estimate of DSM expenditures in 2000 was $2.0 billion; the 1991 estimate was $2.6 billion, 30% higher.

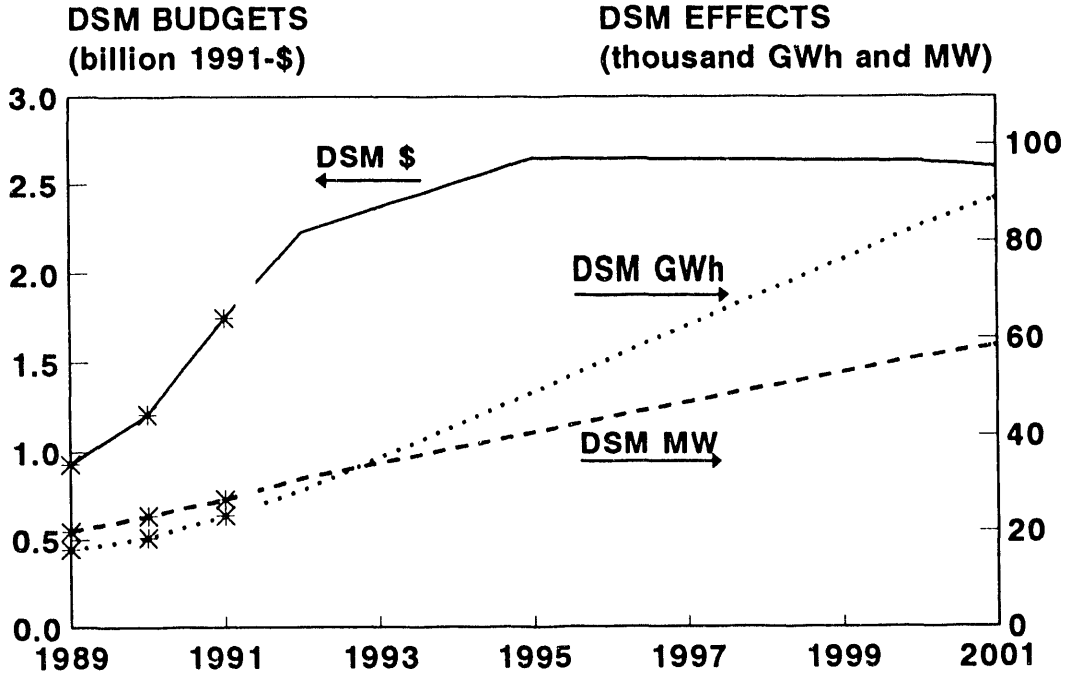

Fig. 8. **Utility forecasts of annual DSM-program costs, energy savings, and peak-demand reductions to the year 2001. The points are historical data, and the lines are forecasts.**

REGIONAL FORECASTS

EIA (1991) developed forecasts of electricity use and revenues from 1990 to 2000 for each of the ten federal regions (Fig. 9); the Appendix lists the states by region. I used these forecasts to normalize the utility reports on planned DSM expenditures and effects to examine regional differences in forecast trends.

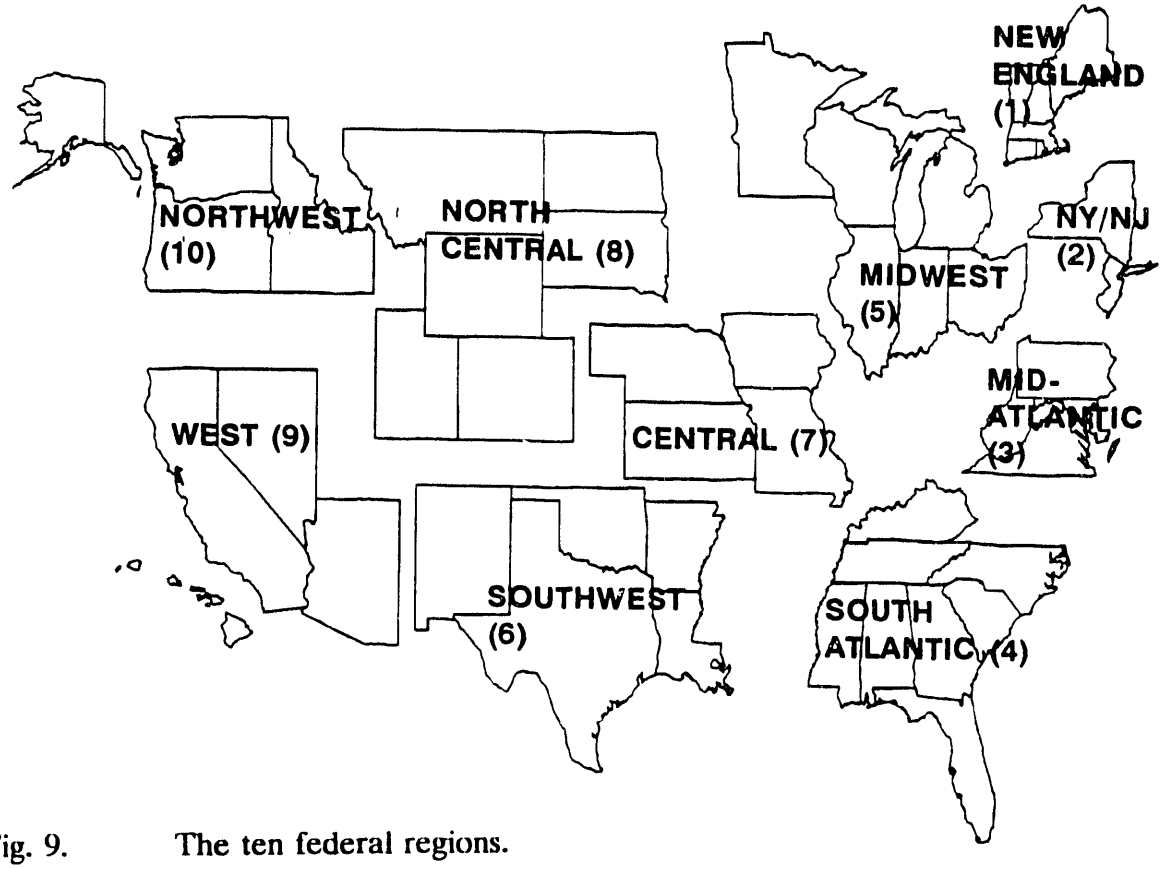

Fig. 9. The ten federal regions.

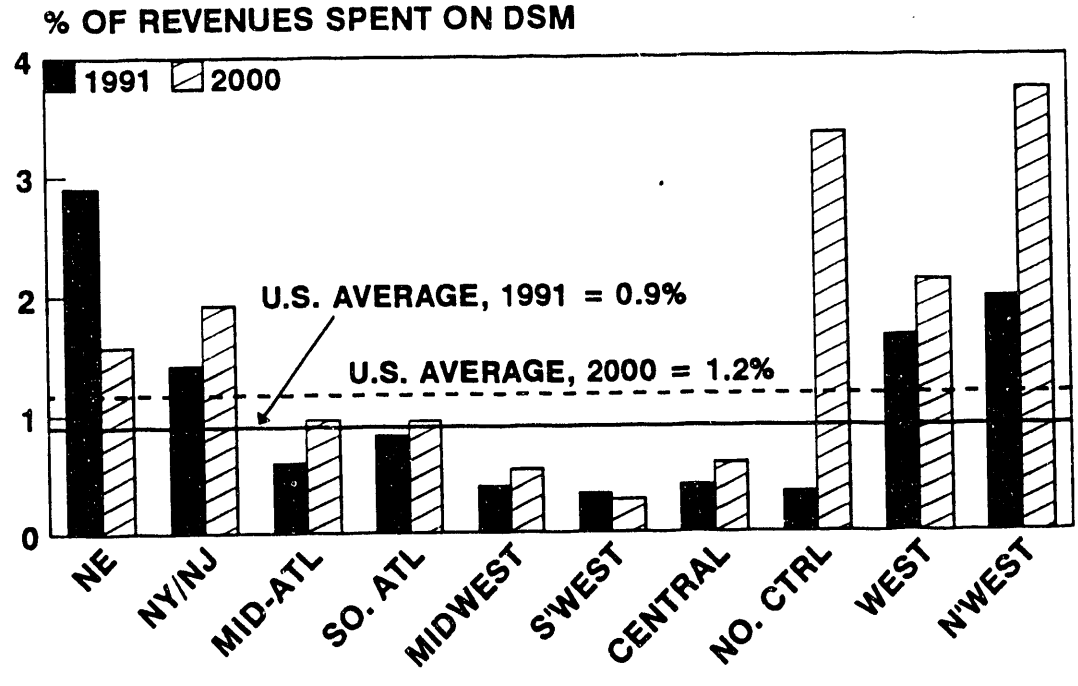

Fig. 10. The percentage of retail revenues spent on utility DSM programs by federal region in 1991 and projections for the year 2000. (Region 1 is on the left, and Region 10 on the right.)

The percentage of retail revenues expected to be spent on DSM programs increases in eight of the ten regions (Fig. 10 and Table 6). Only in New England and the Southwest do these percentages decline. In 1991, New England utilities spent 2.9% of revenues on DSM, more than in any other region. The projections for the year 2000, however, show New England dropping from first to fifth place, planning to spend only 1.6% of revenues on DSM. This decline is likely caused by maturation of the region's DSM programs, high current levels of spending, greater customer contributions to the cost of DSM measures, and the lingering effects of the current recession (which leads to low avoided costs). The decline in the Southwest is much less than in New England.

On the other hand, the planned *increases* in DSM spending are greatest in the North Central and Northwest regions. The percentage of revenues to be spent on DSM increases from 2.0 to 3.7% in the Northwest, making that region the leader in DSM spending for the year 2000.

Table 6. Costs of electric-utility DSM programs by federal region, 1991 through 2001

Region		1991 revenue (million $)	DSM-program costs (million $)					DSM as a percentage of revenues	
			1991	1992	1995	2000	2001	1991	2000
1	New England	9704	282	314	276	257	266	2.9	1.6
2	NY/NJ	18788	268	358	468	606	628	1.4	1.9
3	Mid-Atlantic	19753	117	146	247	318	344	0.6	1.0
4	South Atlantic	36977	305	399	541	587	594	0.8	0.9
5	Midwest	33128	129	211	296	296	297	0.4	0.5
6	Southwest	23104	75	80	102	106	110	0.3	0.3
7	Central	8223	33	41	59	81	68	0.4	0.6
8	North Central	4610	16	28	101	258	250	0.3	3.3
9	West	22821	378	529	673	810	900	1.7	2.1
10	Northwest	5923	117	169	290	368	334	2.0	3.7
	Totals[a]	183031	1720	2275	3053	3686	3790	0.9	1.2

[a]These totals are slightly less than those in Table 1 because 20 wholesale utilities that ran DSM programs provided no state identification; therefore, these utilities are not included here.

The percentage reduction in annual electricity sales caused by DSM is expected to increase in every region (Fig. 11 and Table 7). The planned increases are largest in New England, New York/New Jersey, and the North Central regions. The overall reduction in electricity sales is expected to exceed 3% in the year 2000 in New England, New York/New Jersey, North Central, and Northwest. On the other hand, the contributions of DSM to reduced electricity sales are expected to remain below 1.5% in the Southwest and Central regions.

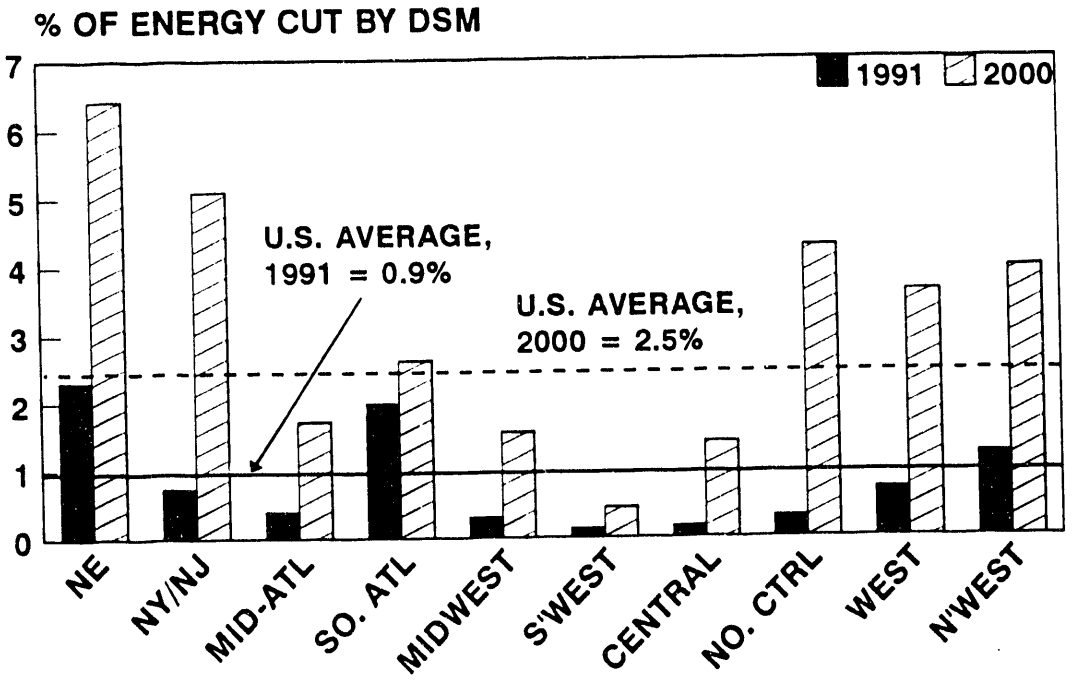

Fig. 11. The percentage of annual electricity sales reduced by utility DSM programs by federal region in 1991 and projections for the year 2000.

Table 7. Effects of electric-utility DSM programs on annual sales to retail customers by federal region, 1991 through 2001

Region		1991 sales (GWh)	DSM-program savings (GWh)					DSM as a percentage of sales	
			1991	1992	1995	2000	2001	1991	2000
1	New England	103231	2391	3051	5109	7876	8401	2.3	6.4
2	NY/NJ	194034	1422	2482	4861	11774	12812	0.7	5.1
3	Mid-Atlantic	284613	1116	1335	2972	5831	6345	0.4	1.7
4	South Atlantic	606780	12025	12635	14636	18909	19687	2.0	2.6
5	Midwest	517791	1551	2314	5121	9558	10172	0.3	1.6
6	Southwest	379092	492	675	1382	1967	2108	0.1	0.4
7	Central	131997	205	224	746	2193	2272	0.2	1.4
8	North Central	85856	253	353	1572	4375	4912	0.3	4.3
9	West	276426	1928	2892	7998	11901	12744	0.7	3.6
10	Northwest	152590	1859	2419	3982	7191	7682	1.2	4.0
	Totals[a]	2732410	23242	28378	48379	81575	87134	0.9	2.5

[a]See footnote to Table 6.

The contribution of DSM programs to meeting future energy growth depends on both energy growth and the extent of the utilities' DSM programs. On a national basis, utility DSM programs are expected to offset 14% of the growth in electricity sales between 1990 and 2000. This estimate, based on utility submissions to EIA in early 1992, may already be out of date. Faruqui et al. (1992) reviewed about 70 utility resource plans and estimated that U.S. utility DSM programs are likely to account for 22% of the growth in electricity sales

that would otherwise occur between 1990 and 2000. This estimate is about 50% larger than the earlier utility reports.

According to the EIA-861 data, DSM programs in New England are expected to meet 35% of the energy growth expected this decade (Fig. 12). DSM is expected to provide substantial contributions, between 20 and 30%, in New York/New Jersey, North Central and the Northwest. At the other end of the spectrum, DSM is expected to offset less than 10% of this decade's load growth in the Midwest, Southwest, and Central regions.

Finally, Fig. 13 and Table 8 show the effects of DSM programs on reducing peak demands in each region for 1990 and 2000. The New York/New Jersey, South Atlantic, North Central and West regions each plan to cut peaks by almost 10% by the year 2000. Three regions, including the Southwest, Central, and Northwest, plan only modest peak-demand reductions of less than 5% by the year 2000.

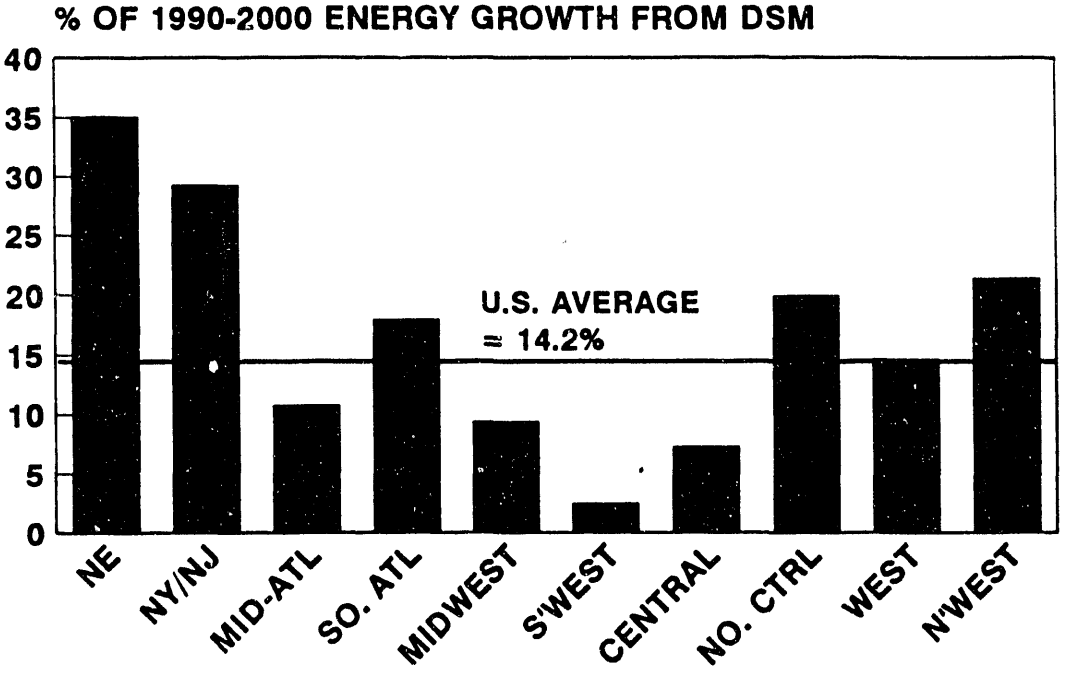

Fig. 12. **The contribution of utility DSM programs to meeting growth in electricity use from 1990 to 2000 by federal region.**

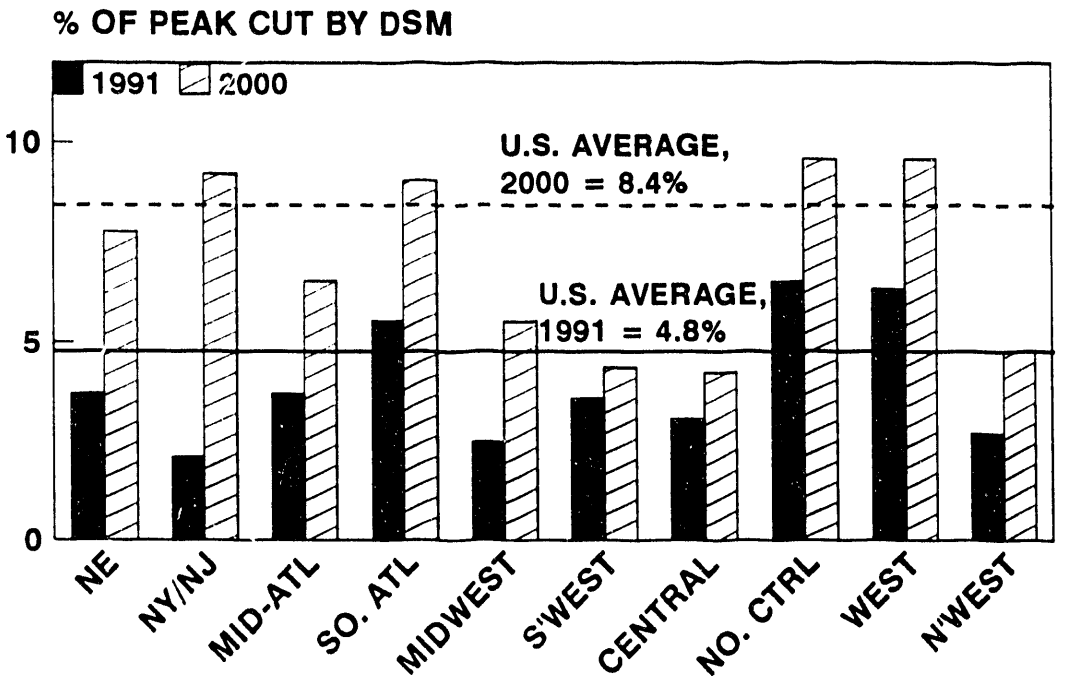

Fig. 13. The percentage of peak demand cut by utility DSM programs by federal region in 1991 and projections for the year 2000.

Table 8. Effects of electric-utility DSM programs on peak demands by federal region, 1991 through 2001

Region		DSM-program load reductions (MW)					DSM as a percentage of peaks	
		1991	1992	1995	2000	2001	1991	2000
1	New England	908	1097	1581	2278	2418	3.7	7.8
2	NY/NJ	928	1434	2684	4802	5172	2.1	9.2
3	Mid-Atlantic	2302	2450	3279	4788	5015	3.7	6.5
4	South Atlantic	9636	10978	13801	18159	18832	5.6	9.0
5	Midwest	2935	3944	5570	7688	8005	2.5	5.5
6	Southwest	3050	3430	3474	4443	4601	3.6	4.4
7	Central	1006	1097	1486	1682	1579	3.1	4.2
8	North Central	1121	1144	1386	2027	2126	6.5	9.6
9	West	3754	4137	5389	7165	7517	6.3	9.6
10	Northwest	984	906	1526	2096	2182	2.7	4.8
	Totals[a]	26625	30618	40176	55128	57448	4.8	8.4

[a]See footnote to Table 6.

CONCLUSIONS

The data and projections that electric utilities submit to EIA on Schedule V of EIA-861 provide valuable and unique insights into the current status and future directions of electric-utility DSM programs in the United States. Although the utilities reported data and estimates in different ways, the level of detail and near-100% coverage of the industry make this a rich source of information.

The data reported for 1991 and projections through the year 2001 lead to several findings:

- The costs and effects of utility DSM programs grew between 1989 and 1990 and again between 1990 and 1991. In 1991, utilities spent 1.0% of their revenues on DSM programs. These programs cut peak demand by 4.8% and cut annual electricity sales by 0.9% that year.

- Utility DSM activity is highly concentrated among a few utilities. For example, only 13 utilities account for fully one-half of all utility expenditures on DSM programs.

- Utility DSM activity is also concentrated among a few states. The utilities in states along the east coast (Maine, Vermont, Massachusetts, Connecticut, Rhode Island, New York, Delaware, the District of Columbia, Tennessee, North Carolina, South Carolina, and Florida); upper midwest (Wisconsin); and west coast (Washington, Oregon, California, and Nevada) spent more than 1% of revenues on DSM, saved more than 1% of annual electricity sales, or both.

- On the other hand, utilities in the middle of the country spent much less money on DSM programs and, as a consequence, produced much smaller demand and energy savings.

- The costs and benefits of DSM programs are expected to increase, in both absolute and relative terms, between 1991 and 2001. For example, DSM expenditures will likely increase from the 1991 level of 1.0% of revenues to 1.2%, while the percentage energy savings provided by DSM will grow from 0.9% to 2.7%.

- DSM programs are expected to offset 14% of the growth in electricity sales between 1990 and 2000. This estimate may be low given the continuing expansion of such programs across the country.

- The contribution of DSM programs to meeting future load growth varies across regions in much the same way that the 1991 costs and benefits did. DSM is expected

to meet more than one-third of the load growth in New England and between 20 and 30% of the growth in New York/New Jersey, North Central, and Northwest. On the other hand, DSM is expected to provide less than 10% of the resources needed to meet growth in the Midwest, Southwest, and Central regions.

These data show that, in spite of all the discussion and debate over the role of DSM as a utility resource, the costs and effects of these programs to date are modest. DSM proponents can point with pride to the substantial growth between 1989 and 1991. DSM opponents can take solace from the fact that the costs and effects of DSM were small relative to total revenues, sales, and peak demands.

The costs and effects of utility DSM programs are expected to continue increasing for at least the next decade. Utility reports to EIA show steady growth in the energy savings and peak-demand reductions caused by DSM programs but much slower growth in DSM-program budgets. These utility reports are likely to underestimate future program costs and effects, as shown by Faruqui et al. (1992) and by the increases in 1991 utility estimates relative to the 1990 utility estimates. This growth is a consequence of increasing concerns about the environmental effects of electricity production and transmission; growing government support, at both the state and federal levels, for utility DSM programs; evidence that DSM programs provide cost-effective energy and capacity resources and improve customer service; and a recognition that utilities are well positioned to help their customers overcome the market barriers to adopting energy-efficiency improvements.

The DSM-program data reported by utilities to EIA will continue to grow in accuracy and value over time. For example, the 1992 Schedule V includes questions on the effects of DSM programs for each customer class and breakdowns by type of program. This additional information will provide a much richer understanding of the market segments at which DSM programs are aimed. EIA's (1993c) integration of the 1990 results from EIA-861 with the 1990 Residential Energy Consumption Survey provide a useful example of how these additional details and use of multiple data sources can improve our understanding of DSM programs.

Finally, it is important to recognize that these data are just numbers. Readers interested in the "flesh and blood" of DSM programs should review material on individual DSM programs published by the Northeast Region Demand-Side Management Data Exchange (Shaw, Ellis, and Titus 1992), IRT Environment (1992), Electric Power Research Institute (Plexus Research 1993), and (soon) the Lawrence Berkeley Laboratory Database on Energy-Efficiency Programs.

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APPENDIX: ANALYTICAL APPROACH

About 3250 electric utilities submitted EIA-861 forms to EIA. These data show total retail sales of 2777 thousand GWh, total generation of 2852 thousand GWh, and total retail revenues of $188 billion in 1991, based on data from 265 IOUs and 2976 consumer-owned utilities. These national totals are within 2% of those reported by EEI (1992) for 1991.

Altogether, 439 utilities reported running a DSM program in 1991, sold more than 120 GWh that year, and provided program data on Schedule V of EIA-861. (An additional 451 utilities reported running a DSM program in 1991 but did not have to provide data on these programs.) Checks on system load factor, retail price, conservation load factor, and percentage of peak demand cut by DSM showed some anomalies among these 439 utilities. In particular, the numbers reported for summer and winter peaks sometimes appeared to be incorrect, especially those from smaller utilities. Such errors probably explain some of the anomalies in system load factor and percentage of peak demand cut by DSM. The error checks I applied included tests for:

- percentage reduction in peak demand from DSM: summer or winter peak demand > 0, and the percentage reduction from DSM between 0 and 100%.
- system load factor: load factor between 0.3 and 0.8. (The national system load factor was 0.57 in 1991.)
- conservation load factor: MW savings > 0 and percentage reduction in peak < 100%.

The utilities that reported running a DSM program in 1991 but were not required to provide data on these programs were generally quite small. (The EIA requirements called for completion of Schedule V only if the utility sold more than 120 GWh in 1991.) These utilities accounted for only 1% of retail sales and revenues of all the 890 DSM utilities. Of these, however, 45 had a total output of more than 120 GWh.

To produce state estimates from the utility data, I allocated data across states for those utilities that sell to retail customers in more than one state. Based on EIA data showing the fraction of utility retail sales by state, I split the data for nine of the largest utilities among their states (Bonneville Power Administration, Potomac Electric Power, New England Electric, Kansas City Power & Light, Carolina Power & Light, Duke Power, PacifiCorp, Tennessee Valley Authority, and Appalachian Power). I assigned the same shares to the DSM totals as to the retail sales totals because EIA does not collect data on DSM expenditures or effects by state. For example, Duke Power retail sales are split 69% and 31% between North Carolina and South Carolina; I assigned these percentages to the company's DSM expenditures, energy savings, and demand reductions for the two states.

In Alaska and Louisiana, only one utility in each state reported data on its DSM programs; thus, the state totals are based on only one data point. In four states (Alaska, Louisiana, Mississippi, and North Dakota), utilities reporting DSM data accounted for less than 20% of the state retail sales and revenues. Finally, 20 utilities had no state identification. All 20 of these utilities are wholesalers that do not sell directly to retail customers. Fortunately, these utilities account for only about 1% of the relevant totals.

The annual and state statistics for 1991 and earlier years were normalized to data from EEI (1992). All the temporal comparisons shown in this report are internally consistent, normalized to the EEI historical data, and reflect recent revisions to the 1989 and 1990 utility DSM data (EIA 1993b). I used EEI numbers because the EIA *Electric Power Annual 1991* was not available at the time of this project.

Utility DSM data are presented as percentages of total sales and total revenues. State, regional, and national results, however, are normalized to retail sales and retail revenues. Inclusion of wholesale sales and revenues in the state, regional, and national totals would double count these wholesale transactions. Exclusion of wholesale sales and revenues from the utility totals would have complicated presentation of results from utilities that have few or no retail customers.

The annual and regional projections of DSM costs and effects were normalized to the reference projections produced by EIA (1991). Table A-1 lists the states by federal region. (EIA did not prepare a 1992 set of forecasts because of work on its new National Energy Modeling System.) I assumed a 4%/year inflation rate from 1991 through 2001 in converting the utility estimates of future DSM expenditures to 1991 dollars. I also assumed a uniform growth rate in sales, demand, and revenues from 1990 through 2000.

In January 1993, EIA published a new *Annual Energy Outlook 1993, with Projections to 2010* (EIA 1993a). This report updates the forecasts in the 1991 Annual Outlook report used as the basis for this report (EIA 1991). The new EIA projections show slightly slower electricity load growth from 1990 to 2000 (1.7 vs 1.9%/year) than the earlier report. I did not use the new EIA projections because they do not include regional projections.

Table A-1. States by federal region

1. New England	4. South Atlantic	7. Central
Connecticut	Alabama	Iowa
Maine	Florida	Kansas
Massachusetts	Georgia	Missouri
New Hampshire	Kentucky	Nebraska
Rhode Island	Mississippi	
Vermont	North Carolina	8. North Central
	South Carolina	Colorado
2. New York/New Jersey	Tennessee	Montana
New Jersey		North Dakota
New York	5. Midwest	South Dakota
	Illinois	Utah
3. Mid-Atlantic	Indiana	Wyoming
Delaware	Michigan	
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