ACHIEVING HIGH PARTICIPATION RATES: LESSONS TAUGHT BY SUCCESSFUL DSM PROGRAMS

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EXECUTIVE SUMMARY

Participation rate (participating customers divided by number of eligible customers) is one of the most critical factors affecting the success of utility demand-side management (DSM) programs. High participation rates are needed to achieve significant savings, and thereby have an impact on a utility's need for power plants and other resources. Several major studies on participation rates were published in 1990, but utility DSM initiatives have expanded rapidly over the past few years, and new program approaches are steadily being introduced, and thus, even data from a few years ago are often out-of-date. This paper attempts to fill this gap by examining recent participation data for many programs.

For this study, programs with high participation rates were identified through a review of the literature, interviews with utility staff and other industry experts, and collection and analysis of data on several hundred DSM programs. Data were collected from utilities on 18 different program categories; this paper summarizes these data for the approximately 2-6 programs in each category with the highest participation rates.

Depending on the program category, maximum cumulative participation rates range from approximately 15% to nearly 100% (see Table ES-1). The program types with maximum participation rates of approximately 15-20% are residential appliance labeling and commercial performance contracting, lighting rebates, and multiple-measure rebates. Participation rates of 64% or more have been achieved by direct installation, new construction incentive, and market transformation programs (programs which seek to transform entire markets by combining education, utility incentives, and government regulation). Areas where these high participation rates have been achieved include water heating retrofits, comprehensive weatherization, refrigerator rebates, and new construction in the residential sector; lighting, comprehensive retrofits, and new construction in the commercial sector; and motors in the industrial sector. Maximum participation rates for other program types and categories lie within the 25-60% range.

With the exception of rebates for commercial HVAC equipment and lighting in new commercial buildings, maximum achieved participation rates for rebate programs are generally less than 30%. Similarly, maximum participation rates for labeling programs are generally less than 30%. Performance contracting programs have yet to break the 15% participation barrier, with the partial exception of two programs that combine a modified shared savings approach with substantial utility subsidies.

The cost of saved energy to the utility (not including costs paid by consumers) for most of these high participation programs is less than $0.035/kWh saved.

Based on findings, new construction programs and market transformation programs appear to be promising avenues all utilities should consider. Direct installation programs also have much to recommend them, although their cost of saved energy to the utility is frequently above $0.035/kWh. On the other hand, since these programs typically pay a large proportion of measure costs, total resource costs and utility costs are frequently similar.

Table ES-1. Summary of Highest Participation Rate by Program Category.

Program Type	Highest Participation Rate (as % of total eligible)
RESIDENTIAL:	
Low-cost weatherization	60-68%
Comprehensive weatherization	87%
Low-cost hot water retrofits	98%
Air conditioner and heat pump rebates	60%
Refrigerator rebates	80%
Compact fluorescent lamps	60%
New construction	100%
Labeling - appliances (net participation)	23%
Labeling - new construction (net participation)	39%
COMMERCIAL:	
Lighting Rebates	21%
HVAC rebates	90-100%
Multiple-measure rebates	17-23%
Lighting direct installation	>85%
Performance contracting retrofits	15%
Comprehensive retrofits	74%
New Construction	70%
INDUSTRIAL:	
Motors	64%
Multiple-measure rebates	36-48%
Custom Rebates	51%

In reviewing the high participation programs, it becomes apparent that there are several factors that differentiate high participation programs from less successful programs. Among these factors, not all of which apply to each program area, are the following:

* Community-based marketing which seeks to involve the entire community in the program;

* Personal contacts, both face-to-face and over the telephone, between utility staff/consultants and customers to market the program and assist with program implementation;

* Availability of technical assistance to customers and trade allies;

* Provision of high-quality services;

* Active involvement of trade allies in helping to design and market the program;

* Efficiency thresholds that push the market, and keep free riders down to manageable levels;

* A marketing message and marketing materials that are catchy and easy to understand;

* Marketing that targets the many different people involved in making decisions and that stresses the factors most likely to influence each type of decision-maker;

* Marketing that emphasizes all of the benefits of efficiency measures, and not just the energy savings.

* Making it easy for customers to participate; direct installation programs are the ultimate example of making it easy for customers to participate;

* Making it easy for manufacturers and distributors to participate, including announcing eligibility thresholds well in advance of program start-up and avoiding frequent changes in eligibility levels;

* Initially targeting customers that are more likely to participate, such as customers with high energy bills;

* Providing substantial financial incentives;

* Building regional consortiums to promote particular efficiency changes;

* Working with government agencies to use utility programs to lay the groundwork for government mandates such as equipment efficiency standards and building codes.

A comparison of these findings with studies from 1990 shows that over the past three years, maximum achieved participation rates have increased for all of the industrial program categories and many of the commercial program categories (i.e. HVAC and multiple-measure rebates, lighting direct installation, and new construction). These increases imply that as utilities continue to operate DSM programs, and gain experience in what works and what does not, participation rates may continue to increase. Among residential programs, only three categories were covered by the 1990 studies; over the past three years maximum participation rates in these three categories are largely unchanged, in part because maximum participation rates in 1990 were already quite high. This analysis should be repeated in a few years in order to assess whether participation rates continue to improve.

INTRODUCTION

One of the most critical factors affecting the success of utility demand-side management (DSM) programs is the participation rate. High participation is generally needed to achieve significant savings, and thereby have an impact on a utility's need for power plants and other resources. Data on participation rates are useful for developing assumptions on participation rates as part of integrated resource planning processes, achievable potential studies, and planning for specific DSM programs. While much has been written on participation in the past (see for example Berry 1990 and Nadel 1990), to our knowledge, there has been no recent review of participation rates achieved by DSM programs. Utility DSM initiatives have expanded rapidly over the past few years, and new program approaches are steadily being introduced, and thus data from even a few years ago are often out-of-date. This paper attempts to fill this gap by examining recent participation data for many programs.

APPROACH

More than 2000 DSM programs have been operated by over 500 utilities (Blevins and Miller 1993). Collecting data on even 10% of these programs was beyond the resources available for this project. In order to bring the project to a manageable scale, we elected to concentrate on programs with the very highest participation rates in each program category. These are the programs that teach the most lessons about how to achieve high participation and these are the programs that, if they are cost-effective and serve utility and customer needs, are most worthy of emulation by other utilities. The range of participation rates that have been achieved in the field have been documented by past studies (see above); we were most interested in whether even higher participation rates have been achieved in recent years. Also, since prior studies have documented that some programs have very low participation rates, by collecting data on the best programs, a broad range is provided for the calibration of models that predict participation levels.

In order to identify programs with high participation rates, a two-pronged strategy was employed. First, existing publications on program participation rates were examined including Berry 1990, Nadel 1990, and Flanigan and Weintraub 1993. Second, we contacted more than a dozen DSM experts and asked which programs they thought had high participation rates. Preliminary participation data was collected on each of these programs and programs with the highest participation rates were selected for detailed data collection. In general, we sought to identify the two to six programs in each program category with the highest participation rates.

Data on each program were collected through a four-stage process. First, a data collection form was prepared, and filled-in, as much as possible, using data in ACEEE files. Second, these partially completed forms were sent to the most appropriate staff at each utility for checking (for data already filled in) and completion (for missing data). These forms also asked utility staff what factors they thought contributed to the program's success. Third, the data was entered in a database and missing and/or questionable data identified. Utility staff were then contacted via the telephone to resolve questions and fill in missing data. Finally, a printout of all data on a program was mailed to the contact at each utility for final checking. In general, data summarized here are self-reported by the sponsoring utility. However, where other data

sources were available, such as program evaluations and published papers, they were also used.

Data were collected for a total of 18 different program types spread among the residential, commercial and industrial sectors. These program types were selected because they are among the most commonly offered types of programs and thus there is a large amount of data available. While we would have liked to collect data on other program types or participation rates for particular market segments (e.g. low-income households), available resources did not permit a broader scope. Program types examined were:

Residential
- Low-cost weatherization
- Comprehensive weatherization
- Low-cost hot water retrofits
- Compact fluorescent lamp incentives
- Refrigerator rebates
- Air conditioner rebates
- Residential new construction
- Labeling

Commercial
- Lighting rebates
- HVAC rebates
- Multiple measure rebates
- Lighting direct installation
- Performance contracting
- Comprehensive retrofit packages
- New construction

Industrial
- Motor rebates
- Multiple measure rebates
- Custom measure incentives

The data collected are subject to several caveats. First, this study concentrates on participation rate, and downplays other important parameters such as the amount of savings achieved and program cost-effectiveness. Thus, the high participation programs featured here may not be cost-effective for all utilities and/or may not adequately address important strategic needs of some utilities. To aid the reader in making these determinations, data on energy savings and cost of saved energy from the utility perspective are provided.[1] However, since programs were selected based on participation rate, the programs examined here may not represent the most successful programs from a savings or cost-effectiveness perspective. Second, data provided were compiled by dozens of different utilities. While we made extensive

[1] As a rough approximation, if levelized long-run avoided costs for a utility are greater than the cost of saved energy of a program, a program is likely to be cost-effective from the utility perspective (cost of saved energy is defined in the next section of this paper).

efforts to define the types of data collected and to check data for reasonableness; there are likely to be some differences in data calculation methods from utility to utility and program to program. In particular, many of the savings estimates are based on engineering estimates, not impact evaluation results. Also, utilities varied in how completely they compiled data on program administrative costs. These issues are discussed further in the Definitions section below. Third, the data provided here do not necessarily include all high participation programs. While great efforts were made to check out all leads provided, it is likely some high participation programs slipped through our net.

DATA TYPES AND DEFINITIONS

In order to understand and interpret the data summarized in this study, it is important to understand the types of data that were collected and how these data types were defined. These definitions are based largely on previous work by Nadel (1991) and Hirst and Sabo (1991). Data

Participation rate is the number of participating customers divided by the number of eligible customers. Participation rates were collected on a cumulative basis since program inception, since we were interested in obtaining insights into the maximum participation rate that can be ultimately achieved. For this study, participants were defined as the number of unique account numbers that install efficiency measures through a program. Under this definition, if a customer receives an audit, but does not install any measures, they are not a participant. If a particular account number receives several different rebates, it is counted only once. On the other hand, if a particular firm has more than one account, and lists different account numbers on different rebate applications, it will be counted once for each participating account. For this study data were collected on the cumulative number of participants, since the inception of each program. Some utilities could only provide data on the number of projects implemented, where one customer might implement several projects. In these cases we attempted to estimate the number of participating customers based on project per customer data obtained from similar programs operated by other utilities. Participation data reflect committed projects (e.g. signed contracts) including projects that are completed and projects still under construction. Participation data generally include *free riders* -- participating customers who would have implemented efficiency measures even if a utility-sponsored DSM program was not offered. Estimates of the proportion of participating customers who were free riders were collected separately. In the text we sometimes refer to participation levels after excluding free riders. Where this is done, the text refers to *net participation*. Conversely, where the term *gross participation* is used, figures include free riders.

The number of eligible customers for a program may be all of a utility's residential or commercial and industrial (C&I) customers, or it may be a subset of this group; e.g., C&I customers with peak demand greater than 500 kW or new C&I accounts. Sometimes, the number of customers eligible for a program is large, but a much smaller number of customers is specifically targeted. In cases where the number of eligible and targeted customers differ, two participation rates were calculated -- one based on eligible customers and one based on targeted customers. If targeted customers are representative of the larger eligible population, participation rates based on targeted customers indicates the participation rate that may be achieved in the future, assuming similar marketing efforts are ultimately used to reach all

eligible customers.

For some programs participation rates are calculated based on factors besides participating and eligible customers. For equipment rebate programs such as motor, ballast, refrigerator, and air conditioning programs, the participation rate is usually described in terms of pieces of equipment that received rebates relative to annual sales of that equipment in a utility's service territory. For commercial new construction programs, participation rates are often based on the floor area of participating buildings relative to the floor area of all new buildings built during the year. To prevent confusion, the database indicates the type of data that were used to calculate participation rates for each program.

In addition to data on participation rates, several other types of data were collected on each program examined including data on energy savings, free riders, incentive levels, measure life, and program costs.

Energy savings (in MWh) were estimated by each utility on a cumulative basis since the inception of the program. Energy savings data are annualized, meaning that impacts are reported for a full calendar year. Energy savings figures generally do not include savings achieved by free riders. Where data are available, energy savings are based on impact evaluation results. These figures are labeled *net* savings if the savings are adjusted to exclude savings not attributable to the program and *gross* savings if no such adjustment was made. In most cases impact evaluations have yet to be completed and thus savings estimates are based on engineering calculations. Where data are based on impact evaluation results, savings estimates in the tables are marked with an asterisk.

The proportion of program participants who are free riders was estimated by each utility based on survey data and/or educated guesses. These data are expressed as a percentage of the program participants and not as a percentage of the total market. Thus, if 20% of the eligible customers participate in the program, and customer surveys indicate that in the absence of the program 10% of the eligible population would implement program measures, the free rider proportion is 50% (10%/20%).

Data on incentive amount are expressed in terms of the percentage of measure costs including capital and labor. For equipment replacement and new construction programs, measure costs are the incremental cost of efficient equipment and practices relative to the cost of standard equipment and practices. For retrofit programs, measure costs are the full cost of high efficiency equipment. These figures are either expressed as an average for a program across all participants or measures, or as a range, where the incentive proportion usually varies by measure.

Measure life is an estimate of the average number of years each measure will remain installed and operating. Measure life figures reflect the useful life of equipment as well as allowances for measure removal (e.g. during remodeling) and inoperable measures (such as may occur with poor maintenance). Measure lives were estimated by each utility. In addition, since measure life estimates varied substantially from utility to utility, ACEEE also estimated typical measure lives based on a systematic examination of measure life commissioned by the Bonneville Power Administration (Gordon et al. 1988) supplemented with other sources. All measure life

estimates are subject to a substantial degree of uncertainty.

Program costs were collected in two categories: direct and indirect costs. Direct costs are funds paid by utilities for DSM measures and include rebates, loan subsidies, and/or utility paid material and installation costs. Indirect costs are all other program costs including utility staff, marketing, administrative, and evaluation costs. However, indirect costs do not include general utility overhead. Data on money paid by customers were not collected since most utilities do not compile this data. Program costs are expressed in nominal terms in the year in which they were spent, since collection of annual program costs and adjustments for inflation were beyond the resources available for this project. Also, because costs were provided by each utility, we cannot vouch for how complete each utility was in its accounting of indirect costs. Finally, some utilities could only provide information on direct costs; in these cases we estimated indirect costs based on data from similar programs operated by other utilities.

Based on this information, two additional pieces of data were calculated: cost of saved energy and savings as a proportion of total electricity sales to the relevant customer sector.

Cost of saved energy (CSE) is the levelized average cost of a measure per kWh saved over the life of the measure. Since only utility costs are included, these levelized costs are from the utility perspective. Total resource costs, which include monies paid by customers, will frequently be higher. Our calculations assume ACEEE's estimate of measure life and a 5% real discount rate.

Savings as a percent of electricity sales to the relevant sector were calculated in order to provide an assessment of how important a particular program is to a utility's resource strategy. High proportions indicate high participation rates and/or large impacts relative to participant pre-program energy use. This measure also allows crude comparisons of energy savings across utilities of different sizes. In calculating this figure, electricity sales to the relevant customer class were generally obtained from utility reports to the U.S. Energy Information Administration (1993a).

RESULTS BY PROGRAM TYPE

Residential

Low-Cost Measures

Low-cost measure programs typically promote low-cost lighting, water heating, and space heating improvements such as compact fluorescent lamps, low-flow showerheads, water heater blankets, weatherstripping, plastic storm windows, and outlet gaskets.

A number of community-based approaches have been used to achieve participation rates in low-cost measure programs of 25-60%. The most common approach in recent years is the "Energy Fitness" program. Originally pioneered in Santa Monica, California, the Energy Fitness program provides free low-cost weatherization services (including materials and installation) to residents on a neighborhood-by-neighborhood basis. A specific day is scheduled

Table 1. Residential Programs with High Participation Rates.

Utility/Sponsor	Program	Program Type	Start Date	End Date	Annualized MWh Savings from Cum. Measures	% of Measure Costs Covered by Utility	Measure Life: Utility Estimate	Measure Life: ACEEE Estimate	# Eligible Customers/ Units Sold Annually		# Targeted Customers
Minnegasco	Neighborhood Energy Workshop	Wz:Low	1981	1984	*1,810,000* *	74%		5	100,000	customers	
City of Santa Monica	Energy Fitness	Wz:Low	1/85	12/85	*242,209* *	100%		5	37,833	customers	35,671
Michigan PSC	Energy Fitness	Wz:Low	10/88	2/89		100%		5	4,253	customers	
Town of Fitchburg	FACE	Wz:Low	~1980	~1980				5			
Wisc. Public Service	Energy Fitness - Stevens Pt.	Wz:Low	8/92	4/93	7,955	100%	12	5	16,068	customers	12,630
BPA	Hood River Conservation Project	WZ:Comp	1983	1985	11,598 *	100%	39	20	3,500	customers	
BPA	Weather wise	WZ:Comp	1983	1993	1,110,000 *	56%	40	20	659,671	customers	
Eugene WEB	Comprehensize Weatherization	WZ:Comp	1982	7/93	61,333	71-85%	20	20	40,169	customers	
Ontario Hydro	Espanola Power Savers	WZ:Comp	6/91	9/92	5,722 *	50-100%	39	20	1,821	customers	
TVA	Home Weatherization	WZ:Comp	1979	1987	1,883,500	35%	20	20	2,800,000	customers	
Boston Edison	Wattbusters tank wrap	WtrLo	6/89	12/90	7,882 *	100%	8	13	40,000	customers	
CMP	Regular Bundle-Up	WtrLo	1984	1988	34,046 *	88%	6	13	182,897	customers	
GMP	Powersavers	WtrLo	7/89	7/91	17,646	100%	13	13	23,684	customers	
MECo	Water Heater Wrap	WtrLo	5/87	12/89	56,327 *	100%	12	13	185,024	customers	
Osage Municipal	Showerhead/Aerator Giveaway	WtrLo	1991	3/92		100%	10	13	1,666	customers	
Osage Municipal	Water Heater Jacket Giveaway	WtrLo	1988	1991		100%	10	13	1,666	customers	
Seattle City Light	Blanket Seattle	WtrLo	1981	1983	44,979 *	100%	10	13	156,827	customers	
Baltimore G&E	Air Conditioner Rebate	AC	2/92	12/92	5,007	70-90%	15	12			27,000
City of Austin	Residential Appliance Efficiency Prg	AC	10/82	8/93		25%	15	12			
PEPCo	High-efficiency AC	AC	4/90	7/93	3,707	80%	15	12	41,715	units	
PG&E	Air Conditioner Rebate	AC	1/92	12/92	3,802	46%	18	12	40,000	units	
BC Hydro	Efficient Refrig Rebate Prgrm	Frig	6/89	1/93	68,300 *	100%	20	19	66,500	units	
NYSEG	Refrigerator Rebate Pilot	Frig	1985	1986	413		20	19	18,732	units	
PG&E	Refrigerator Rebate program	Frig	6/81	9/91	12,505	100%	20	19	150,000	units	
PG&E	Refrig. Salesperson/Dealer Incentive	Frig	1979	1991	5,513		20	19	150,000	units	
SMUD	Refrigerator Rebate	Frig	10/90	12/92	9,513	100%	20	19	35,000	units	

Notes: italicized values indicate gas savings (therms and $/therms)

** Asterisk indicates that savings are based on impact evaluation*

Table 1. Residential Programs with High Participation Rates (continued).

Utility/Sponsor	Program	Cumulative # of Participating Customers/ Units Participating/Year		Participation Rate (% of Total Eligible)	Participation Rate (% of Targeted)	% Free Riders	Cumulative Program Costs			Levelized Utility Cost ($/kWh Saved)
							Direct	Indirect	Total	
Minnegasco	Neighborhood Energy Workshop	25,000	customers	25%			$2,000,000		$2,000,000	*$0.255*
City of Santa Monica	Energy Fitness	12,485	customers	33%	35%		$112,000	988,000	$1,100,000	*$0.420*
Michigan PSC	Energy Fitness	2,096	customers	49%					$305,000	
Town of Fitchburg	FACE			60%						
Wisc. Public Service	Energy Fitness - Stevens Pt.	8,595	customers	53%	68%				$472,725	$0.014
BPA	Hood River Conservation Project	2,989	customers	85%			$14,000,000	$1,771,000	$15,771,000	$0.109
BPA	Weather wise	384,259	customers	58%			$570,000,000	$82,107,506	$652,107,506	$0.047
Eugene WEB	Comprehensize Weatherization	28,126	customers	70%			$36,000,000	$15,000,000	$51,000,000	$0.067
Ontario Hydro	Espanola Power Savers	1,578	customers	87%					$4,402,000	$0.062
TVA	Home Weatherization	631,123	customers	23%					$214,195,000	$0.009
Boston Edison	Wattbusters tank wrap	18,613	customers	47%		50-60%	$1,674,849	$414,640	$2,089,489	$0.028
CMP	Regular Bundle-Up	103,761	customers	57%		25%	$2,070,990	$516,371	$2,587,361	$0.008
GMP	Powersavers	18,000	customers	76%		2%			$2,100,000	$0.013
MECo	Water Heater Wrap	119,210	customers	64%		0%			$10,672,680	$0.020
Osage Municipal	Showerhead/Aerator Giveaway	1,183	customers	71%		insignif.			$10,200	$0.001
Osage Municipal	Water Heater Jacket Giveaway	1,632	customers	98%		insignif.			$17,000	$0.001
Seattle City Light	Blanket Seattle	107,459	customers	69%			$4,076,339	$309,802	$4,386,141	$0.010
Baltimore G&E	Air Conditioner Rebate	15,000	units		56%	0-10%	$4,200,000	$1,500,000	$5,700,000	$0.128
City of Austin	Residential Appliance Efficiency Prgm			~60%		15-20%				
PEPCo	High-efficiency AC	5,936	units	14%		0-10%			$4,238,000	$0.129
PG&E	Air Conditioner Rebate	8,771	units	22%			$2,980,764	$745,191	$3,725,955	$0.111
BC Hydro	Efficient Refrig Rebate Prgrm	53,500	units	80%		20%	$8,000,000	$2,500,000	$10,500,000	$0.013
NYSEG	Refrigerator Rebate Pilot	8,018	units	49-60%		31%				
PG&E	Refrigerator Rebate program	78,730	units	52%		81%	$8,809,725	$1,460,680	$10,270,405	$0.068
PG&E	Refrig. Salesperson/Dealer Incentive	51,488	units	34%		71%	$772,190	$249,094	$1,021,284	$0.015
SMUD	Refrigerator Rebate	24,416	units	70%			$6,038,785	$1,027,966	$7,066,751	$0.061

Note: italicized values indicate gas savings (therms and $/therm)

Table 1. Residential Programs with High Participation Rates (continued).

Utility/Sponsor	Program	Program Type	Start Date	End Date	Annualized MWh Savings from Cum. Measures		% of Measure Costs Covered by Utility	Measure Life: Utility Estimate	Measure Life: ACEEE Estimate	# Eligible Customers/ Units Sold Annually		# Targeted Customers
Boston Edison	Lighting Rebate program	CF	1987	12/91	20,723		25-67%	9	8	550,000	customers	
Burlington ED	Smartlight Leasing	CF	10/89	6/93	4,800	*	14%	5	8	14,400	customers	
CMP	Operation Lightswitch	CF	1/91	12/91	10,727	*	75%	6	8	450,000	customers	
Los Angeles DWP	A Better Idea program	CF	8/91	7/93	103,000		100%	7	8	1,169,000	customers	
Madison G&E	Power Plus Residential Lighting	CF	6/92	12/92	5,800		30-90%	7	8	100,000	customers	
NEES	Energy Fitness	CF	1989	1991	14,253	*	100%		8	74,400	customers	
SCE	CF Manufacturer's Rebate	CF	7/92	12/92	47,382		33%	7	8	3,600,000	customers	
Traer Municipal Util.	Light Bulb Retrofit	CF	2/87	3/87	0		100%		8	877	customers	
UI	Homeworks	CF	1990	7/93	14,618	*	100%	8	8	100,000	customers	
Wisc. Public Service	Compact Fluorescent Rebate	CF	9/91	12/93	33,600		48-75%	7	8	301,000	customers	
BCHydro	Remote Power Smart Options - Pilot	NC	5/90	10/93	1,067		100%	20	40	140	units	
BPA	MAP	NC	4/92	4/93	78,000		68%	45	40	13,000	units	
BPA	Northwest Energy Code	NC	10/84	6/93	29,682		100%	70	40	214,581	units	
BPA	Super Good Cents	NC	1/86	6/93	73,451		100%	70	40	214,581	units	
Carolina P&L	Conservation Rate Discount Program	NC	1980	12/87			0%		40			
Duke Power Co.	Res. Cons. Rate &Energy Ef Structur	NC	9/78	12/87			0%		40			
PSI	Smart Saver	NC	1989	1992	3,200	*			40	1,805	units	
Austin Electric Util	Energy Star Rating	Lbl-NC	1986	1992	3,011		0%	40	40	608	units	
Boston Edison Co	Blue Ribbon Appliance Lblng-Refrig	Lbl-Ap	1990	1991	132	*	0%	17	19	20,256	units	
Gulf Power Co	Good Cents New Home Program	Lbl-NC	1975	1992	120		0%	40	40	5,840	units	
NYSEG	Refrigerator Rebate Pilot - Labeling	Lbl-Ap	1985	1986	77		0%	20	19	5,539	units	
NEES	Blue Ribbon Appliance Lblng-Refrig	Lbl-Ap	1990	1991	467	*	0%	17	19	65,145	units	
Salt River Project	Climate Crafted Home	Lbl-NC	1/90	12/93	36,692		0%	20	40	33,974	units	

** Asterisk indicates impact evaluation has been conducted*

Table 1. Residential Programs with High Participation Rates (continued).

Utility/Sponsor	Program	Cumulative # of Participating Customers/Units		Participation Rate (% of Total Eligible)	Participation Rate (% of Targeted)	% Free Riders	Cumulative Program Costs			Levelized Utility Cost ($/kWh Saved)
							Direct	Indirect	Total	
Boston Edison	Lighting Rebate program	128,301	customers	23%		11%	$6,197,236	$2,148,397	$8,345,633	$0.062
Burlington ED	Smartlight Leasing	6,118	customers	42%			$233,000	$688,000	$921,000	$0.030
CMP	Operation Lightswitch	43,000	customers	10%		2%	$1,542,513	$276,912	$1,819,425	$0.026
Los Angeles DWP	A Better Idea program	409,150	customers	35%						
Madison G&E	Power Plus Residential Lighting	59,000	bulbs	12%			$407,000	$90,000	$497,000	$0.013
NEES	Energy Fitness	37,200	customers	50%						$0.075
SCE	CF Manufacturer's Rebate	950,000	bulbs	5%		11%	$4,041,780	$304,220	$4,346,000	$0.014
Traer Municipal Util.	Light Bulb Retrofit	526	customers	60%					$87,500	
UI	Homeworks	26,985	customers	27%			$2,756,105	$256,032	$3,012,137	$0.032
Wisc. Public Service	Compact Fluorescent Rebate	83,000	customers	28%		7%	$4,200,000	$2,100,000	$6,300,000	$0.029
BCHydro	Remote Power Smart Options - Pilot	100	units	71%		20%	$633,900	$934,800	$1,568,700	$0.086
BPA	MAP	13,000	units	100%		0-10%	$32,500,000	$6,500,000	$39,000,000	$0.029
BPA	Northwest Energy Code	21,892	units	10%		0-10%	$25,305,170	$2,526,868	$27,832,038	$0.055
BPA	Super Good Cents	56,819	units	26%		0-10%	$27,117,520	$11,617,526	$38,735,046	$0.031
Carolina P&L	Conservation Rate Discount Program			53%						
Duke Power Co.	Res. Cons. Rate &Energy Ef Structure			73%						
PSI	Smart Saver	1,625	units	90%					$3,700,000	$0.067
Austin Electric Util	Energy Star Rating	547	units	90%					$1,046,500	$0.020
Boston Edison Co	Blue Ribbon Appliance Lblng-Refrig	9,622	units	48%		67%				
Gulf Power Co	Good Cents New Home Program	1,962	units	34%		21%				
NYSEG	Refrigerator Rebate Pilot - Labeling	1,928	units	35%		35%				
NEES	Blue Ribbon Appliance Lblng-Refrig	28,664	units	44%		73%				
Salt River Project	Climate Crafted Home	18,346	units	54%		28%				

to target each individual neighborhood. Advance publicity is used to inform residents about the program, including the date services will be provided in their neighborhood. The week before a neighborhood is served, door-hangers are left at each home which discuss the services that will be available the next week. On the day services are provided (or the evening in neighborhoods with many working families), a canvasser knocks on each door and asks residents if they would like to participate. If the answer is yes, an installation crew is contacted by radio and an appointment is made for that day. For residents not home that day, information is left on the next time the crew will be in the neighborhood. If no contact is made on the second visit, information is left on how to schedule an appointment at a future time. Staff for the program can be either utility employees, or the utility can hire one or more outside contractors to manage the program.

The Santa Monica Energy Fitness program achieved a participation rate of 35% (Egel 1986). Subsequently the Michigan Public Service Commission ran a demonstration Energy Fitness program in five communities and achieved an average participation rate of 49%. Depending on the community, participation rates ranged from 36-59% (Kushler et al. 1989). Similarly, Wisconsin Public Service ran a pilot program in the Stevens Point community and achieved a 53% participation rate (Zehren 1993).

Another community-based approach was used in Fitchburg, Massachusetts and Minneapolis, Minnesota. In both the Fitchburg Action to Conserve Energy and the Minnegasco Neighborhood Energy Workshop (NEW) programs, neighborhood workshops were held throughout the city to teach local residents simple low cost/no cost energy efficiency measures. Marketing of the workshops is the responsibility of local neighborhood coordinators. In the Minnegasco program, $40-50 of weatherization materials were provided to participants at no charge. In the Fitchburg program, free materials were only provided to low-income households. In both programs, volunteers were recruited to assist with measure installation for residents needing assistance. In Fitchburg, a small city of 49,000, approximately 60% of households participated in less than one year. This participation rate was achieved in the late 1970's at the height of the oil shortage caused by the Iran-Iraq war (FACE undated; Berry 1990). In Minneapolis, a much larger city (approximately 600,000), it has taken much longer to target the entire community. After four years of program operation, 24% of eligible households had been served, which represented 35-40% of the households in the city neighborhoods that had been specifically targeted (Brummitt 1984; Dunsworth 1984).

In both the Energy Fitness and neighborhood energy workshop programs the key to high participation appears to be the community-oriented marketing approach that resulted in a high degree of knowledge about and buy-in to the program. In these programs community organizations and community leaders were involved in program planning and program outreach. The programs were adapted to the needs of the local community. Marketing was designed to build a sense of excitement throughout the community. In addition, all of these programs involved little or no monetary cost to participating households.

Low-cost measure programs typically result in only modest savings per household. For example, an impact evaluation of the Santa Monica program found average net natural gas savings of 5% of pre-program gas use and average net water savings of 16% (Egel 1986). An impact evaluation of the Michigan program found average net energy savings of 1-6% depending

on the fuel and end-use being examined and average net water savings of 14% (Kushler and Witte 1990). An impact evaluation of the Minnegasco program found net gas savings of 4-5% (Dunsworth 1984). But while savings are modest, costs are also modest. The programs discussed above have ranged in cost per household served from $55-145, resulting in a cost of saved energy of $0.01-0.03/kWh or $0.23-0.42/therm.

In addition to these direct program benefits, low-cost measure programs can be useful marketing devices for interesting homeowners in more comprehensive retrofits. For example, the Minneapolis NEW program was used to market the more comprehensive Operation Insulation program. Likewise, Energy Fitness programs operated by New England Electric and Wisconsin Public Service have promoted more comprehensive weatherization programs offered for electric heat customers. Also, low-cost measure programs can help build a community and political constituency for more extensive DSM programs.

Comprehensive Weatherization

Comprehensive weatherization programs generally feature an energy audit followed by installation of a complete weatherization package incorporating most of the cost-effective recommendations from the energy audit. Among the measures that are commonly installed are wall and attic insulation, window improvements, and infiltration reduction measures.

As with low-cost weatherization programs, the highest participation rates have generally been achieved by community-based programs. For example, both the Hood River Conservation Project (serving the town of Hood River, Oregon) and the Espanola Power Savers Project (serving the town of Espanola, Ontario) achieved participation rates of 85-87% by systematically targeting all homes in a single community over a 1 1/2 to 3 year period. Both programs were experimental projects designed to assess the maximum amount of energy savings that can be achieved in a community. In both programs, measures were installed in customer homes at no cost to the customer (although in Espanola's case some measures that were cost-effective to the customer but not cost effective to the utility were only partially subsidized). Both programs also involved extensive community-based marketing including extensive exposure in local media and at local events, a storefront office in the middle of town, periodic informational mailings and newsletters to town residents, and signs at the entrance to town showing project progress. In both communities, the high participation rate has been attributed to the extensive community-based marketing effort and to the high incentives that were provided (Hirst 1987; IRT #16 1992).

Among non-experimental programs, the highest participation rate was achieved by the Eugene Water & Electricity Board (EWEB) Comprehensive Weatherization program. This program is operated by EWEB as part of the Bonneville Power Administration's (BPA) Residential Weatherization program. The BPA program is administered by consumer-owned utilities throughout BPA's service area. Under the BPA program, the utility has paid an average of 58% of weatherization cost; the remaining 42% is paid by the customer. In the early years of the program, the utility cost share was approximately 80%. Overall, the BPA program has achieved a 58% participation rate over ten years. EWEB has been the most aggressive municipal utility in operating the program, achieving a participation rate of 70%. EWEB has been particularly successful because they developed special targeted marketing efforts aimed at

rental and low-income units and because they arranged a creative financing package (EWEB sold revenue bonds which BPA guaranteed) to keep their program operating when direct funds available from BPA were limited (Lorenzen 1993). BPA staff attribute the high participation rate for the region-wide program, despite very low electricity rates, to high incentives and an environmental ethic throughout the region (Craig-Arnold 1993).

Loan programs have not achieved participation rates of this magnitude. Perhaps the most successful loan program was the Tennessee Valley Authority's Home Weatherization Program. The program operated from 1978 to 1988 and provided zero interest loans to families for weatherization improvements. After ten years, over 600,000 homes participated, which represented 23% of eligible households. Reasons for this high participation rate include the attractive interest rate, the availability of free energy audits, and extensive advertising during a period of high consumer interest in energy issues (Depen 1993).

Savings from comprehensive weatherization programs are often substantial. For example, in the Hood River program, an impact evaluation found net savings of 15% of pre-program electricity use. Evaluations of BPA's weatherization program have found net first year savings ranging from 6-16% depending on the year being analyzed, with average savings over the life of the program of approximately 12% (Brown and White 1992). Even five years after weatherization, impact evaluations found that 79-93% of the first year savings remained (Keating 1991). On the other hand, comprehensive weatherization programs tend to be among the more expensive types of DSM programs. The cost of saved energy for the three incentive programs discussed above range from approximately $0.05-0.11/kWh saved which is greater than long-run avoided costs for many utilities. These programs often included expensive measures, such as new windows, with high costs per kWh saved. Eliminating these expensive measures may improve program cost effectiveness. For example, the Massachusetts Electric Residential Electric Space Heat Program has a cost of saved energy of about $0.04/kWh from both the utility and total resource perspectives (the utility pays all costs). The TVA loan program was less expensive (utility and total resource cost of approximately $0.01 and $0.03 per kWh respectively), and may be an effective approach during periods of high consumer interest in energy issues.

Low-Cost Hot Water Retrofits

Low-cost hot water retrofit programs typically promote water heater wraps, low-flow showerheads and faucet aerators, and sometimes, reducing water heater setpoints.

Probably the highest participation program was run by the Osage Municipal Utility (OMU). Osage is a small town in Iowa with 2,100 electric customers and 1,600 gas customers. As part of a comprehensive package of DSM services, OMU promoted water heater jackets, and low-flow showerheads and faucet aerators. The first phase of the program involved promoting various efficiency measures such as water heater wraps through talks to community groups, numerous articles and advertisements in the local news media, and a bi-monthly newsletter mailed to all utility customers. These efforts resulted in a water heater wrap saturation of approximately 50%. OMU then gave wraps away to customers beginning in 1988, with installation done by homeowners, or in the case of low-income customers, Jaycee volunteers. After three years this effort raised the saturation of water heater wraps to an estimated 98%.

In 1991 OMU began giving away low-flow showerheads to customers through the utility office (customers could pick up showerheads at a drive-up window). After one year, 71% of OMU's customers had picked up showerheads; data on installation rates are not available but are estimated by the utility to be very high. Keys to the success of the Osage programs include an active long-term education program to promote efficiency throughout the community (in particular program staff credit their newsletter, a simple, colorful publication that is mailed separate from utility bills and is designed not to look like junk mail), a clear explanation of program goals (reduce growth in energy use to less than 3% per year, allowing the deferral of a new power plant), and a gradual step-by-step process to promote a few measures at a time and gradually build trust and interest throughout the community (IRT #5 1992, Birdsall 1993).

Many utilities have operated low-cost hot water retrofit programs with participation rates of 47-76% of eligible customers including Boston Edison, Central Maine Power, Green Mountain Power, New England Electric, and Seattle City Light. In the programs in New England, materials and installation were provided at no cost to the customer, and installation was scheduled at times convenient to the customer including evenings and weekends. Introductory letters followed by telemarketing were used to market the programs and schedule installation appointments. The Seattle program also featured free materials and installation, but marketing was done door-to-door by community groups under contract to the utility.

All of the high participation programs examined feature free materials. Most of these programs include free installation, convenient installation times, initial introductory letters, and personal marketing via either the telephone or site visits.

Several utilities have conducted impact evaluations on their low-cost hot water retrofit programs. For example, an evaluation of Seattle water heater programs estimated net savings from tank wraps and temperature setback of 200-300 kWh/year (Okumo et al. 1992). Similarly, New England Electric found average gross savings from water heater wraps of 367 kWh/year (Mystakides 1988). With regards to low-flow showerheads, an end-use metering study on 85 homes in the Pacific Northwest found average net savings of 363 kWh/household, where low-flow showerheads were installed in all showers in a home (Warwick 1993). A field study by Northeast Utilities of homes served by a low-cost hot water retrofit program found that even 12 years after initial installation, the majority of measures were still in place (Bordner et al. 1993). Costs of these high participation programs have ranged from about $10 per customer for the Osage programs to just over $100 per customer for the New England direct installation programs including administrative costs. The cost of saved energy has generally ranged between $0.01-0.02/kWh.

Central Air Conditioner and Heat Pump Rebates

In most central air conditioner rebate programs, utilities pay rebates to homeowners and/or dealers for the installation of air conditioners which exceed Federal minimum efficiency standards. In examining participation rates in air conditioner (and other equipment rebate) programs, eligibility levels are a critical factor. If eligibility levels are set low enough that the majority of units on the market qualify for rebates, then participation rates will be very high, but most of the participants will be free riders. Thus, for these rebate programs, a critical parameter is the *net participation rate*, meaning the proportion of eligible equipment sales that

participate in a program but are not free riders.

Probably the highest participation rate in a residential air conditioning program is the approximately 60% participation rate achieved by City of Austin's Residential Appliance Efficiency program -- Austin reports 50% among replacement units and 70-80% in new construction (Myers 1993). Austin does not attempt to estimate free riders and hence the net participation rate for this program cannot be estimated. The Austin program features rebates ranging from $220-500/unit -- incentives are higher for air conditioners that replace existing units and also increase as unit efficiency increases. This program has been underway for more than ten years; over this time the utility has built a strong relationship with builders and HVAC contractors. It is these trade allies who are the primary marketers of the program. Other factors contributing to the program's success are the hot local climate, where average air conditioning costs approach $500 per year (EIA 1993b) and the fact that the Austin utility serves a limited geographic area that makes it easier to build personal relationships with customers and trade allies. The program proved so successful at promoting units with a Seasonal Energy Efficiency Ratio (SEER) of 11 (9% above the Federal minimum efficiency standard), that beginning in 1993, the program eligibility threshold was increased to SEER 12 (Batt 1993, Myers 1993).

Among larger utilities, Baltimore Gas & Electric claims a participation rate of 56% of air-conditioner sales to the replacement air conditioner market. This participation rate assumes that since the program is not promoted to the new construction market, none of the participants come from this market. If some new homes do in fact participate in the program, then the participation rate in the replacement air conditioner market would be lower than 56%. This program combines rebates with active efforts to encourage trade allies to promote efficient air conditioners and heat pumps to their customers.

Pacific Gas & Electric (PG&E) estimates a participation rate of 22% of estimated annual air conditioner sales for their Air Conditioner Rebate program. Free riders have not yet been estimated for this program and hence net participation cannot be estimated. Similarly, Potomac Electric Power Company (PEPCo) has achieved gross participation rates of 14-17% and net participation rates of approximately 13-16%. These programs are similar to the BG&E program in that they combine rebates with active programs to encourage trade allies to promote efficient air conditioners and heat pumps to their customers. The PEPCo program has only been in operation for a few years and participation rates are still increasing.

All of the high participation programs discussed above share two attributes: a strong working relationship with trade allies such as HVAC contractors, allowing the trade allies to be the primary mechanism to market efficient air conditioners to consumers, and significant financial incentives (e.g. on the order of 80% of the incremental cost of efficiency improvements).

For air conditioner and heat pump incentive programs, energy savings are generally proportional to increases in unit efficiency. Thus, relative to a SEER 10 unit, units with SEERs of 11, 12, and 13 will save approximately 9%, 17%, and 23%. Air conditioner and heat pump programs are primarily justified on the basis of peak demand savings. Energy savings are usually modest because air conditioners operate for only a limited number of hours each year. For this reason, cost of saved energy calculations are not especially relevant for this program

category.

Refrigerator Rebates

In refrigerator rebate programs, utilities offer rebates to customers who purchase high efficiency refrigerators. On a few occasions utilities have offered rebates to refrigerator dealers. "High efficiency" is defined in different ways by different utilities, but typically encompasses the 10-15% most efficient units on the market. If a higher proportion of units qualify, free rider levels may be substantial, and thus, as with other types of rebate programs, net participation rates are of critical importance.

Several refrigerator rebate programs report gross participation rates of 60% or more including programs offered by B.C. Hydro, New York State Electric & Gas (NYSEG), PG&E, and the Sacramento Municipal Utility District (SMUD). Net participation rates range from -3-54% for PG&E to 23-41% for NYSEG to approximately 64% for B.C. Hydro. Data on free riders for the SMUD program have not been collected and hence the net participation rate cannot be estimated.

The B.C. Hydro program was offered from 1989 through early 1993. The goal of the program was to influence the provincial legislature to adopt minimum efficiency standards for refrigerators. During this period, rebates were used to promote refrigerators which met the proposed standards. In 1991, the gross participation rate was 80% and the net participation rate approximately 64%. Rebates covered the full incremental cost of efficient refrigerators. In addition to customer rebates, the program included consumer advertising, point of purchase promotional materials, salesperson incentives, and technical assistance to retailers. Also, the utility worked with refrigerator manufacturers to help ensure that qualifying units would be available during the program period. In 1991 the provincial government adopted minimum efficiency standards which became effective January 1, 1992. Since this time, B.C. Hydro has promoted refrigerators exceeding the provincial efficiency standards by a significant margin (Yazdi 1993).

The NYSEG program was an experimental program operated during 1985-86. For this experiment, NYSEG offered different incentives and different levels of advertising and information in different sections of their service territory. Relative to a control area with no incentives or information campaign, net participation rates ranged from 23% in an information and advertising area (no incentives) to 41% in an area that included information, advertising, and incentives of $50 per refrigerator. The information and advertising component of these programs included point of purchase informational materials, bill inserts, and close dealer involvement and support. This experiment illustrates the importance of both information and rebates for achieving high participation levels (Kreitler and Davis 1987).

PG&E runs two programs to promote high efficiency refrigerators each year. During June through September they run a customer rebate program which features rebates for units exceeding Federal minimum efficiency standards. Eligibility levels and rebates are set each year. For example, in 1991, rebates of $50, $75, and $150 were provided for units which exceeded Federal standards by 10%, 15% and 20%. During the other months of the year they run a salesperson/dealer incentive program in which incentives are paid to salespersons for

selling efficient refrigerators and to dealers for stocking these units. In 1991, salesperson/dealer incentives ranged from $10/$3 for models which exceeded Federal standards by 10% to $20/$10 for models 20% more efficient than Federal standards. PG&E uses the customer rebate to establish high efficiency refrigerators in the market, then uses the salesperson/dealer incentives to maintain these units in the market while reducing costs to the utility (PG&E 1992).

In 1991, during the customer rebate program, an estimated 52% of new refrigerator purchasers received rebates, while during the dealer incentive program, incentives were paid for approximately 34% of refrigerators purchased. However, these figures include free riders, and exclude free drivers (equipment purchasers who are eligible for incentives but do not apply for incentives). A fuller picture is provided by the program evaluation, which, based on refrigerator sales data estimated that 90% of the refrigerators sold during the rebate period was eligible for rebates, including 54% which qualified for the maximum rebate. Relative to control areas outside of the PG&E service area, net participation rates were 10-42% for all qualifying units (the two different control areas provide widely differing results), and 49-54% for units exceeding Federal standards by at least 20% (in the control areas, many of the units sold met the 10% and 15% energy savings thresholds, but very few met the 20% threshold). During the salesperson/dealer incentive program, 76% of units sold met the program's eligibility standards including 18% which met the highest efficiency threshold, and net participation rates were -3-28% and 15-17% respectively. Overall, the combined program throughout 1991 had gross participation rates (including free drivers) of 83% for all qualifying models and 36% for the most efficient models, and net participation rates of 4-35% and 33-36% respectively (HBRS and Barakat and Chamberlin 1992).

One important aspect of the PG&E program is that dealers are extensively involved in many aspects of the program. Dealers actively promote qualifying units to their customers. Dealers stock rebate forms and have the customer fill out the form in the store. Rebate applications are then sent to the local appliance dealer association which administers the program under contract to PG&E. PG&E field staff continually work with local dealers to deliver rebate forms, point-of-sale information materials, and answer questions. PG&E also promotes the program through its newsletter, bill inserts, and radio advertisements. All promotions refer PG&E customers to their local appliance dealer for more information. Refrigerator manufacturers are also involved in the program design. Manufacturers are consulted before eligibility thresholds are set and manufacturers are notified about eligibility levels in advance of program start-up, thereby permitting them sufficient time to produce and ship models that meet the program's eligibility levels (Casentini 1993).

The SMUD Refrigerator Rebate program had a 70% gross participation rate in 1991. The program features rebates equal to the full incremental cost of more efficient refrigerators, which range from $50-175 per refrigerator depending on unit size. Rebate eligibility levels are coordinated with PG&E and other California utilities and are the same as for the PG&E program described above. An additional $100 is paid to the customer if the old refrigerator is given to the dealer and then delivered to SMUD for disposal. Dealers receive a fee of $20 per refrigerator for this pick-up service, which increases their interest in promoting the program. In fact, SMUD relies primarily on dealers to promote the program (Lindeleaf 1993).

From this review of high participation refrigerator rebate programs, it appears that there

are several factors linked with program success including: (1) the active involvement of appliance dealers in the program in order to entice them to promote efficient refrigerators to consumers; (2) a consumer information program to encourage buyers to look for efficient products (much of these activities can take place at the point of sale); (3) high eligibility levels to keep free rider proportions low (recall for example that the PG&E program had much higher net participation at the 20% savings level than at the 10% participation level); and (4) significant financial incentives (recall the NYSEG experiment).

Savings from promoting efficient refrigerators vary depending on the efficiency levels being promoted. In the PG&E program discussed above, relative to the annual energy consumption of a typical new refrigerator being sold in areas not offering rebates, rebated units used 0-10% less energy, with no significant savings for the lowest eligibility threshold, approximately 5% savings for the middle threshold, and 10% savings for the highest threshold. Savings for the entire program averaged approximately 5% (HBRS and Barakat and Chamberlin 1992). The cost of saved energy for these programs varies widely, from a low of $0.01/kWh saved for B.C. Hydro's program (which achieved substantial energy savings with a modest investment because the lack of minimum efficiency standards in the province left ample room to improve efficiency) to $0.068/kWh saved for the PG&E program which paid very large incentives in a (successful) attempt to transform the market.

Compact Fluorescent Lamps

Utilities have promoted compact fluorescent lamps (CFLs) to customers for about ten years. Over this time period many approaches have been used including coupons ("instant rebates"), mail-in rebates, leasing, door-to-door sales, mail-order sales, manufacturer cost credits, and give-aways.

Perhaps the highest participation rate achieved to date was achieved by the Traer, Iowa lightbulb exchange. Traer is a small town in Iowa -- population 1,700. In 1987 the municipal utility teamed up with the state government and a major lamp manufacturer to provide free energy-saving lamps to town residents over a one week period. Under the program, residents brought their standard incandescent lamps to a central location where they picked up an equivalent number of CFL or reduced-wattage incandescent lamps. Lamps were sold by the manufacturer to the utility almost at cost. About 60% of the town's residents participated in the program, with an average of 38 lamps replaced per participant. Of the new lamps installed, approximately 35% were CFLs and 65% were reduced-wattage incandescent lamps. Only two types of CFLs were available through the program, and these two types could not fit in the majority of fixtures. These limitations on CFL retrofits resulted in limited savings per bulb (CFLs could not fit in many high-use locations). Reasons for the high participation rate include the availability of free lamps and the sense of community spirit generated by the program (Trombly 1990).

The Burlington Electric Department's Smartlight program has achieved a 42% participation rate. In this program, the utility leases CFLs to residential customers for $0.20/month. Lease payments are included on the customer's monthly bill and are structured so that as long as the lamp is used at least 1.5 hours per day, monthly energy savings will exceed the lease cost. Lease payments cover the costs of bulbs but not program administrative

costs. The Burlington program is promoted via a customer newsletter, media advertisements and telemarketing. Customers can pick up bulbs at the utility office or, through the Neighbor$ave Program (a component of Smartlight) they can schedule a home visit conducted by college students hired by the utility. Because Burlington is a small community (only 14,000 eligible households), it has been possible to reach most of the community in this manner (Buckley, 1993).

The importance of the telemarketing approach following by home visits is illustrated by a similar program offered by the Taunton Municipal Lighting Plant. The program is very similar to the Burlington program but marketing is primarily done by direct mail -- customers receiving the direct mail pieces can either pick bulbs up at the utility's office, or can request that bulbs be mailed. The participation rate in this program is just under 5% (IRT #42 1993).

For larger service territories, probably the highest participation rates have been achieved by direct installation programs operated by the New England Electric System (NEES), the Los Angeles Department of Water & Power (LADWP) and United Illuminating (UI). The NEES program was similar to Energy Fitness programs described in the low-cost weatherization section of this report. However, few homes served by the NEES program had electric space heating and thus for most homes the program emphasized CFLs. Program operators estimate that as many as 98% of customers who were home when field staff arrived at their doors ended up participating in the program. Since many residents were not home when field staff arrived, overall participation rates in the program averaged about 50%. Despite this high participation rate, the program was not quite cost-effective because of the high costs of site visits. The program was subsequently blended into other existing site visit programs (Granda 1992).

The UI and LADWP programs get around this cost-effectiveness problem by also including low-cost water saving measures in the package of services, thus increasing the energy and water saved during each home visit. In fact, part of the cost of the UI and LADWP programs are paid by local water utilities because the programs represent a cost-effective approach to reducing water use. After two years the LADWP program has served 35% of the 1.2 million eligible customers (Petok 1993) while the UI program has served 28% of households in targeted communities (Unger 1993).

All three direct installation programs are marketed door-to-door on a neighborhood-by-neighborhood basis. Also, all three make extensive use of community organizations to deliver program services under contract to the utility.

For Wisconsin Public Service, a mail order program has resulted in considerable success. In this program, which has achieved a 28% participation rate, the utility buys CFLs in bulk and sells them to customers via the mail for $5-7 each, a substantial discount off of normal retail costs. The program was first marketed via direct mail, supplemented with an advertising campaign. This part of the program resulted in a 5% participation rate. The utility then began using telemarketing and achieved an acceptance rate of 21-25% depending on the script used. Consumers can request bulbs via mail or a toll-free phone number. Order fulfillment and telemarketing are handled by a private contractor (Pitts 1993).

Coupon programs, in which customers are mailed coupons good for substantial discounts

on CFLs purchased from retail stores, have also often achieved good participation rates. Typically coupons are good for only a limited period, in order to reduce the "I'll do it some other time" effect. Before the coupon period begins, extensive outreach is made to retail outlets that sell lamps, such as grocery and hardware stores, to encourage them to stock CFLs during the program period. In addition to the utility-funded coupons, sometimes manufacturers or retail outlets provide additional discounts. This approach was pioneered in Europe and achieved participation rates as high as 15% (Mills 1991). In the U.S., Central Maine Power pioneered the approach and achieved a 10% participation rate in the first year (Michelsen and Lonergan 1992). Subsequently, Madison Gas & Electric distributed 59,000 bulbs with this approach (Miller 1993). Although MG&E does not have data on bulbs per participant, if we assume an average of five bulbs per participant (based on data reported for the Boston Edison and Wisconsin Public Service programs described below), the MG&E participation rate works out to 12%.

For very large service areas, Southern California Edison (SCE) has used a different program approach that merits mention. SCE issues a request for proposals to CFL manufacturers asking them to compete against each other for utility incentives paid direct to the manufacturer. Manufacturer bids are ranked using a multi-faceted scoring system and each manufacturer is allocated a portion of SCE's incentive dollars -- the higher each manufacturer's score, the more bulb rebates it is allocated. SCE then pays manufacturers for each CFL shipped to retail stores in the SCE service area. Incentives have averaged $5 per bulb. As a result of the manufacturer-direct incentive, distributor and retailer mark-up amounts are reduced because the price distributors and retailers pay for CFLs is reduced by the incentive paid to the manufacturer. Also, competition between manufacturers prompted many manufacturers to match a portion of the SCE incentive with an additional discount to their normal wholesale price. As a result, CFL costs were reduced substantially, with typical retail CFL prices of only $3-12 per bulb. In the first 12 months of the program, 950,000 lamps were sold. Assuming five bulbs per participant (see above), this amounts to 5% of SCE's 3.6 million residential customers (SCE 1993; Grimm 1993).

Different approaches can also be combined. For example, Boston Edison has achieved a 23% participation rate through a combination of mail order sales, direct sales through utility bill-paying centers, mail-in rebates for CFLs purchased in retail stores, door-to-door sales by the local Lions Club (as part of the Lions Club's annual lightbulb sale done to raise funds), and direct installation in conjunction with other programs (Greer 1993).

The high participation programs discussed above appear to share many common attributes. First, they all make CFLs available to consumers at reasonable costs -- typically from $0-9 per bulb , substantially less than the retail price of unsubsidized bulbs sold in small quantities. Second, these programs make CFLs readily available to consumers, either through the utility or through improved availability in retail stores. Third, the programs include a substantial education component, to inform consumers about the benefits of CFLs.

Many of the CFL programs examined have a cost of saved energy of approximately $0.01-0.03/kWh saved. Direct installation programs can have particularly high participation rates, but these programs tend to be of borderline cost-effectiveness (for example the NEES Energy Fitness program had a cost of saved energy of $0.075). LADWP and UI have solved

this problem by offering a combined direct installation program to address both lighting and water saving retrofits.

New Construction

Residential new construction programs generally specify minimum construction criteria for a home to be classified as energy-efficient. Financial incentives and a blend of complementary education and marketing efforts are used to encourage builders to construct and home buyers to purchase homes that meet the utility's efficiency criteria. Some programs do not include financial incentives -- these are discussed in the next section of this report on labeling programs. For programs offered by electric-only or gas-only utilities, education and marketing assistance are often provided regardless of fuel used to heat the home, but financial incentives are limited to homes which use energy from the sponsoring utility as their primary heating source. For these programs, when calculating participation rates, the eligible population is generally limited to new homes using a particular fuel for space heating. As with appliance rebate programs, participation rate is also affected by the stringency of the criteria used to identify energy-efficient homes. Accordingly, to the extent possible, the discussion below focuses on net participation rates.

Perhaps the only DSM program with close to a perfect 100% participation rate is the Bonneville Power Administration's (BPA) Manufactured Housing Assistance Program (MAP). In the MAP program, BPA negotiated with all 18 builders of manufactured housing in its service area to build nothing but homes that meet BPA's energy-efficiency standards. In exchange, BPA pays an incentive directly to the manufacturer for every home built. As a result, approximately 13,000 homes per year are build to BPA's standards (IRT #30 1992).

Another set of complementary BPA programs have also achieved high participation rates -- the Northwest Energy Code and Super Good Cents programs. In the early 1980's BPA and other northwest organizations developed Model Conservation Standards (MCS) for new residential construction. These standards represented a significant departure from prevailing construction practices, reducing energy use per home by an estimated 35-50% depending on climate zone. To promote homes meeting these standards, BPA developed the Northwest Energy Code and Super Good Cents programs. The Northwest Energy Code program encouraged local municipalities to adopt the Model Conservation Standards in their local building codes. As inducements to municipalities, BPA helped cover local government costs for code adoption, start-up, and implementation. In addition, builders were eligible for incentive payments that were designed to cover the extra costs of a MCS home. The Super Good Cents program promoted voluntary acceptance of the MCS standards in new homes that were not subject to MCS code requirements. The program featured training, incentives and marketing assistance for builders who built to the MCS standards (Brown et al. 1991). During the program period, 36% of eligible new homes participated in these two programs including 26% who participated in the Super Good Cents program alone (Couch 1993). In 1990, due to the impact of these programs, combined with a number of other efforts, the state of Washington incorporated the MCS requirements into its building code, effective mid-1991. In 1991, Oregon followed suit (BPA 1991). As a result of these actions, more than 85% of new homes in BPA's service area were expected to meet the MCS standards in 1993 (Watson and Eckman 1993).

Another approach to promoting efficient residential construction is to make certified efficient homes eligible for discounted electric rates. The discounted rates are attractive to home purchasers, which makes home builders more willing to spend some money on energy-saving improvements. Examples of rate discount programs include programs offered by Public Service of Indiana (PSI), Carolina Power & Light (CP&L) and Duke Power.

For the PSI program, a 30% rate reduction on electricity used for heating during the winter months is offered for homes meeting "Smart Saver" standards. The standards require use of a high efficiency air conditioner or heat pump, attic insulation in excess of code requirements, ducts located within the heated envelope (or heavily insulated), and reduction of air infiltration with a seal-up service aided by use of a blower door (PSI provides the seal-up service for free). In 1992, 42% of new homes built in the PSI service area participated in the Smart Saver program including almost 90% of new electrically heated homes (only electrically-heated homes are eligible for the reduced rate). Incentives are also offered for installing high efficiency air conditioners and heat pumps. PSI also provides a "Comfort Guarantee" for homes using heat pumps -- if the homeowner is dissatisfied with the system, PSI will either repair or replace the system in order to ensure that the customer is satisfied. PSI employs an extensive sales force to promote the program to home builders. While the program achieves extensive energy savings (in excess of 7000 kWh/home each year according to utility estimates), the program is in part a "valley-filling" program designed to increase off-peak winter loads. Since the inception of the program, the proportion of new homes with electric heat has risen from 26% to 42% (PSI 1992).

Data on the CP&L and Duke programs are presently not available, and hence we had to rely on previously published information from 1987. At that time, the CP&L and Duke programs were somewhat similar to the PSI program, but with smaller rate discounts and less extensive energy efficiency requirements. For 1987, CP&L estimated that 53% of new homes were participating in the program while Duke estimated a 73% participation rate. Like the PSI program, these programs have both energy-saving and valley-filling objectives (Vine and Harris 1988).

Under the right conditions, rebate programs can also achieve high participation in new construction markets. In addition to the BPA Super Good Cents program discussed above, an even higher participation rate (70% gross, approximately 56% net) has been achieved by B.C. Hydro's Remote Power Smart Options pilot program. This pilot program is offered in small remote communities which are off the main power grid and whose primary source of energy is diesel-generated electricity. Under the program, builders and developers of new housing are offered an incentive of up to $3000 to cover the incremental costs of installing oil or propane space heating and water heating and propane clothes drying instead of electric equipment. In remote non-integrated areas, electricity is very expensive to generate, so B.C. Hydro saves a substantial amount of money by dissuading builders from using electric furnaces, water heaters, and clothes dryers. The high participation rate can be attributed to customer bill savings (electricity is substantially more expensive than oil or propane), high incentives, as well as to extensive personal contacts between utility field staff and local builders (Eakins 1993).

The programs discussed above appear to achieve their high participation rates for several reasons. All of the programs establish strong working relationships with home builders.

Elements of this relationship may include regular personal contacts by utility staff, training of builders on efficient construction practices, and jointly funded advertising on efficient homes built by individual builders. Many of these programs seek to establish a demand for efficient homes among home buyers by emphasizing the quality and comfort associated with an efficient home, in addition to the energy savings. Some programs even provide discounted energy rates to further establish a demand for qualifying homes. Many of the high participation programs provide substantial financial incentives, which cover most if not all of the incremental cost of building an efficient home. And some programs even seek to influence building codes, in order to ensure that only efficient homes will be built.

Residential new construction programs can vary substantially in cost. A recent study by the Washington State Energy Office (Schwartz et al. 1993) found that BPA's efforts to transform building practices in the Pacific Northwest, including the Super Good Cents and Northwest Energy Code programs, cost BPA less than $0.01/kWh saved when the benefits of the new Washington State Energy Code are factored into the calculations. At the other extreme, the B.C. Hydro program cost over $0.08/kWh saved. However, relative to the cost of avoided diesel generation capacity and fuel, the program was cost-effective.

Labeling

Labeling programs identify high efficiency homes or products, helping consumers to differentiate between efficient and less efficient offerings. Labeling programs frequently include education and advertising on the benefits of high efficiency homes and products. For purposes of this study, we only include labeling programs which do not offer financial incentives for efficient products; when labeling and incentives are combined in a single program, it is difficult to differentiate the impact of labeling from that of incentives.

With labeling programs, like many of the programs discussed above, eligibility levels for the "high efficiency" label can play an important role in program participation rate. Accordingly, as much as possible, this analysis focuses on net participation levels. In calculating the number of participants, we count the number of efficient homes or appliances that are purchased, which is different from the number of items which are labeled. A key factor in assessing the net participation of labeling programs is to estimate what would have happened if the program was not offered. As noted below, evaluations of labeling programs are very limited and hence estimates of labeling program free rider levels are very approximate. As a consequence, the results summarized below should be considered as preliminary, pending the availability of additional evaluations.

Labeling programs have largely been limited to two areas -- appliances and new homes.

Among appliance labeling programs, only a few programs have been evaluated. For example, as discussed above under refrigerator rebates, NYSEG ran a program that featured information and advertising in some areas without any incentives. Net participation rates averaged 23% (Kreitler and Davis 1987). Likewise, several New England utilities offered a "Blue Ribbon" appliance program during 1990 in which refrigerators, freezers, and room air conditioners in the top 15% of energy efficiency for each appliance category received a distinctive point-of-purchase blue ribbon label which sought to draw purchasers to high

efficiency models. The labels were supplemented with other point-of-purchase educational information, an efficient appliances brochure mailed to customers, newspaper advertisements, a toll-free information line, and efforts to encourage salespersons to promote high efficiency models. Evaluations of the program found that approximately 45% of refrigerators purchased from participating dealers were blue ribbon models, while approximately one-third of units purchased from non-participating dealers (and hence without Blue Ribbon labels) qualified for the Blue Ribbon designation. Thus, the net participation rate was approximately 12-15% (Sabo and Parfomak 1992).

Among new home programs, several programs have gross participation rates of 40% or more including programs offered by the City of Austin, Gulf Power Co., and the Salt River Project. The Austin Energy Star program is a home energy rating system in which homes that exceed the city building code receive one, two or three "stars" based on projected energy savings relative to a home that just meets code. A one star rating corresponds to 5% energy savings while two and three star ratings designate homes with 12.5% and 20% energy savings respectively. Since the program inception, about 75% of new homes have received at least a one star rating, including approximately 90% of new homes built in 1990-91. Data on free riders have not been collected and hence net participation rates cannot be calculated. While incentives are not provided for Energy Star homes, incentives are provided for high efficiency air conditioners and heat pumps. By installing one of these units, builders can easily achieve a one star rating and thus the participation rates probably are significantly influenced by the air conditioner and heat pump incentives (IRT #11 1992). For example, in 1992 an estimated 70-80% of new homes participated in the air conditioner rebate program (Myers 1993), implying a net participation rate for the Energy Star program of 10-20%.

Gross participation rates in the Salt River Project Climate Crafted Home program is estimated by the utility at 54%. For the Climate Crafted Home program, homes must use 30% less kWh per sq.ft. than typical all-electric homes to receive the Climate Crafted designation. Builders demonstrate compliance through a point system that assigns points, positive or negative, to a variety of features found in potential Climate Crafted Homes. A builder survey conducted prior to the beginning of the program found that approximately 15% of new homes met the program's efficiency levels, and thus net participation rates are approximately 39%. This estimate of free rider levels has not been checked for several years and thus may not adequately portray current conditions. The program is primarily promoted to home buyers through media advertising and cooperative builder advertising in an effort to create a demand for the Climate Crafted product (Pentecost 1993).

The Gulf Power Good Cents program is similar in many respects to the Salt River program. For this program the gross participation rate was 34% in 1993. Based on an estimated free rider rate of 21%, net participation was 27%. According to the utility, the key to the success of the program is the one-on-one relationship between builders and utility field representatives which has been built up over the ten year life of the program. The program gives builders many options to have their homes certified through the program. Builders can either use a checklist of energy-saving measures -- depending on the type of home, builders must install five to eight out of the ten measures on the checklist -- or they can use a computer program to demonstrate energy savings relative to a home built to code. Another key feature of the program is extensive promotion to consumers emphasizing that a Good Cents home

represents superior quality construction with comfort and performance. As a result of these promotion efforts, many customers now seek the Good Cents certification when they buy a home (Russell 1994).

Factors associated with effective labeling programs are similar to the factors associated with successful appliance and new construction programs, except for the role of incentives. Thus, with labeling programs, relationships with trade allies (appliance dealers and builders) and effective consumer education programs, that create a demand for efficient products, become doubly important.

Savings from labeling programs have rarely been evaluated. An evaluation of Boston Edison's Blue Ribbon appliance labeling program found average net savings of 1.5% relative to new refrigerators that would be purchased without the program (Sabo and Parfomak 1992). We are not aware of impact evaluations on new construction labeling programs, but if free rider estimates discussed above for Austin, and estimates made by Gulf Power and the Salt River Project, are correct, then savings from these programs could range from negligible savings to as much as 25% compared to standard new homes. These programs tend to be inexpensive, with a cost of saved energy (based on engineering estimates) on the order of $0.02/kWh saved.

Commercial

Lighting Rebates

Lighting rebates are probably the most common type of commercial sector DSM program. Most programs provide rebates for a wide-array of lighting measures including efficient lamps, ballasts, fixtures, reflectors, and lighting controls. Many lighting programs are part of multiple measure rebate programs that include rebates for non-lighting measures. For many of these programs it is not possible to obtain data on participation in just the lighting portions of the program. For those programs for which data could be obtained, participation rates of up to 29% are reported.

The highest participation rate, 29%, was achieved in the lighting portion of Wisconsin Electric Power Company's (WEPCo) Smart Money program. This estimate is based on the number of rebates that have been paid and does not adjust for the fact that over the life of the program, some customers will receive more than one rebate (Spang 1993 and IRT #32 1992). Research on other utility commercial and industrial rebate programs indicates that the typical participating customer applies for 1.5-2 rebates (Nadel 1990). Applying this estimate to the WEPCo program results in a participation rate of 14-19% of eligible customers over a four-year period. The WEPCo program has been heavily promoted throughout the period through printed materials and personal contacts. Printed materials include flyers, brochures, special mailings, bill inserts, and a quarterly newsletter. Personal contacts are made by utility representatives as well as trade allies such as lighting contractors. WEPCo deploys 90 people in the field to promote and implement this program. A 1989 survey of participants found that personal contact by utility staff and presentations at association meetings were the most effective methods of informing participants about the program. In addition, WEPCo has enrolled many lighting dealers in an "instant-rebate" program in which the dealer deducts the value of the rebate at the

time of equipment purchase. The dealer then bills WEPCo for the rebate plus a small handling fee (IRT #32 1992).

Two experimental lighting rebate programs indicate that participation rates of approximately 20% are possible with lighting rebate programs. In 1988-89, Niagara Mohawk ran an experimental rebate program for energy-saving fluorescent lamps. The experiment tested several different rebate levels and several different marketing methods. For the group that received rebates equal to 100% of the incremental measure cost and received an in-person presentation on the program, 21% participated during the six-month program period (Clinton and Goett 1989). This finding is subject to several caveats. On the one hand, the in-person presentation group was made up of large customers -- other studies have found that large commercial customers are more likely to participate in rebate programs than small commercial customers. On the other hand, the program only operated for six months. Such a short period of program operation tends to reduce participation rates because many customers cannot respond to rebate programs in so short a period. Similarly, in a small pilot program, Rochester Gas & Electric offered a limited group of customers a free lighting audit and a rebate for implementing audit recommendations -- 20% of the targeted customers applied for the rebate (Nadel 1990).

The programs discussed above all include multi-faceted marketing campaigns, with an emphasis on personal marketing, simple application procedures (particularly WEPCo's instant rebate), and substantial financial incentives. In addition, the WEPCo program, which is the only full-scale program addressed here, also includes the active involvement of trade allies.

Only a few impact evaluations have been conducted on lighting rebate programs. An evaluation of the lighting portion of NEES' Energy Initiative program found that participating customers reduced their energy use by 6% (net savings (MECo 1993; Xu 1993). The cost of saved energy for these programs has ranged from approximately $0.01-0.03/kWh saved.

HVAC Rebates

HVAC rebates promote use of high efficiency chillers and packaged HVAC equipment. As with lighting rebate programs, HVAC rebates are often part of multiple measure rebate programs and it is generally not possible to obtain data on participation rates for just HVAC equipment. Among programs for which data could be obtained, Northern States Power (NSP) claims the highest participation rate -- close to 100% for chillers and approximately 25% for packaged equipment. Data on free riders are not available. However, eligibility levels for chillers are not stringent (most of the equipment on the market meets the eligibility levels) and thus the free rider proportion for the chiller program is likely to be substantial. Marketing of these programs emphasizes face to face contact between utility representatives and customers. Also, trade allies, such as HVAC contractors, are actively involved in promoting the programs. The program has been in operation for seven years with only limited changes, which has allowed the utility to build a good working relationship with its trade allies. (Conners, Herd and Leaf 1993).

Based on the NSP program, as well as the similarities between commercial HVAC programs, commercial lighting programs, and residential air conditioning programs, it appears that several factors contribute to high participation rates including the active involvement of

Table 2. Commercial Programs with High Participation Rates.

Utility/Sponsor	Program	Program Type	Start Date	End Date	Annualized MWh Savings from Cum. Measures*	% of Measure Cost Covered by Utility	Measure Life: Utility Estimate	Measure Life: ACEEE Estimate	# Eligible Customers/ Units Sold Annually		# Targeted Customers
Niagara Mohawk	High Efficiency Fluorescent Lightin	Ltg:Reb	1988	1989		100%		15	175	customers	
Northeast Utilities	Energy Saver Lighting Rebate	Ltg:Reb	1986	10/93	413,631 *	100%	14	15	118,999	customers	
WEPCo	Smart Money: Comm. Lighting	Ltg:Reb	1987	1991	628,054	~45%	10	15	85,204	customers	
Northern States Power	Chiller Efficiency Prgrm	HVAC	1986	1993	9,782		23	20	25-28	customers	
Northern States Power	Rooftop Efficiency Program	HVAC	1988	1993	16,876		15	15	1,600	customers	
MECo	Energy Initiative	MM	1989	1992	300,328 *	55%	17	15	85,404	customers	
Palo Alto	Partners Electric Incentive	MM	1985	7/89	22,280			15	2,409	customers	
SCE	Hardware Rebate: Commercial	MM	1980	1992	860,000 *	31%		15	370,000	customers	
WEPCo	Smart Money: TOTAL	MM	1987	1991	670,603	~45%	10	15	85,204	customers	
MECo	Enterprise Zone One-Stop-Shop	Ltg:DI	8/85	12/86	5,900 *	100%	3-20	15		customers	2,263
MECo	Small C&I Program	Ltg:DI	1989	1992	41,469 *	100%	14	15	39,398	customers	
PG&E	Model Energy Communities-Comm	Ltg:DI	8/91	2/93	3,367 *	avg 84%	17	15	2,351	customers	736
SMUD	Comm. Lighting Installation	Ltg:DI	7/86	12/88	6,880	100%	7	6	20,000	customers	
BECo	Encore	ESCo	1988	1991	40,379 *	100%	10	15	1,200	customers	
Commonwealth Electric	Customized Rebate Program	ESCo	1989	1992	72,150 *	up to 100%		15	3,586	customers	
PG&E	Bay Division	ESCo	12/91	12/92	6,180 *	64%	18	15			404
Northeast Utilities	Energy Action Program	Comp	1988	7/93	199,867	50-100%	15	15	2,700	customers	
Puget P&L	Commercial Conservation Service	Comp	1979	1992	370,600	60-100%	15	15	68,000	customers	
SCE	Large Commercial Plan	Comp	1/80	12/83	233,000 *			15	855	customers	
Snohomish	Commercial Non-Profits	Comp	3/88	12/88	900	100%		15	35	customers	
BC Hydro	Commercial New Construction	NC	10/90	7/93	39,400	80%	20	15	22,000,000	sq. ft.	
MECo	Design 2000	NC	1989	1992	45,215 *	100%	15	15			
PacifiCorp	Large Commercial Energy Finanswe	NC	1/93	12/93	31,232	0-80%	16	15	10,000,000	sq. ft.	
PG&E	Comm. New Construction	NC	6/90	12/91	24,827	50%	13	15	45,555,000	sq. ft.	
UI	Energy Blueprint	NC	1990	12/93	28,650	50-75%	15	15			

* Asterisk indicates that savings are based on impact evaluation

Table 2. Commercial Programs with High Participation Rates (continued).

Utility/Sponsor	Program	Cumulative # of Participating Customers/ Units Participating/Year		Participation Rate (% of Total Eligible)	Participation Rate (% of Targeted)	% Free Riders	Cumulative Program Costs			Levelized Utility Cost ($/kWh Saved)
							Direct	Indirect	Total	
Niagara Mohawk	High Efficiency Fluorescent Lighting	37	customers	21%		66%				
Northeast Utilities	Energy Saver Lighting Rebate	11,512	customers	10%		0-24%	$40,717,726	$8,185,131	$48,902,857	$0.011
WEPCo	Smart Money: Comm. Lighting	12,503-25,007	customers	14-29%			$63,356,000	$19,006,800	$82,362,800	$0.013
Northern States Power	Chiller Efficiency Prgrm	25	customers	~90-100%					~$2,800,000	$0.023
Northern States Power	Rooftop Efficiency Program	400	customers	~25%					~$3,850,000	$0.022
MECo	Energy Initiative	9,772	customers	11%		1-37%	$56,513,000	$23,203,000	$79,716,000	$0.026
Palo Alto	Partners Electric Incentive	387	customers	8-11%			$1,432,000	$788,000	$2,220,000	$0.010
SCE	Hardware Rebate: Commercial	46,000	customers	12%		50%			$60,000,000	$0.007
WEPCo	Smart Money: TOTAL	14,885-29,770	customers	17-35%		13-17%	$93,442,000	$28,032,600	$121,474,600	$0.017
MECo	Enterprise Zone One-Stop-Shop	775	customers		34%	12%			$2,200,000	$0.036
MECo	Small C&I Program	6,536	customers	17%	>85%	2-23%	$25,002,000	$2,490,000	$27,492,000	$0.064
PG&E	Model Energy Communities-Comm	328	customers	14%	45%		$1,224,786	$35,951	$1,260,737	$0.036
SMUD	Comm. Lighting Installation	7,339	customers	37%		5%	$450,000	$792,300	$1,242,300	$0.036
BECo	Encore	143	customers	12%		<5%	$6,239,204	$1,699,892	$7,939,096	~$0.090
Commonwealth Electric	Customized Rebate Program	502	customers	14%					$43,506,000	$0.058
PG&E	Bay Division	36	customers		9%		$1,694,053	$32,708	$1,726,761	$0.027
Northeast Utilities	Energy Action Program	480	customers	18%			$41,982,000	$14,500,000	$56,482,000	$0.027
Puget P&L	Commercial Conservation Service	8,638	customers	13%			$59,000,000	$10,325,000	$69,325,000	$0.018
SCE	Large Commercial Plan	629	customers	74%					$15,936,000	$0.007
Snohomish	Commercial Non-Profits	25	customers	71%			$171,000	$51,000	$222,000	$0.024
BC Hydro	Commercial New Construction	13,800,000	sq. ft.	63%			7,980,000	1,137,000	$9,117,000	$0.022
MECo	Design 2000	534	customers	35%		32-51%	$12,064,000	$2,578,000	$14,642,000	$0.031
PacifiCorp	Large Commercial Energy Finanswer	6,300,000	sq. ft.	63%		5-10%	$10,085,800	$1,198,700	$11,284,500	$0.035
PG&E	Comm. New Construction	17,796,000	sq. ft.	39%			$1,482,600	$2,660,300	$4,142,900	$0.016
UI	Energy Blueprint	307	customers	70%		5%	$3,488,341	$1,857,043	$5,345,384	$0.018

HVAC dealers in marketing the program, personal marketing by utility representatives, and consistency in program design from year to year.

Utility HVAC equipment rebate programs typically target 10% energy savings relative to standard equipment. For example, an Energy Efficiency Ratio (EER) of 10 may be targeted when standard equipment has an EER of 9. The cost of saved energy for the NSP programs is approximately $0.02-0.03/kWh saved, based on NSP's assumption that the number of free drivers (non-participating customers who purchase efficient equipment because of the program's impact on equipment that is stocked) equals the number of free riders. To the extent free riders are greater than free drivers (which is likely for the chiller program), the cost of saved energy will be higher.

Multiple Measure Rebates

Multiple measure programs provide rebates for many different end-uses such as lighting, HVAC, motor, and building shell measures. These programs differ from the comprehensive retrofit programs discussed below because comprehensive retrofit programs primarily promote optimized comprehensive packages of efficiency improvements while multiple measure programs not emphasize packages of measures. Often these programs serve both commercial and industrial customers and results for the two different sectors cannot be separated from each other.

Among multiple measure programs, Wisconsin Electric Power Company (WEPCo) claims a 35% participation rate over a five year period. However this estimate assumes that no customer receives more than one rebate. Assuming 1.5-2.0 rebates per customer (as discussed in the Commercial Lighting Rebate section) results in an adjusted participation rate of 17-23%. The success of the program can be attributed to the intensive, multi-pronged marketing effort including printed materials, personal contacts by utility staff and trade allies, and "instant rebates" provided by equipment dealers. These are discussed in more detail in the Commercial Lighting Rebate section of this paper. The program has been particularly successful at promoting lighting measures -- 84% of the projects and 70% of the energy savings are lighting measures. Significant savings are also attributable to air conditioning and industrial process measures (IRT #32 1992).

Several other multiple measure rebate programs have achieved cumulative participation rates of approximately 8-12% including the Southern California Edison (SCE) Hardware Rebate: Commercial program, the NEES Energy Initiative Program, and the Palo Alto Partners program. All three programs feature a multi-pronged marketing approach with an emphasis on personal contacts by utility staff and trade allies. All three programs also pay substantial financial incentives, averaging 30-55% of measure cost. Of the three programs, the SCE program has been in operation the longest (13 years), although for several of these years it was not actively promoted. The Palo Alto program operated for only five years, although most of the participation was within the first three years when the program was heavily promoted (Nadel 1990). This program illustrates the benefits of being able to heavily market a program within a small area. The NEES program has been in operation since 1989 throughout the utility's three state service area. It illustrates the benefits of high incentive levels -- for several years incentives covered the full cost of energy-saving retrofits. Participation for this program would

have been much higher except for budget constraints during two years of program operation. In 1991 the program budget was exhausted about 25% into the year and no more rebate applications were accepted. In 1992, the program accepted applications for only a one week period -- these applications exhausted the annual budget (Stout 1992). In 1993, rebates were cut substantially and the program has operated throughout the year.

High participation multiple measure rebate programs have many things in common with high participation lighting and HVAC rebate programs, particularly a multi-pronged approach to program marketing with an emphasis on personal marketing, simple application procedures, and substantial incentives. Most multiple measure rebate programs have emphasized lighting improvements in their early years, but over time they try to gradually increase the proportion of rebates in other end-uses.

Only a few multiple measure rebate programs have been evaluated. An evaluation of SCE's Hardware Rebate program found average net savings of 7% of pre-program electricity use (Train and Ignelzi 1986). The cost of saved energy for these programs has ranged from $0.01-0.03/kWh.

Lighting Direct Installation

Direct installation programs provide complete services for the identification, installation, and financing of energy efficiency measures. The most common type of direct installation program is a small commercial and industrial direct installation program for lighting. Under this type of program, utility contractors conduct a lighting audit of a facility, prepare a work order for cost-effective lighting efficiency measures, obtain owner or tenant approval to install the recommended measures, finance the measures, and install the measures. Financing is most commonly in the form of a grant which covers all material and installation costs. Some utilities ask participating customers to help pay for measures, up to the point that the simple payback on the customer's investment is one or two years. These programs are generally targeted at small commercial customers because these are the customers who are least likely to participate in lighting rebate programs. These programs generally fall into two major categories -- lamp-only programs which provide energy-saving fluorescent tubes and compact fluorescent lamps, and comprehensive programs which also include electronic ballasts, reflectors, and perhaps lighting controls and high intensity discharge lamp retrofits. While programs of this type emphasize lighting improvements, some programs also include non-lighting measures such as clock thermostats and water heater insulation.

Among programs of this type, probably the highest participation rate has been achieved by NEES. In the NEES program, over 85% of targeted customers have participated. Making some allowance for the fact that customers more receptive to a program as likely to participate in its early years, NEES expects to serve 75% of eligible customers over the life of the program. The high acceptance rate can be attributed to the ease of customer participation -- NEES conducts a lighting assessment and specifies a comprehensive package of measures to be installed, pays all program costs, schedules work at times convenient to the customer, and trouble-shoots any problems that develop. The program is primarily marketed via the telephone on a town-by-town basis, supplemented by word-of-mouth (MECo 1993; Horton 1992; IRT #1 1992).

Another program with a high participation rate was PG&E's Model Communities program. For this program 736 customers in a single district of PG&E's service area were targeted and offered a free energy audit and heavily subsidized installation of lighting, air conditioning, refrigeration, and motor efficiency measures. The program was marketed using door-to-door canvassing, supplemented with newspaper advertisements, direct mail and word-of-mouth. Marketing efforts advertised that PG&E would pay up to 90% of the installed cost of qualifying measures. The average incentive was 84% of installed cost. The requirement for a customer cost share necessitated an average of five to six visits to close the deal after the initial proposal was presented to the customer. Of the targeted customers, 63% had energy audits conducted and 45% ultimately had measures installed. A major factor contributing to the program's success was the tenacity of the contractor who made repeated visits to close deals (Cohen et al. 1993).

Marketing of the NEES and PG&E programs has yet to be extended to all small commercial customers. Among programs that target all eligible customers, the highest participation rate (37%) has been achieved by the SMUD Commercial Lamp Installation Program (CLIP), which, as the name implies, includes only lamps and not comprehensive lighting retrofits. When minimal use customers (e.g. billboards, water pumps) are factored out, the participation rate climbs to approximately 55%. The participation rate could have been higher, but the program was terminated due to utility-wide budget cutbacks and increasing marketing costs per customer served. SMUD estimates that if the program had continued, a participation rate of 68-70% could have been achieved (excluding minimal-use customers). This program provided up to 100 free reduced-wattage fluorescent lamps to small C&I customers (peak demand less than 50 kW). Customers received free lamps and installation. In the last year of the program, up to 50 energy-saving incandescent or compact fluorescent lamps were also installed in customer facilities. Marketing emphasized door-to-door solicitations by energy auditors who determined eligibility and prepared work-orders (Neos Corp. 1989; Itow 1989).

From the discussion above, it appears that several factors contribute to high participation rates including providing complete services so it is easy for customers to participate, providing services at no cost to the customer, and personal marketing such as a door-to-door canvass and/or telemarketing.

Impact evaluations on lighting direct installation programs have found savings of 8-13% relative to pre-program whole-building electricity use by participating customers (Nadel 1988; MECo 1993). Most of the high participation programs have an estimated cost of saved energy of $0.03-0.04/kWh, although one program (the NEES program) has a cost of saved energy of more than $0.06/kWh.

Performance Contracting Retrofits

In performance contracting programs, an energy service company (ESCo) is paid on the basis of actual savings achieved. Performance contracting payments are sometimes calculated as a percentage of the money saved from energy efficiency measures (often called *shared savings* programs), and sometimes they are calculated as a set payment per kWh and/or kW saved. Occasionally a utility functions as its own ESCo; more often the utility relies on private ESCos. Utilities have operated performance contracting programs for more than ten years, although, to

our knowledge, no performance contracting program has operated for this long. Instead, performance contracting programs are typically operated by utilities for a few years and then discontinued due to high costs and/or low participation rates. Among the more successful programs have been Commonwealth Electric's Customized Rebate program, Boston Edison's Encore program, and the PG&E Bay Division program -- these programs have achieved cumulative participation rates of 9-14%.

Commonwealth Electric's Customized Rebate program targeted large commercial and industrial customers and had achieved a 14% participation rate before the program was ended. Under the program, customers contracted with ESCos or equipment vendors for installation of energy-saving measures. After measures were approved by Com/Electric and installed, Com/Electric paid the ESCo or vendor based on the actual energy savings achieved. In many cases, the customer paid for the measures and the contractor guaranteed that a specified level of savings would occur. In these cases, utility payments went directly to the customer. For both payment approaches, payments could be spread over a period as short as two years to as long as seven years. The present value of incentive payments increased as the payment period increased in order to encourage long-term performance contracting arrangements. However, the vast majority of participants elected the two-year payment period. Incentive payments were generally sufficient to cover the full cost of measures, resulting in extensive marketing efforts by ESCos and equipment vendors and a high participation rate but also resulting in a high cost to the utility (nearly $0.06/kWh saved). Due to these high costs, the program was discontinued in 1991 (Com/Electric 1990; Com/Electric 1992; Carvallo 1992).

Boston Edison's Encore program was a performance contracting program for large commercial and industrial customers in which ESCos identified, financed and installed measures at customer facilities and are reimbursed by the utility each year for actual energy savings based on utility avoided costs. In general, incentive payments covered all measure costs and allowed ESCos to make a good profit, which made the program attractive to ESCos and customers. Most marketing was done by ESCos, supplemented by utility efforts including direct customer contacts, contractor referrals, breakfast meetings and newspaper advertisements. The utility also reviewed ESCo proposals to customers for reasonableness and provided technical assistance to customers. A pilot program operated during 1988-89 to a random sample of 162 C&I customers resulted in a 15% participation rate including approximately 25% of the customers with peak demand of 150 kW or more. ESCos were particularly interested in customers with peak demand greater than 500 kW. A full-scale program operated until 1991, and resulted in a 12% participation rate. This program proved expensive to operate (estimated cost of saved energy of approximately $0.09/kWh) and was replaced with a program that paid incentives directly to participating customers (Boston Edison 1989; Murphy 1989; Greer 1993).

PG&E conducted a pilot program in its Bay Division to test a shared savings approach for promoting energy-saving improvements among medium-sized commercial customers. A private ESCo pursued shared-savings agreements with 404 target customers. Audits were conducted on 15% of the target customers and ultimately three customers signed shared-savings agreements (a 1% participation rate). In addition, in lieu of the shared-savings agreement, 33 customers agreed to partially pay for projects out of their own funds or with loans they arranged, resulting in completed projects among 9% of the targeted customers. On average, PG&E paid 64% of installed measure costs (Cohen et al. 1993).

The high participation programs discussed above all provide high incentives, making it attractive for ESCos and customers to participate. Other attributes that contribute to high participation include utility technical assistance to customers such as ESCo referrals and review of ESCo proposals (which can improve customer trust in what the ESCo proposes), performance guarantees (provided for many Com/Electric projects), and ESCo flexibility to deal with other financing approaches besides shared savings (critically important in the PG&E program).

Savings from performance contracting programs vary depending on how many efficiency measures are installed in customer facilities. Savings can range from just a few percent of participating customer pre-program energy use to as much as 15-18% for comprehensive packages of measures. The high end of this range comes from engineering estimates reported for Boston Edison's Pilot Encore program and a pilot performance contracting program offered by BPA in the mid-1980s (Nadel 1990). An impact evaluation of Com/Electric's program found gross savings of 10-11% of participating customer pre-program energy use (Scandia Consultants et al. 1992). The cost of saved energy for performance contracting retrofit programs has ranged widely, from less than $0.03/kWh for the PG&E program to nearly $0.06/kWh for the Com/Electric program to approximately $0.09/kWh for the Boston Edison program.

Comprehensive Retrofits

Comprehensive retrofit programs seek to systematically identify a comprehensive package of energy-saving measures and provide assistance to customers to implement these measures. Comprehensive programs generally provide one-stop-shopping to the C&I customer. Services provided under a comprehensive program typically include audits, arranging (e.g., preparing specifications and soliciting bids), financing assistance (loans or partial grants), and sometimes operations and maintenance and other follow-up services. These programs are designed for customers who lack the time or expertise to identify and implement comprehensive efficiency projects on their own.

Probably the highest participation rates for comprehensive retrofit programs are the 70%+ participation rates achieved by the SCE Large Commercial Plan and the Snohomish Public Utility District Commercial Non-Profit program. The SCE program, which had a 74% participation rate, offered free detailed energy audits, rebates and technical assistance to 855 commercial customers with peak demand of 500 kW or more. The program was personally marketed to all eligible customers and included extensive post-audit follow-up visits to promote and verify measure installation (SCE 1984). The Snohomish program reached 71% of its 35 commercial non-profit customers with a program which combined audits, extensive arranging assistance and 100% financing (a mixture of grants and loans) of cost-effective conservation measures. The program was personally marketed to all eligible customers who were told that the program was only available for one year (Pendleton 1989a and 1989b).

Boston Edison achieved a 40% participation with its pilot Design Plus Program. The program included a free detailed engineering analysis of DSM opportunities, preparation of specifications, supervision of bids and construction, and a grant of 50% of the measure cost. The program was initially offered to ten of Edison's largest commercial customers through a CEO-to-CEO letter and personal contacts. All customers initially agreed to participate but then six customers subsequently dropped out for various reasons including customers who moved,

changed the building's use, and were involved in a takeover fight. The program proved to be very expensive and was discontinued by the utility in favor of a similar program with tighter cost controls (Barry 1989; Greer 1993; Coakley 1994).

Among full-scale programs open to thousands of customers, probably the highest participation rates have been achieved by Northeast Utilities' (NU) Energy Action program and by Puget Sound Power & Light's Commercial Conservation Service program. Both programs offer all of the services described above, including financial incentives that cover from 50-100% of measure costs. Due to the extensive services provided, both programs can only handle a limited number of participants each year. As a result, neither program is actively promoted to all eligible customers. Instead, limited program publicity, word-of-mouth, and personal contacts by utility field representatives are used to market the programs. The Puget program has often had long waiting lists of customers waiting to receive services. To date, the NU program has provided services to 1112 customers over six years (41% of eligible customers),including 480 who have signed contracts to implement measures (18% of eligible customers). Based on a process evaluation of early participants in the program, NU estimates that approximately 70% of customers who receive services will ultimately implement measures (Sayko 1994). The Puget program has served 8,600 customers over 13 years, which represents 13% of eligible customers. Initially the program focused on large commercial and industrial customers -- the participation rate is higher among these customers although no precise figures are available. Both programs are on-going and anticipate significantly higher cumulative participation rates in the future (Bernard 1993; Veneski 1993; IRT #6 1992; Donaldson 1993; France 1989).

All of the high participation programs examined include comprehensive services to assist the customer throughout the project implementation process. In some programs, the utility even takes the lead in directing project implementation. All of these programs also rely on personal contacts, starting with initial marketing and continuing through post-installation services such as a quality control inspection. Each of these high participation programs also include substantial financial incentives.

Only a few impact evaluations have been conducted on comprehensive retrofit programs. In these evaluations, net savings have ranged from 11-26% of pre-program electricity consumption (Keating and Blachman 1987; Cambridge Systematics 1990). With the exception of the Design Plus program (which was nicknamed "Cost-Plus" within the sponsoring utility), the high participation programs range in cost from $0.02-0.05/kWh saved. Only the NU and Puget programs were able to provide data on indirect costs; for the other programs we assumed indirect costs were 30% of direct costs, based on work by Berry (1989).

New Construction

Commercial new construction programs seek to promote efficient construction practices. By "building it right", subsequent retrofit programs may not be needed for buildings served by new construction programs. Many utilities have begun commercial new construction programs over the past five years. Typically these programs have two tracks -- a prescriptive track which provides rebates for common measures such as high-efficiency lighting and HVAC equipment, and a performance track which provides design assistance and custom rebates for comprehensive packages of efficiency measures which are optimized through the design process. In just a few

years, several of these programs have achieved participation rates of more than one-third of new commercial floor area including a few programs which have exceeded a 50% participation rate.

United Illuminating (UI) estimates that 70% of new buildings built in its service area participate in the Energy Blueprint program. This participation rate was achieved in only the third year of program implementation. However, this estimate is very approximate as UI has not recently estimated the amount of new commercial floor area built annually. The program includes both prescriptive and performance tracks. The prescriptive path accounts for the vast majority of participants; under this track lighting measures are most frequently implemented. Incentives typically cover 50-75% of incremental measure costs. The performance track provides higher incentives, but to participate on this track facilities must reduce energy use by 20% relative to local construction practices. The program also offers Design Grants to help cover the additional costs of designing efficient buildings, and commissioning grants, to help ensure that building systems are set-up properly. Interest in design and commissioning grants has been limited. Participants in the UI program generally emphasize simple prescriptive measures for which design and commissioning grants may not be needed. The Energy Blueprint program is principally marketed by word-of-mouth -- utility representatives regularly contact developers, architects, engineers, and designers as well as owners of buildings in the construction process. Most owners hear about the program through their architects or engineers who in turn learn of the program through UI staff (IRT #50 1993).

B.C. Hydro serves an estimated 63% of new commercial square footage with its New Building Design program. Like the UI program, this participation rate has been achieved only three years after program inception. Also like the UI program, this program includes both prescriptive and performance paths. Prescriptive paths target efficient HVAC products and lighting designs. These include an Express Option which features simplified application procedures for small building projects with short design and construction schedules. Performance paths include incentives for energy studies on large and energy-intensive buildings and further incentives for implementing measures identified in the energy studies. Energy study funds can be used at the conceptual design and/or the preliminary design stages. At the conceptual design stage, architects can explore issues such as building shape, orientation, siting, daylighting strategies, thermal mass, and cooling and heat storage. At the preliminary design stage, various lighting, HVAC, and building envelope measures can be assessed relative to a prototype building that meets the Vancouver building code. On average, program incentives cover 80% of the incremental cost of high efficiency measures.

Program marketing emphasizes personal visits to customers and the building design community. In addition, educational seminars and workshops are offered throughout the year and an annual design competition is held to raise the awareness and importance of energy-efficient design and technology. Recognition advertising, for those who have made significant contributions towards saving energy in the design and construction of their projects also plays an important role.

According to the utility, factors contributing to the program's success include marketing efforts aimed at all levels from Vice Presidents to facility managers, consultants and architects; active efforts by consultants and designers to promote the program to their clients; financial incentives; adoption of the new Vancouver energy code, which increased attention to and

awareness of energy-efficiency issues; and the overall success of the utility's full range of DSM programs which provides instant credibility to new programs such as the New Building Design program (Chanin and Uncyk 1993; BC Hydro 1992).

PacifiCorp's Large Commercial Energy FinAnswer program has achieved an estimated 45% participation rate in the second year and 63% in the third year. The program provides a wide range of services to building owners and design teams including computer modeling, financing, and performance verification. Marketing emphasizes personal contacts between utility sales representatives and engineers and owners and designers of new buildings. Information is provided to prospective participants including a description of program procedures, answers to commonly asked questions, information about computer modeling and building commissioning, and profiles of various completed projects.

A unique aspect of the Finanswer program is the financing approach -- PacifiCorp provides a loan to customers at the prime interest rate (currently 6%) to finance 100% of the incremental costs of efficiency measures. Customers then pay the loan back through their utility bill over a 10-20 year period. Program administrative costs are paid by the utility. Typically customer loan payments cover 70-80% of program costs and the utility funds the remainder.

The program emphasizes a comprehensive, whole-building approach to achieving energy savings. Large buildings are analyzed with a computer model to estimate energy savings from different packages of measures and to select the optimal package. Smaller buildings can take advantage of measure packages developed by PacifiCorp based on prototypical small buildings. In order to participate in the program, buildings must reduce energy use by at least 10% relative to prevailing local construction practices.

Unlike most other commercial new construction programs, the PacifiCorp program requires commissioning of all projects to ensure that systems are set-up and running properly. The program also includes an audit one year after occupancy to verify savings. If savings are less than expected, customer loan payments are reduced accordingly. These extra services help ensure that savings are achieved, providing major benefits to participants and the utility (IRT #46 1993; Haberman 1993; PacifiCorp 1993).

Two other programs have also served 35-39% of new commercial square footage in their most recent year of program operations -- the PG&E Commercial New Construction program and the NEES Design 2000 program. Both programs emphasize prescriptive rebates for common energy-saving design improvements such as efficient lighting and HVAC systems. Both programs also provide comprehensive design services for customers who are interested. Like the other programs discussed above, both programs emphasize personal contacts with developers and designers. The NEES program pays high incentives -- typically full incremental measure costs -- while the PG&E program pays more modest incentives -- typically 50% of incremental measure costs. The difference in incentives does not appear to have affected the participation rate, but does appear to affect the savings achieved. Energy savings achieved by the NEES program are approximately twice as large as those achieved by the PG&E program, despite the fact that PG&E serves a much larger population (IRT #33 1992; Furness 1993; Fitzpatrick 1993; Miller 1993).

The high participation programs examined here share several common attributes including an emphasis on personal marketing and building relationships with the design and building community, and the availability of financing or financial incentives that cover most or all of the incremental cost of efficiency measures. Many of the programs emphasize ease of participation; these programs have achieved high participation rates by emphasizing simple, prescriptive measures such as lighting improvements. The PacifiCorp program has taken a different tact. The PacifiCorp program is not simple; instead it emphasizes quality services, including substantial energy savings from a comprehensive package of measures, building commissioning and a post-occupancy audit.

Savings from commercial new construction programs have rarely been empirically evaluated. A pilot program offered by BPA that provided similar services to the PacifiCorp program found net savings relative to prevailing construction practices of 19%. Savings were somewhat lower than expected because not all measures were properly installed (Piette et al. 1993). Engineering estimates from the PG&E and UI programs imply savings of approximately 10%. The cost of saved energy for these programs range from $0.015-0.035/kWh.

Industrial

Motor Rebates

Motor rebates are among the most common types of industrial DSM programs. In the typical program, the utility adopts a set of efficiency values that define " high efficiency motor." Rebates are paid to customers for the purchase of motors that meet or exceed the utility-set efficiency thresholds. Efficiency and rebate levels generally vary depending on the size of the motor.

Probably the highest participation rate achieved by a motor rebate program has been achieved by B.C. Hydro. In 1991, four years after the program began, an estimated 64% of the motor horsepower sold in British Columbia met the utility's efficiency thresholds. Keys to the success of the B.C. Hydro program are the active involvement of motor dealers and an intensive, multi-faceted marketing effort. B.C. Hydro staff regularly visit motor dealers and repair shops to promote the program and to provide information and promotional material motor dealers can use to sell high efficiency motors to their customers. Motor dealers also receive an incentive from the utility for each qualifying motor sold -- vendor incentives are equal to 20% of the customer incentive. As a result of these efforts, vendors now routinely stock and recommend efficient motors. B.C. Hydro staff also personally visit large customers to apprise them of the program and provide customers with information about high efficiency motors such as a database of motors sold in the province (which indicates the amount of incentive available for specific high efficiency models), and calculational tools to allow customers to estimate the benefits of upgrading their motor purchases. In addition, utility staff work with motor manufacturers to apprise them about the program because an estimated 22% of motor sales in the province are direct from manufacturers to customers. Yet another factor contributing to the success of the program is the fact that a large portion of B.C. motor sales are to large wood product and mineral companies -- companies that show an above-average interest in improving energy efficiency. B.C. Hydro is now trying to convince the provincial legislature to adopt B.C.

Table 3. Industrial Programs with High Participation Rates

Utility/Sponsor	Program	Program Type	Start Date	End Date	Annualized MWh Savings from Cum. Measures	% of Measure Costs Covered by Utility	Measure Life: Utility Estimate	Measure Life: ACEEE Estimate	# Eligible Customers/ Units Sold Annually	# Targeted Customers
BC Hydro	Motors program	Motor	1988	1992	68,300 *	67%	20	15	346,445 HP	
Ontario Hydro	C&I Motors Plan	Motor	10/89	8/93	300,160	50%	17	15	22,000 motors	
WEPCo	Smart Money: motors	Motor	1987	1992	25,492		15	15	5,000 motors	2,036
WEPCo	Smart Money: Industrial	MM	1987	1992	300,200	45%	10	15	5,000 customers	
BC Hydro	Bonus Partners	Custom	1990	1992	77,533 *	15-25%	20	15	20,000 customers	400
BPA	ESP	Custom	1988	1992	145,992 *	60-70%	15	15		300
CMP	C&I Custom Rebate Program	Custom	3/89	4/92	4,200	80%		15	339 customers	

* Asterisk indicates that savings are based on impact evaluation

Utility/Sponsor	Program	Cum. # Partic./ Units Partici-pating/Year	Participation Rate: % of: Eligible	Targeted	% Free Riders	Cumulative Program Costs Direct	Indirect	Total	Levelized Utility Cost ($/kWh Saved)
BC Hydro	Motors program	220,514	64%		9%	$4,712,400	$2,042,400	$6,754,800	$0.010
Ontario Hydro	C&I Motors Plan	11,000	50%		11-25%	$8,000,000	$3,600,000	$11,600,000	$0.004
WEPCo	Smart Money: motors	476-953	1%	23-47%	13-17%	$2,942,000	$882,600	$3,824,600	$0.014
WEPCo	Smart Money: Industrial	3,582	36-72%		15%	$33,914,000	$37,216,400	$71,130,400	$0.023
BC Hydro	Bonus Partners	204	1%	51%	5-10%	$1,335,200	$1,343,000	$2,678,200	$0.003
BPA	ESP	85		28%	30%	$7,533,000	$3,013,200	$10,546,200	$0.007
CMP	C&I Custom Rebate Program	74	22%		0%			$544,800	$0.012

Hydro's motor efficiency levels as a minimum efficiency standard. If this happens, high efficiency motors will be required by law and B.C. Hydro will stop offering motor rebates (IRT #38 1992; Henriques 1989).

One year after B.C. Hydro began its program, Ontario Hydro began a very similar program. In fact, the two utilities routinely share ideas and information. As of 1992, high efficiency motors accounted for 50% of the motors sold in Ontario (Burrell 1993).

In the U.S., the highest participation rate has been achieved by WEPCo's Smart Money for Business program. WEPCo does not have data on the current market share of high efficiency motors within its territory. Instead, WEPCo estimates its participation level based on the number of rebates issued relative to the number of industrial customers who are eligible or targeted. If we assume that the typical participating customer has received 1.5-2 rebates (see the Commercial Lighting Rebate discussion), the participation rate in the WEPCo program varies from 10-20% of the eligible customers and 23-31% of the targeted customers (Spang 1993). Reasons for the success of WEPCo's program are discussed in the Commercial Lighting Rebate section of this paper.

High participation motor rebate programs appear to share several characteristics including active involvement of trade allies such as motor manufacturers and dealers; personal contacts by utility staff with motor manufacturers, dealers, and large purchasers; a multi-faceted information program to inform dealers and customers about the availability and advantages of high-efficiency motors; and significant financial incentives.

Relative to standard efficiency motors, savings from high efficiency motors range from 1-9% depending on motor horsepower (savings are highest for small motors and lowest for large motors) (Nadel et al. 1992). The cost of saved energy for motor rebate programs has averaged approximately $0.01/kWh.

Multiple Measure Rebates

Multiple measure rebate programs offer incentives for many measures such as lighting, motor, and industrial process improvements. These industrial programs typically combine prescriptive incentives for specific high-efficiency motors and lighting equipment with custom incentives (e.g. payments per kW or kWh saved) for process improvements proposed by customers.

Of the programs of this type, one program clearly stands out -- WEPCo's Smart Money for Business: Industrial program. Over the five years of this program, WEPCo estimates a participation rate of up to 72% of the 5000 eligible customers. However, this participation rate assumes that no customer receives more than one rebate. If, instead, we assume 1.5-2.0 rebates per customer on average (see the Commercial Lighting Rebate section for an explanation) the participation rate becomes 36-48%. The WEPCo program offers customers zero-to-low interest loans or cash rebates for installing qualifying energy-efficient measures. Prescriptive rebates are available for lighting, motor, HVAC, and refrigeration measures. Custom incentives are available for process-related improvements and are negotiated with each participant. Between 15-30% of a custom project's total costs are typically covered by the incentive. If a project

requires a feasibility study, WEPCo will pay up to 50% of the costs of a comprehensive audit. WEPCo has focused on securing the technical expertise necessary to do a thorough job; engineering consultants having particular expertise with relevant industrial processes are available to participants to perform feasibility studies.

WEPCo's marketing approach involves a two-pronged strategy: utility sales executives (typically engineers) communicate with and market the program to process-level plant personnel, such as plant engineers and maintenance operators. Simultaneously, utility account executives interact with and market the program to industrial vice presidents. Generally, smaller projects can be handled by the process-level employees, whereas larger projects must be dealt with at a senior management level.

The majority of participants have focused on prescriptive measures, with approximately two-thirds of rebates being prescriptive. More than half of the industrial energy savings have been due to lighting measures, while process-oriented measures are responsible for approximately 30% of the savings. The program manager noted that it has taken time to gain the trust of the industrial customers with regard to DSM, especially in moving from lighting and HVAC measures to process measures.

The utility attributes the program's success to the utility's focus on understanding the customer's perspective, making personal one-on-one customer contact, simplifying the program while still offering a comprehensive package, and securing technical expertise necessary to do a good job (Hawley 1992).

Impact evaluations on the WEPCo program are not available. The cost of saved energy for the WEPCo program is approximately $0.025/kWh based on engineering estimates of energy savings.

Custom Incentives

Industrial custom incentive programs invite customers to submit proposals for energy-saving projects to the utility. Engineers hired by the utility review proposals for reasonableness and technical merit, and if a proposal is acceptable, agree to pay an incentive once the project is implemented. Incentives may be paid per kW or kWh saved, or frequently, they take the form of "payback buydowns" in which the utility incentive reduces the simple payback to the customer to a particular level, typically one, two, or three years. The rationale for custom programs is that many customers know of ways to save energy in their facilities, but projects are not implemented for financial or other reasons. By paying incentives for these projects, utilities can improve the financial attractiveness of these energy-saving projects to industrial customers, thereby spurring action. Custom incentive programs are particularly useful for implementing process improvements -- because each industrial facility and process is unique, projects to improve these processes must be done on a custom basis.

The highest participation rate for a custom incentive program is the 51% participation level achieved among the 400 large industrial customers targeted by B.C. Hydro's Bonus Partners program. Under Bonus Partners, industrial customers propose energy-conserving, process-related projects to B.C. Hydro; financing or cash grants are offered for qualifying

projects. If an approved project yields savings of less than 200 MWh per year, the participant generally receives an incentive which brings the project's payback period down to two years. For larger projects, the utility meets with the customer and negotiates the incentive that the customer needs in order to proceed with the project. In determining the incentive, other factors beyond the energy savings are considered; the utility works with the customer to determine the effects the project will have on maintenance costs, productivity, product quality, equipment reliability and other important industrial concerns. The utility and the participant jointly assign monetary values to these effects and factor these values into the incentive calculation. According to program staff, pointing out the other benefits of efficiency projects generally enhances participation in the program. Incentives generally cover between 15-30% of the project costs; with B.C. Hydro's incentive approach, an incentive covering 80-100% of project costs is not needed. Keys to the success of this approach include a good working relationship on energy efficiency issues built up between the utility and its industrial customers and the fact that larger Bonus Partners projects are generally at plants which are large energy users -- such as paper and pulp, mining, and food processing plants -- where customers are more interested in improving the energy efficiency of their facilities than the average industrial firm. One downside of the negotiated incentive approach is that the negotiation process adds to the length of time needed to implement projects (Hessen 1993).

Another custom program with good participation rates is BPA's Energy Savings Plan (ESP) which has achieved a 28% participation rate among targeted (large) customers. Under the ESP, either industrial customers propose energy-efficiency projects to their local utility (customer-owned utilities who buy power from BPA) or, if the customer needs assistance in identifying conservation opportunities, BPA will provide an Energy Review Service for identifying, analyzing, and proposing a package of energy-efficiency measures. This Service includes short walk-through audits and more detailed energy audits when necessary. Measures most commonly performed are installation of energy-efficient refrigeration, motors, energy management systems, air compressors, and waste heat recovery equipment. When the program first began, participants generally received $0.05/kWh saved in the first year. Initial participation rates were disappointing, so BPA raised the incentive to an average of $0.15/kWh saved in the first year or 80% of the project costs, whichever is smaller. Staff note that as long as a project's payback can be reduced to less than three years, most industrial firms are interested in participating. At the same time incentives were raised, the marketing approach for the program was revamped. Vendors now play a central role in "selling" the program to industrial customers, and BPA staff cite this as largely contributing to the increased success of the program in attracting participants and savings. Utility marketing staff attend trade shows and offer vendor seminars in order to educate vendors on how ESP works and on effective methods for marketing their products by marketing the ESP program (Aho 1989, Peters 1992, Tawney 1992).

Central Maine Power (CMP) has achieved a 22% participation rate among the 339 large customers eligible for its Custom Rebate Program after three years of program operation. CMP attributes the success of the program to active marketing efforts by equipment vendors and to one-on-one contacts by utility field staff with eligible customers (Gervais 1993).

Based on these three programs, a number of factors appear to contribute to high participation rates including a good working relationship between the utility and its large

industrial customers, flexibility to adapt the program to the needs of individual customers, a focus on all of the benefits of proposed projects and not just energy savings (many projects can provide productivity, maintenance, environmental compliance or other benefits in addition to energy savings), significant financial incentives, use of equipment vendors to help market the program, and concentrating initial efforts on energy-intensive firms who are more likely to be receptive to the program.

Savings from custom industrial programs vary widely from project to project. The cost of saved energy for these programs tend to be quite low -- less than $0.01/kWh.

DISCUSSION AND CONCLUSIONS

The participation rates for each of the 18 program categories discussed in this paper are summarized in Table 4. Depending on the program category, the highest participation rates range from approximately 15% to nearly 100%.

The major program types with maximum participation rates of approximately 15-20% are residential appliance labeling, commercial performance contracting, and commercial lighting and multiple-measure rebates.

Participation rates of 64% or more have been achieved by direct installation, new construction incentive, and market transformation programs (programs which seek to transform entire markets by combining education, utility incentives, and government regulation). Areas where these high participation rates have been achieved include:

* Direct installation programs for residential water heating retrofits, residential comprehensive weatherization, commercial lighting, and commercial comprehensive retrofits;

* New construction programs involving residential rate discounts, residential HVAC incentives, and commercial incentives for lighting and HVAC; and

* Market transformation programs for residential refrigerators, residential new construction, and industrial motors.

Maximum participation rates for other program types and categories lie within the 25-60% range.

With the exception of rebates for commercial HVAC equipment and lighting in new commercial buildings, maximum achieved participation rates for rebate programs are generally less than 30%. Similarly, maximum participation rates for labeling programs are generally less than 30%. Performance contracting programs have yet to break the 15% participation barrier, with the partial exception of BED's Smartlight Leasing program and PacifiCorp's Energy FinAnswer program. These latter two program's combine a modified shared savings approach with substantial utility subsidies.

Table 4. Summary of Participation Rate Ranges by Program Category.

Program Type	Participation Rates (as % total eligible)		
	Low	Median	High
RESIDENTIAL:			
Low-cost weatherization	25%	49%	68%
Comprehensive weatherization	23%	70%	87%
Low-cost hot water retrofits	47%	64%	98%
Air conditioner and heat pump rebates	14%	36%	60%
Refrigerator rebates	34%	56%	80%
Compact fluorescent lamps	~5%	28%	60%
New construction	10%	71%	100%
Labeling - appliances (net participation)	12-15%	17%	23%
Labeling - new constructtion (net participation)	10-20%	27%	39%
COMMERCIAL:			
Lighting Rebates	10%	~18%	21%
HVAC rebates	~25%		90-100%
Multiple-measure rebates	8-11%	12%	17-23%
Lighting direct installation	14%	34%	>85%
Performance contracting retrofits	9%	13%	15%
Comprehensive retrofits	13%	40%	74%
New Construction	35%	63%	70%
INDUSTRIAL:			
Motors	1%	42%	64%
Multiple-measure rebates		36-48%	
Custom Rebates	1%	25%	51%

Based primarily on engineering estimates of electricity savings, the cost of saved energy to the utility for most of these high participation programs is less than $0.035/kWh saved.

Based on these findings, new construction programs and market transformation programs appear to be promising avenues all utilities should consider. Direct installation programs also have much to recommend them, although their cost of saved energy to the utility is frequently above $0.035/kWh. On the other hand, since these programs typically pay a large proportion of measure costs, total resource costs and utility costs are frequently similar.

In reviewing the results summarized in Table 4, it is useful to compare these results to findings from previous studies that were conducted circa 1990. Such a comparison is contained in Table 5. This comparison, which covers 1990 studies by Berry and Nadel, shows that over the past three years, maximum participation rates have increased for all of the industrial program categories and many of the commercial program categories (i.e. HVAC and multiple-measure rebates, lighting direct installation, and new construction). These increases imply that as utilities continue to operate DSM programs, and gain experience in what works and what does not, participation rates may continue to increase. Higher participation rates are particularly likely in programs where available resources cannot meet the demand for program services. Among residential programs, only three categories were covered by the 1990 studies; over the past three years maximum participation rates in these three categories are largely unchanged, in part because maximum participation rates in 1990 were already quite high.

As part of our research, we also examined links between participation rates and a number of other variables including incentive amount, cost of saved energy, number of eligible customers, and program duration. These analyses are summarized in a series of graphs in an appendix to this paper. In general, these analyses found large amounts of scatter in the data which makes identifying patterns difficult. Still, two patterns did emerge. First, participation rates tend to be higher in programs whose incentives cover 80-100% of measure cost than in programs with lower incentives (see Figure A-1). However, these high participation programs do not necessarily have a high cost of saved energy to the utility (see Figure A-2). Second, participation rates were generally higher for programs with small targeted populations than for programs with large targeted populations (see Figures A-4 and A-8). In general, it is easier to market a program to a small number of potential participants than to a large number. This finding is also illustrated by some of the high participation rates achieved by pilot programs and by programs that target a single community such as the Fitchburg, Osage, Hood River, and Espanola residential programs.

In reviewing the high participation programs, it becomes apparent that there are several factors that differentiate high participation programs from less successful programs. Among these factors, not all of which apply to each program area, are the following:

* Community-based marketing which seeks to involve the entire community in the program (particularly important in the residential sector);

* Personal contacts, both face-to-face and over the telephone, between utility staff and customers to market the program and assist with program implementation;

Table 5. Comparison of Highest Participation Rates From this Study with Previous Studies Published in 1990.

Program Type	Maximum Participation Rate		
	This Study	Berry	Nadel
RESIDENTIAL:			
Low-cost weatherization	68%	60%	NA
Comprehensive weatherization	87%	90%+	NA
Low-cost hot water retrofits	98%	52-60%	NA
COMMERCIAL:			
Lighting rebates	21%	NA	~10-25%
HVAC rebates	90-100%	NA	10%
Multiple-measure rebates	17-23%		10-16%
Lighting direct installation	>85%	50-60%	30-55%
Performance contracting retrofits	15%	NA	15%
Comprehensive retrofits	74%	NA	70-74%
New construction	70%	20%	low
INDUSTRIAL:			
Motors	64%	NA	15%
Multiple-measure rebates	36-48%	NA	5-9%
Custom rebates	51%	NA	5-9%

* Provision of high-quality services;

* Availability of technical assistance to customers and trade allies;

* Active involvement of trade allies in helping to design and market the program (particularly important with equipment and new construction programs);

* Efficiency thresholds that push the market, and keep free riders down to manageable levels (if eligibility thresholds are too lose, free rider levels will be high and *net* participation rates will suffer);

* A marketing message and marketing materials that are catchy and easy to understand;

* Marketing that targets the many different people involved in making decisions and that stresses the factors most likely to influence each type of decision-maker (for example, what influences an architect is somewhat different from what influences a building owner);

* Marketing that emphasizes all of the benefits of efficiency measures, and not just the energy savings.

* Making it easy for customers to participate, including easy to understand procedures, simple application requirements, and where possible, instant-rebates (rebates at time of purchase). Direct installation programs are the ultimate example of making it easy for customers to participate;

* Making it easy for manufacturers and distributors to participate, including announcing eligibility thresholds well in advance of program start-up to allow manufacturers to gear up production, and avoiding frequent changes in eligibility levels;

* Initially target customers that are more likely to participate, such as customers with high energy bills;

* Substantial financial incentives;

* Building regional consortiums to promote particular efficiency changes -- builders, equipment suppliers, and large firms often operate in several utility service areas, by coordinating on program features, utilities can make it easier for these players to participate in different utility programs;

* Working with government agencies to use utility programs to lay the groundwork for government mandates such as equipment efficiency standards and building codes.

In conclusion, this review demonstrates that in all program categories examined,

participation rates of at least 15% have been achieved, and in many program categories, participation rates of 60% or more have been achieved. For most of these programs, the cost of saved energy to the utility is less than $0.04 per kWh saved, which is lower than the avoided costs of most of the sponsoring utilities. In many program categories, the highest participation rates achieved to date are higher than maximum participation rates three years ago, indicating that DSM programs continue to mature and improve. This analysis should be repeated in a few years in order to assess whether this trend continues. In the interim, there is a need to improve data tracking for and evaluations of DSM programs so that data is more accurate and consistent across utilities than the data examined here.

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Figure A-1. Residential Program Participation as a Function of Percent of Measure Cost Paid by Utility

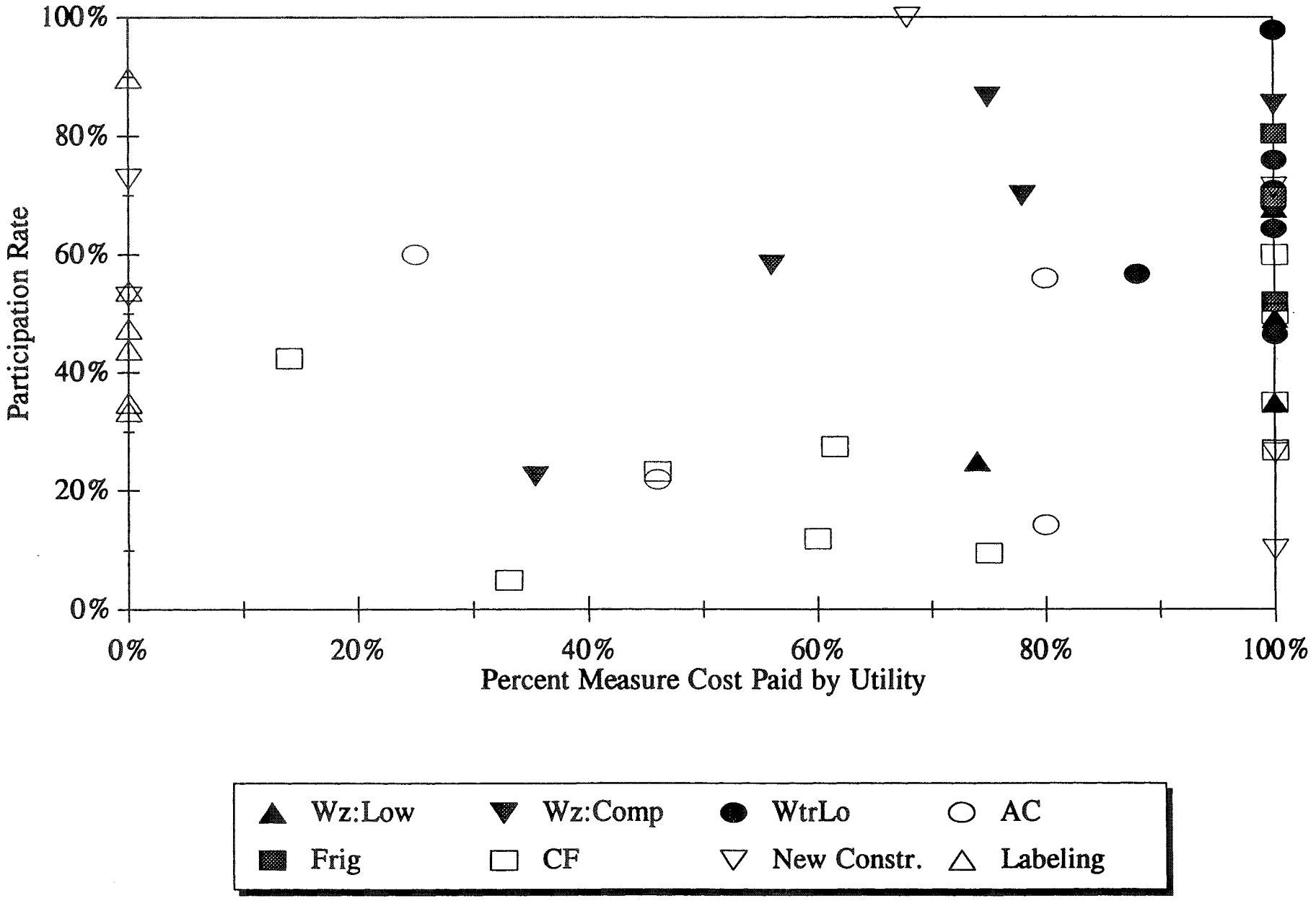

Figure A-2. Residential Program Participation as a Function of Cost of Saved Energy to the Utility

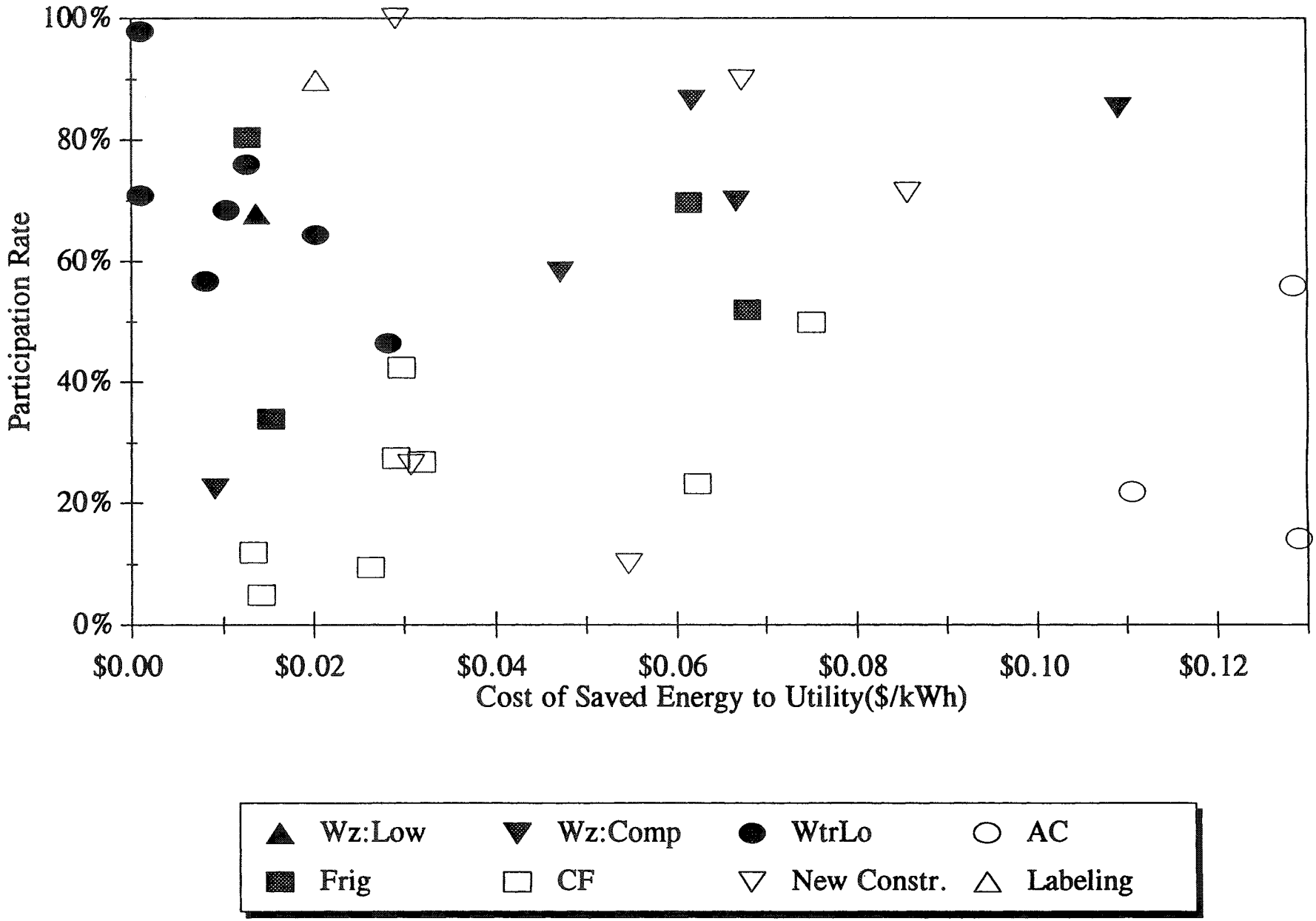

Figure A-3. Residential Program Participation as a Function of Program Duration

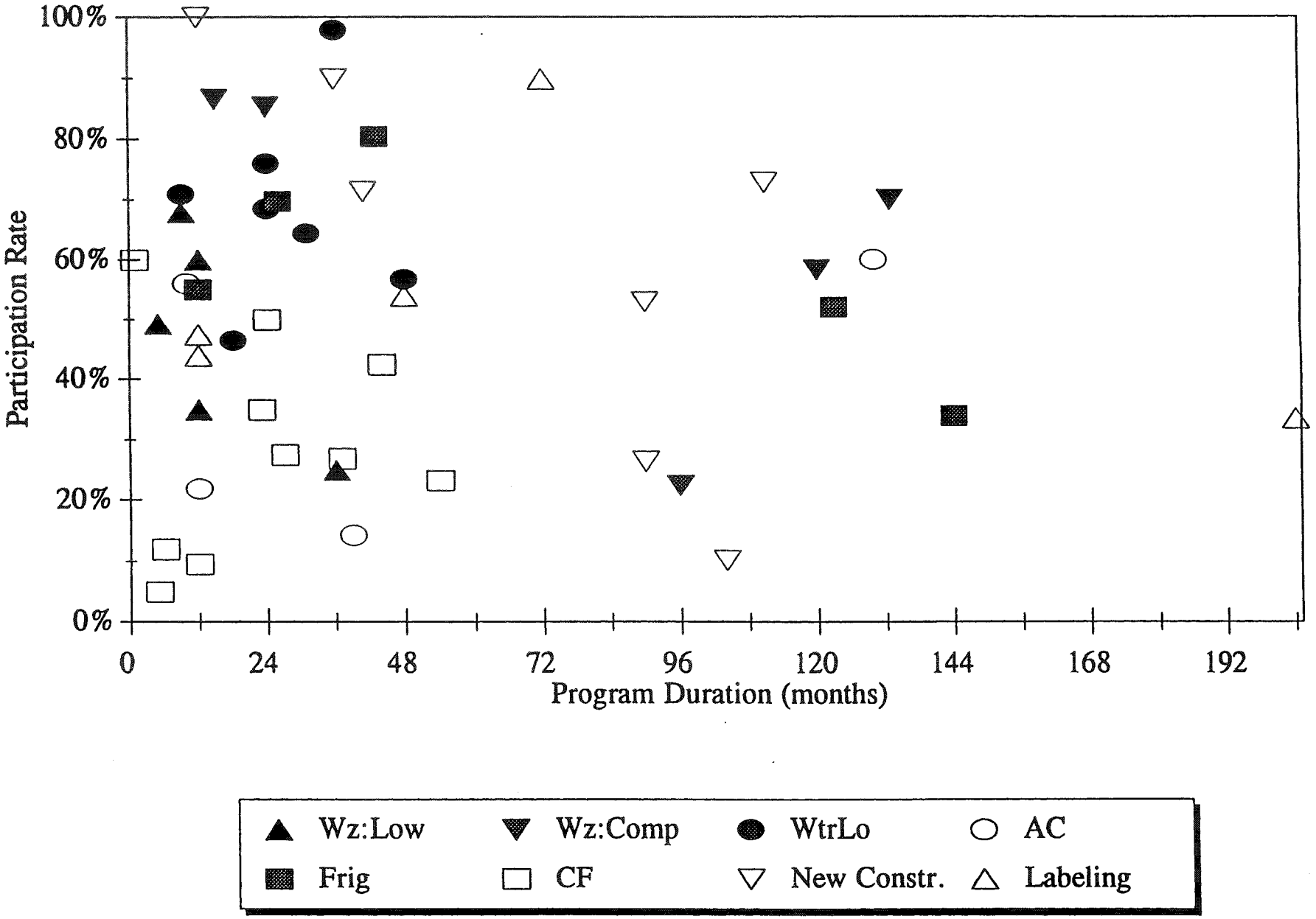

Figure A-4. Residential Program Participation as a Function of Size of Eligible Population

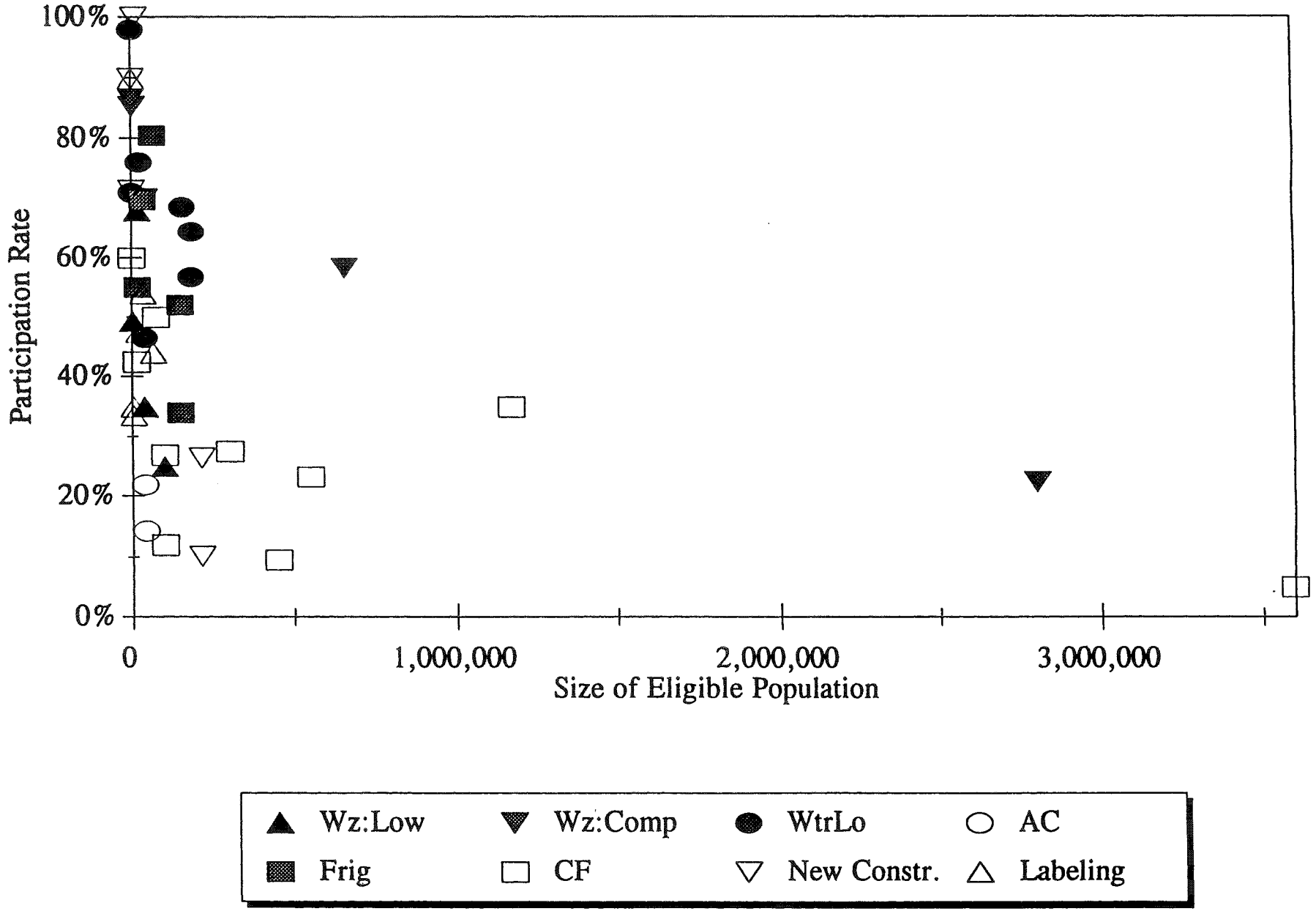

Figure A-5. Commercial Program Participation Rates as a Function of Percent of Measure Cost Paid by Utility

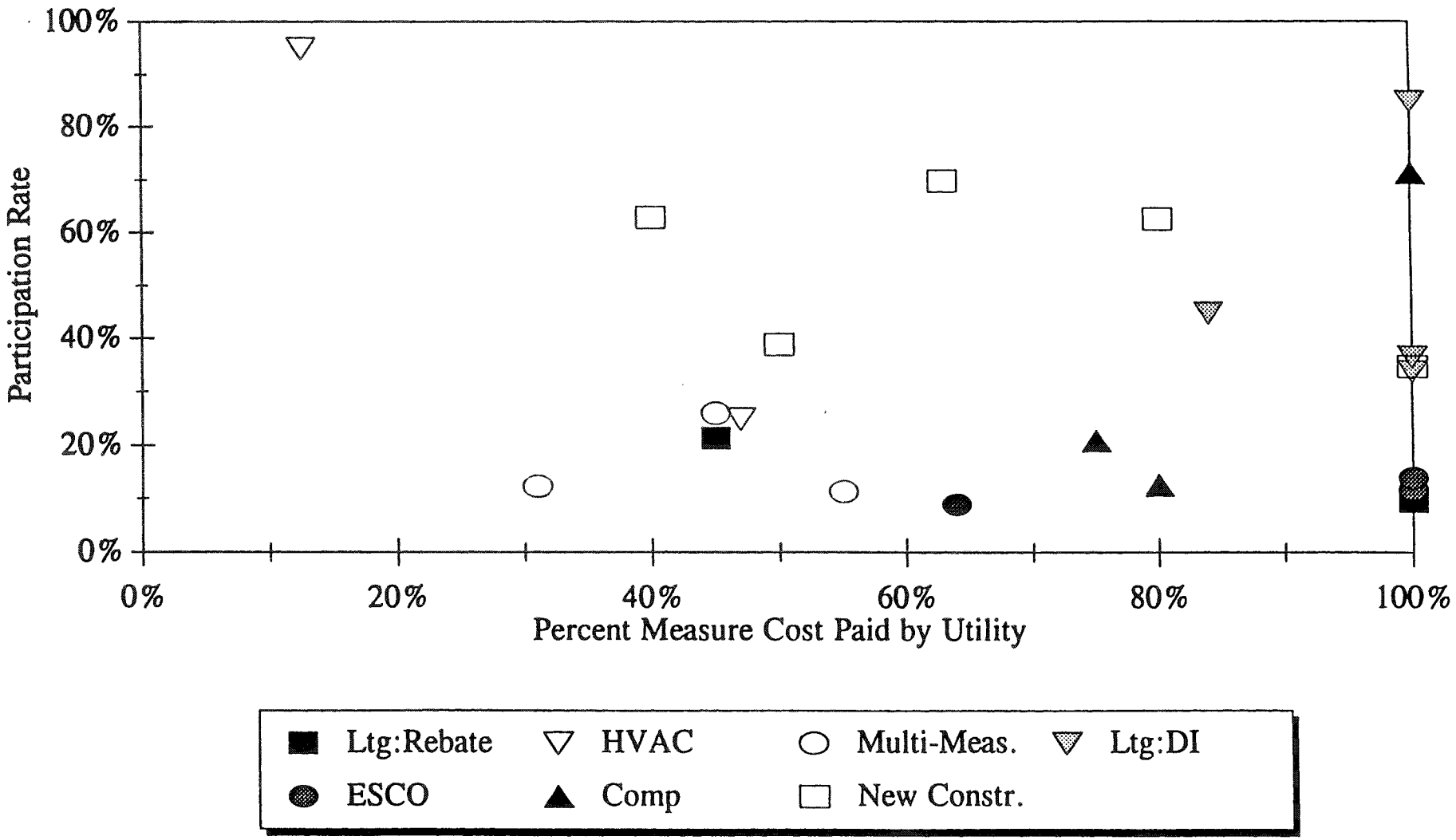

Figure A-6. Commercial Program Participation Rates as a Function of Cost of Saved Energy to the Utility

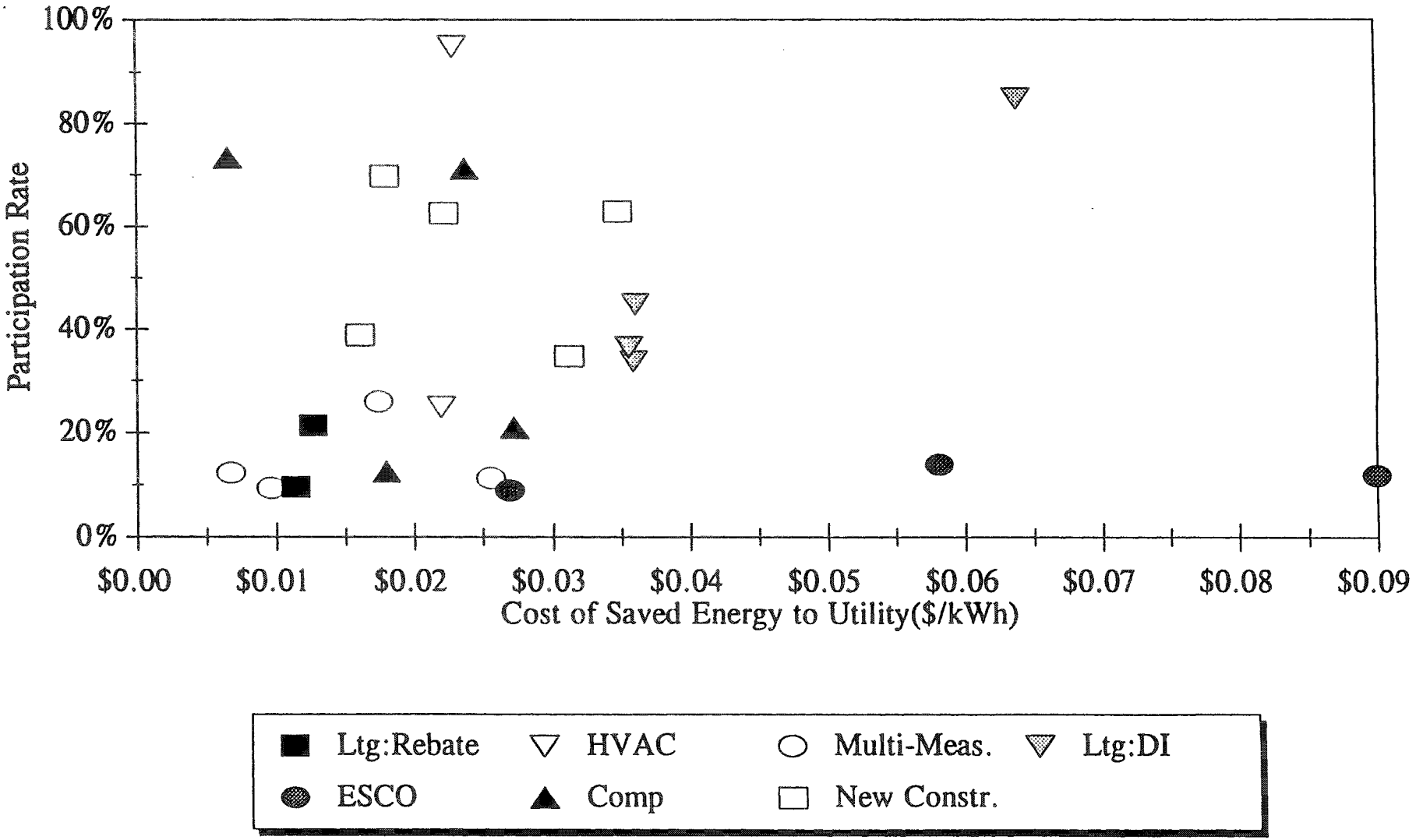

Figure A-7. Commercial Program Participation Rates as a Function of Program Duration

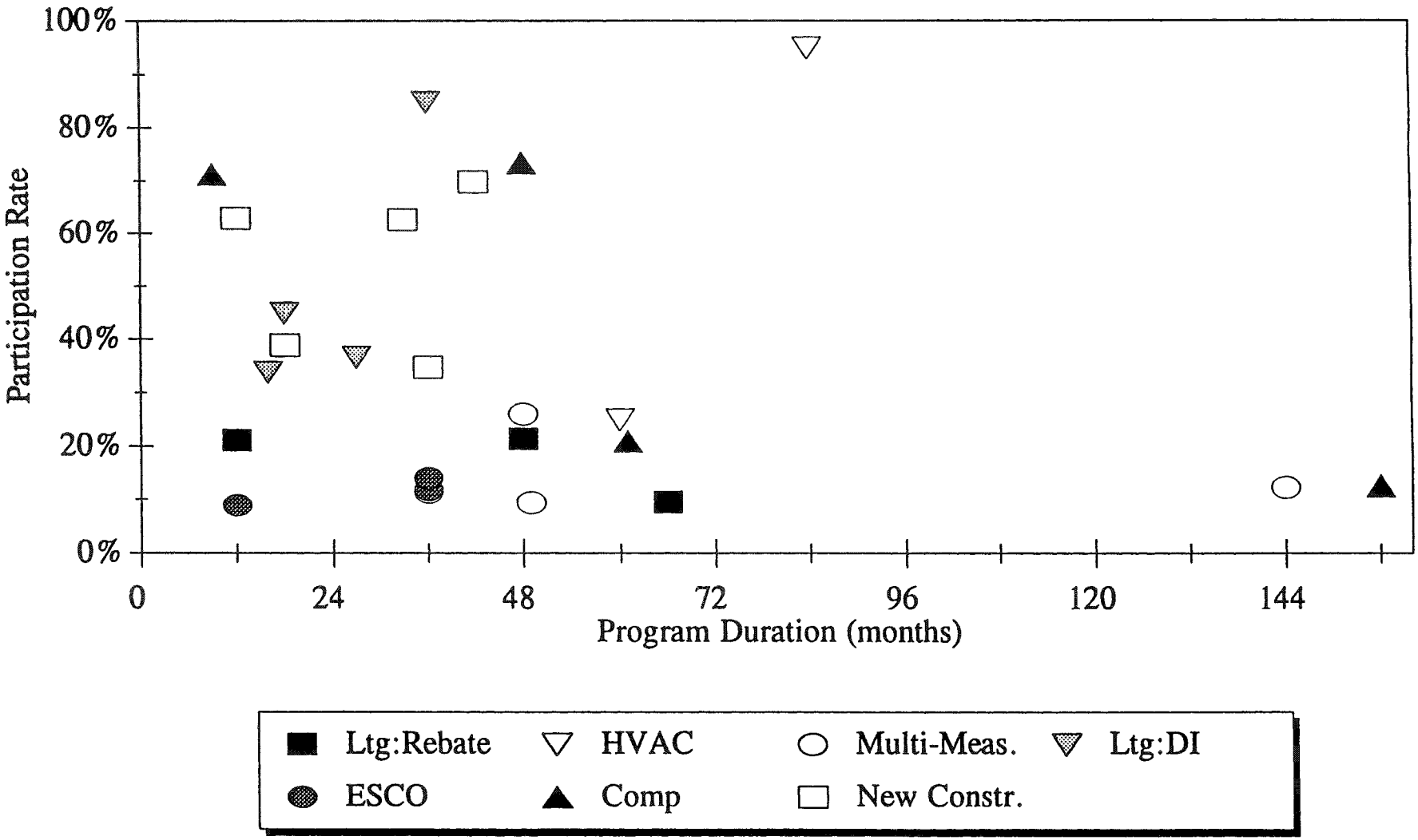

Figure A-8 Commercial Program Participation Rates as a Function of Size of Eligible Population

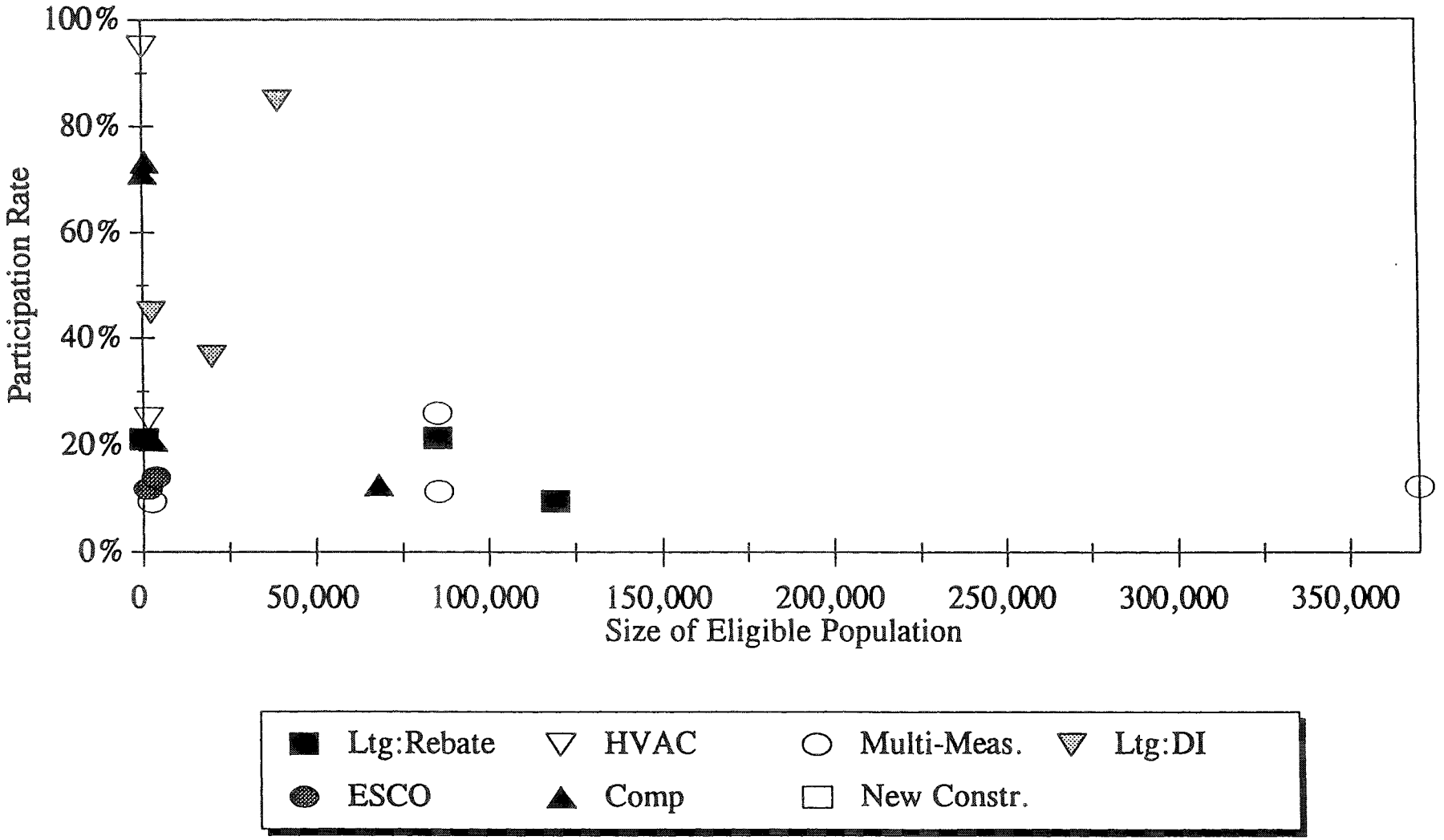

Figure A-9 Industrial Program Participation Rates as a Function of Percent of Measure Cost Paid by Utility

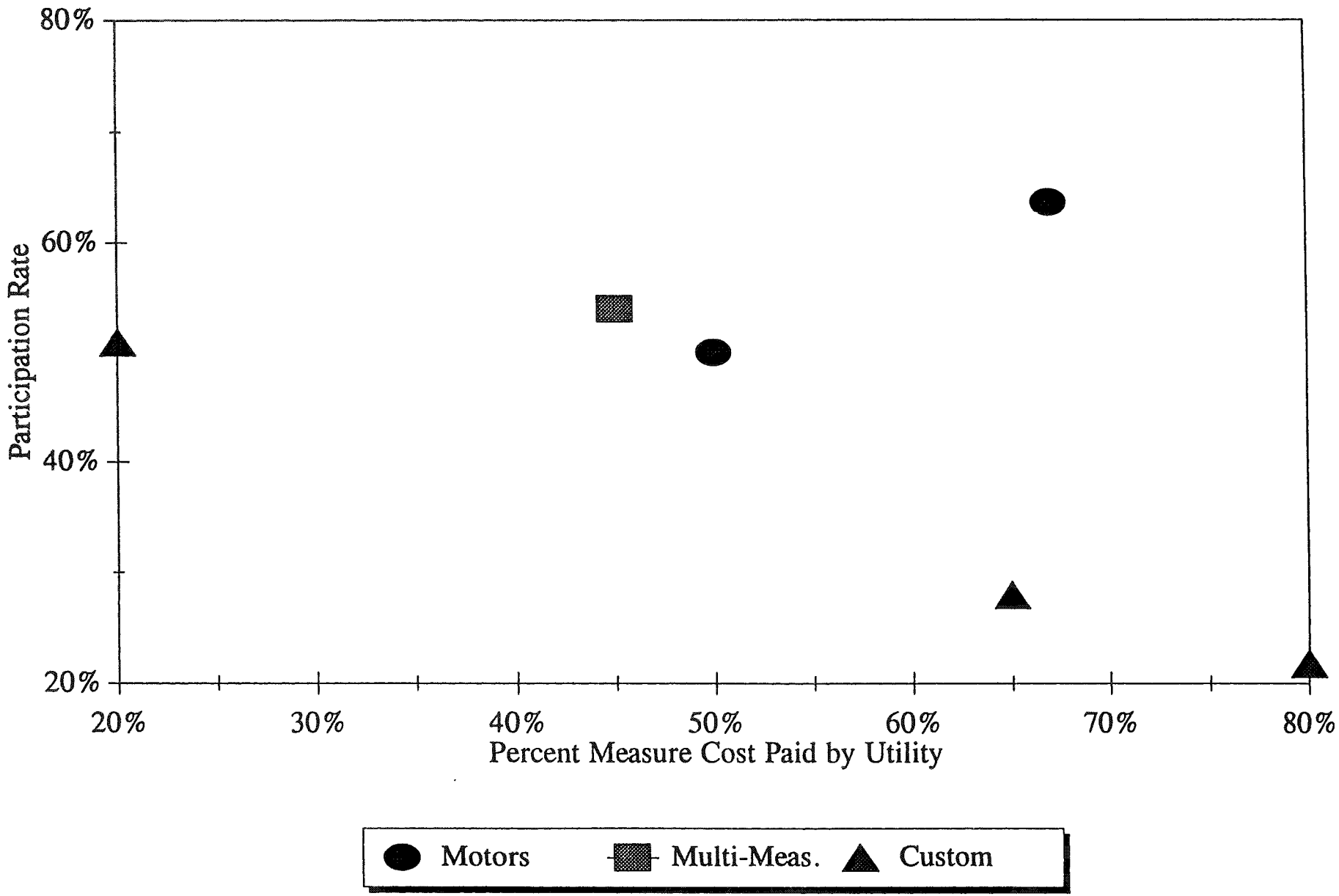

Figure A-10. Industrial Program Participation Rates as a Function of Cost of Saved Energy to the Utility

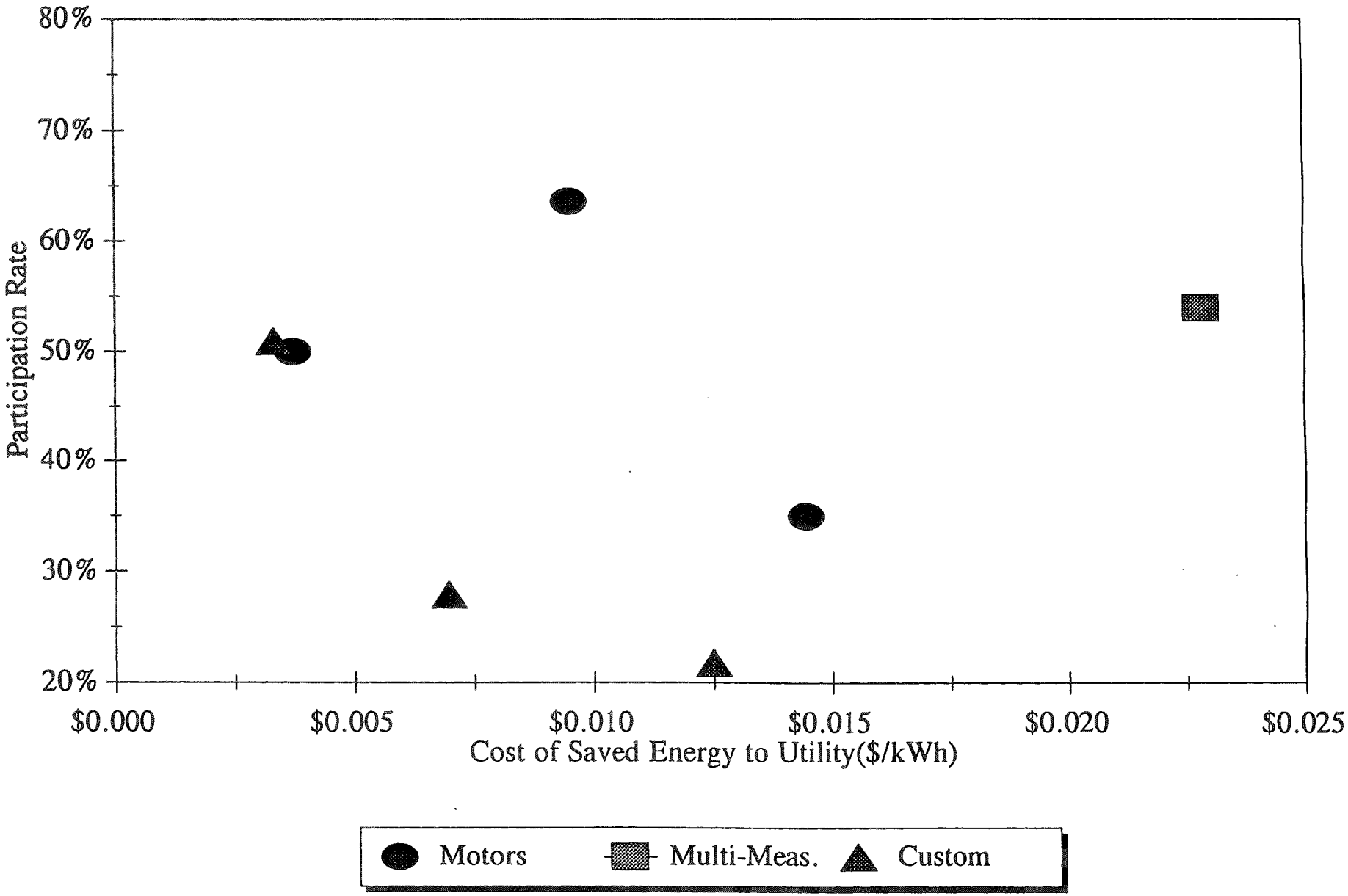

Figure A-11. Industrial Program Participation Rates as a Function of Program Duration

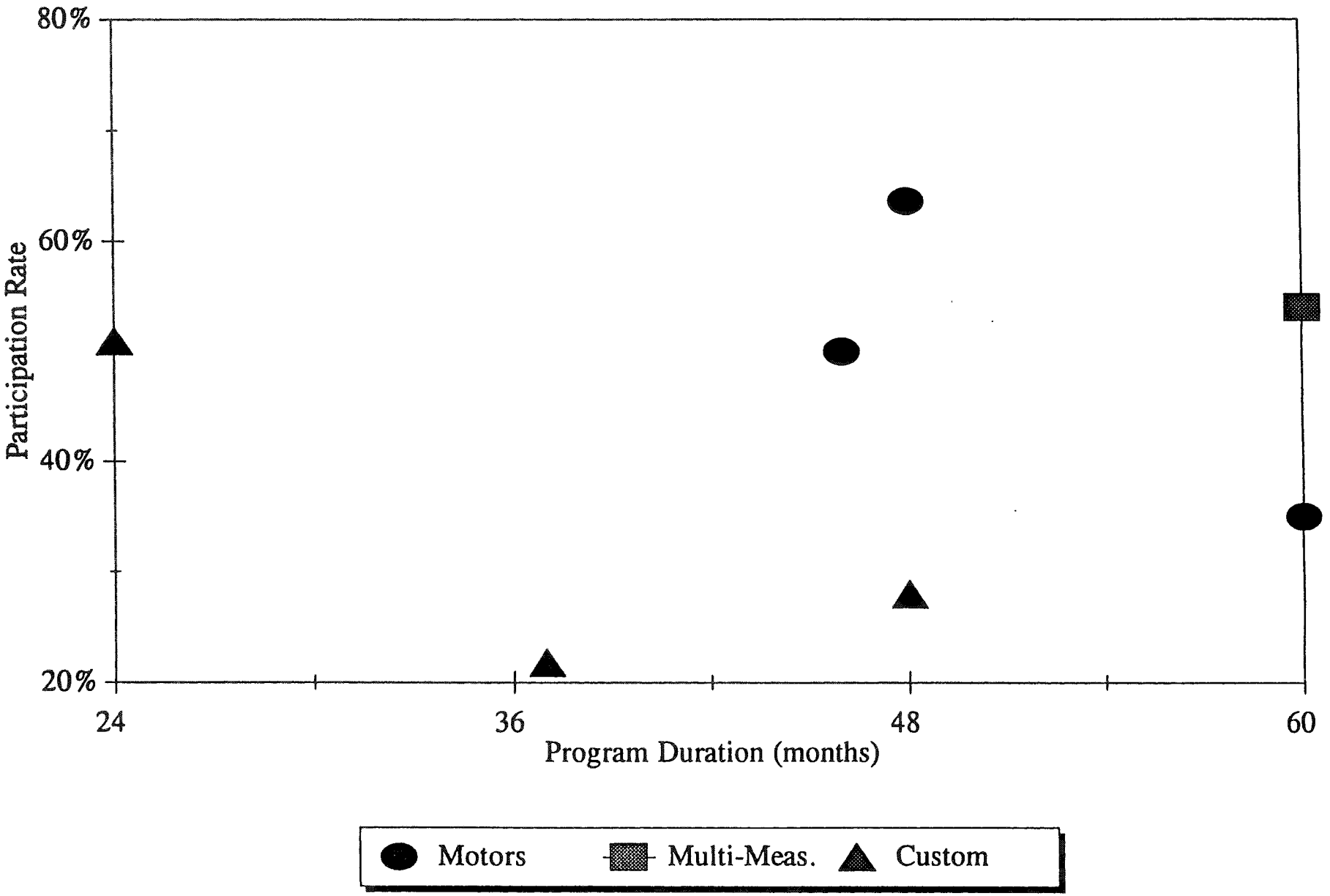

Figure A-12. Industrial Program Participation Rates as a Function of Size of Eligible Population