UTILITY COMMERCIAL/INDUSTRIAL LIGHTING INCENTIVE PROGRAMS: A COMPARATIVE EVALUATION OF THREE DIFFERENT APPROACHES USED BY THE NEW ENGLAND ELECTRIC SYSTEM

Steven Nadel
New England Power Service Company

ABSTRACT

Over the past three years, the New England Electric System (NEES), one of New England's largest utilities, has run three different programs to promote energy-efficient lighting to commercial and industrial (C&I) customers within its service territory. These programs are:

1. A customer-based rebate program under which rebates were given to C&I customers who purchased qualifying energy-efficient lighting products.

2. A "one-stop-shop" efficient lighting give-away program under which small- and medium-sized C&I customers received a free energy audit and free installation of energy-efficient lighting retrofit measures that met specified cost-effectiveness criteria.

3. A dealer-based rebate program under which dealers are paid rebates for sales of qualifying energy-efficient lighting products. The dealer-based rebates are designed to give dealers a strong incentive to promote energy-efficient lighting products to their customers.

The customer-based rebate program was easy to administer, had a low proportion of free riders, and may have the best cost-benefit ratio of the three programs. However, it had the lowest participation rate and low percent savings per participating customer. The one-stop-shop program had the highest participation rate and percent savings per customer. It had a low free rider proportion. However, it was complicated to administer and it had a higher cost-benefit ratio than the customer-based program. The dealer-based rebate program has only been in operation nine months, so definitive conclusions cannot yet be drawn. Experience to date indicates that this program will have a participation rate in-between those of the other two programs. This program has very high free riders but it still has a favorable cost-benefit ratio. Depending on future participation rates and free rider proportion, this program may be the most cost-effective of the three, or its cost benefit ratio may be in-between the other two programs.

All three programs have costs substantially less than the benefits to NEES. Based on the NEES experience, the customer-based rebate approach appears to be well suited for situations where program simplicity and cost-effectiveness are of primary concern. Conversely, the one-stop-shop approach appears to be well suited for situations where high participation rates and energy and demand savings are of primary concern and cost and administrative simplicity are of lesser concern. Initial experience with the dealer-based approach suggests that it falls in-between the other two approaches on each of these criteria.

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INTRODUCTION

Over the past three years, the New England Electric System (NEES), one of New England's largest utilities whose retail companies serve large sections of Massachusetts and Rhode Island and a small part of New Hampshire, has run three different programs to promote energy-efficient lighting among commercial and industrial (C&I) customers within its service territory. Each of these programs has taken a different approach to promoting efficient lighting. Two of the programs were run as pilot programs, in order to experiment with different program approaches, and the third program is now being run throughout the NEES service territory and is an attempt to combine some of the best features of the two pilot programs. This paper briefly describes these three programs and then compares them on a number of criteria including participation rate, "free riders", demand reduction, energy savings, program operations, customer and dealer satisfaction, and costs and benefits to the utility.

PROGRAM DESCRIPTIONS

The three programs were: (1) a customer-based rebate program, (2) a "one-stop-shop" efficient lighting give-away program, and (3) a dealer-based rebate program. Summary statistics on each of the programs can be found in Table 1.

Narragansett Electric Customer-Based Lighting Rebate Program

The customer-based program was a pilot program offered in the Rhode Island portion of the NEES service territory for a one-year period (July, 1986 - June, 1987). The program, which was very similar to rebate programs operated by many other utilities throughout the United States, provided rebates to C&I customers for the replacement of inefficient lighting products with more efficient lighting products. Products eligible for the program (and rebate levels) were energy-efficient fluorescent lamps (rebate of $1-$2 per lamp depending on size), elliptical reflector lamps ($2/lamp), screw-in fluorescent lamps ($5/lamp), and conversion to high pressure sodium and metal halide fixtures ($30/fixture). The maximum rebate amount was $3000 per customer.

Steps in the program included: (1) a low-cost ($25) energy-audit provided by a contractor to the utility, (2) purchase and installation by the

customer of eligible products recommended by the audit, (3) submission of a simple rebate application by the customer, (4) verification of measure installation by the utility, and (5) payment of the rebate by the utility. Marketing for the program included a mailing to all eligible customers, several additional targeted mailings, advertisements in newspapers, and telemarketing near the end of the program to all audit recipients who had yet to submit a rebate request.

Enterprise Zone Small C&I One-Stop-Shop Lighting Giveaway Program

The one-stop-shop program was a pilot program offered in 20 "Enterprise Zone" communities located in central and western Massachusetts. The Enterprise Zone consisted of 20 economically depressed communities where NEES offered a comprehensive series of pilot conservation programs for residential, small C&I, and large C&I customers. These programs ran from August, 1985 to December, 1986. The one-stop-shop, lighting giveaway program was available to small C&I customers (customers with average monthly billing demand less than 100 kW and annual electricity use less than 24,000 kWh). Larger customers were not eligible because larger customers were the target of another Enterprise Zone program. However, a few larger customers who did not participate in the large C&I Program were included in the final stages of the small C&I one-stop-shop program.

The small C&I one-stop-shop program was designed to promote high energy savings among eligible customers by making it as easy as possible for customers to participate. Customers were provided free energy audits and free installation of lighting retrofit measures which passed a cost-effectiveness test.

Cost-effective measures were those for which material and labor costs were less than or equal to the value of energy savings to the utility over a ten year period. At the time of program start-up, this value was estimated to be $.36 per kWh saved in the first year (the net present value of $.07/kWh for ten years).

Contractors hired by the utility performed all the work -- all the customer had to do was say "yes". Measures covered by the program included efficient fluorescent tubes and ballasts, compact fluorescent lamps, and new fluorescent, high pressure sodium, and metal halide fixtures. The utility provided a one year warranty on all measures installed. The program was heavily marketed including two mailings to all eligible customers, telephone calls to all eligible customers and site visits to customers loacted in large towns. In addition, general publicity on the Enterprise Zone initiative increased customer awareness of the program.

System-Wide Dealer-Based C&I Lighting Rebate Program

The dealer-based rebate program is a full-scale program in operation throughout the NEES service territory. The program began in July, 1987 and

is scheduled to run for five years. Under this program, dealers are given rebates for sales of lighting products of qualifying efficiency levels to C&I customers in the NEES service territory. The dealer-based rebates are designed to give dealers a strong incentive to promote energy-efficient lighting products to their customers. The program began by offering rebates for energy-efficient fluorescent lamps (rebate of $.80/lamp), fluorescent ballasts ($5/ballast), and fluorescent fixtures containing both efficient lamps and ballasts ($5-$20/fixture, depending on fixture size). Rebate levels for these products were set so dealers could sell efficient products at approximately the same price as conventional products. Dealers are not required to pass on rebates to customers. Instead, this decision is left to the dealer, although NEES hopes that competitive pressures will force dealers to pass much of the rebate onto customers. Periodic dealer and customer surveys are planned to see how much of the rebate is actually passed on to customers.

In December, 1987, high intensity discharge (HID) lamps, compact fluorescent lamps, and fluorescent reflectors were added to the program (typically rebates of $.30/Watt saved). The HID and compact fluorescent programs are for energy saving retrofits only and require preapproval by a utility representative. The other products require no preapproval, and, except for fluorescent reflectors, are eligible for installation in both existing and new buildings.

The program was designed to make it easy for dealers to participate. On a monthly basis, dealers provide basic information on customers and the products they purchased. Upon receipt of this information the utility pays the rebate due, generally within one to two weeks. The program is primarily marketed to dealers. Each dealer receives regular mailings and as well as periodic visits from a local utility representative. Customers learn about the program in three ways: (1) through their dealers, (2) through a brochure mailed to all C&I customers, and (3) through regular contact between customers and utility service representatives.

PARTICIPATION

Program target markets and participation rates are described in Table 1. The participation rate for the one-stop-shop, give-away program is dramatically higher than the other two programs; 34.2% of eligible customers received lighting improvements under the one-stop-shop program (over 17 months), compared to 2.4% in the customer rebate program (over 12 months) and 2.8% in the dealer rebate program (after nine months). Audit requests in the one-stop-shop program were even higher -- over 60% of the targeted customers requested free energy audits under the program. The majority of customers who received energy audits under the one-stop-shop program but did not have lighting measures installed had insufficient operating hours to pass the cost-effectiveness test (low operating hours reduces annual savings, making it more difficult for the eligible measures to pass the cost-effectiveness test). Clearly the combination of focused, intensive marketing with the offer of free retrofit measures and utility arranged installation is attractive to customers. Available data do not allow us to isolate the

Table I. Summary data on three NEES lighting programs.

	Program		
	Customer Rebate	One-Stop-Shop	Dealer Rebate*
Start date	7/86	8/85	7/87
End date	6/87	12/86	ongoing
Target population - est.	18,000	2,263	70,000
Number of participants	431	775	1,972
Participation rate	2.4% over 12 mo.	34.2% over 17 mo.	2.8%** over 9 mo.
Avg. consumption per Participating customer (kWh/year)	494,000	42,000	1,876,000
Freerider proportion	6% - 23%	approx. 12%	60% - 80%
Total program savings			
-MW	1.2	1.9	2.4
-GWh	5.4	5.9	9.0
Avg. annual savings/customer			
-kW	2.8	2.4	1.2
-kWh	12,644	7660	4554
Avg. % kWh saving/customer	2.6%	13%	0.2%
Program cost (to date, 1987 $)	$400,000	$2.2 million	$1.9 million
Cost/benefit ratio	.27	.61	.21 - .50***
Present worth $/kWh (1987 $)	$.009	$.023	$.007-.017***

* Based on data on participants for program's first nine months.

** Based on recent trends, at the end of one year the participation rate is expected to top 4%.

*** The low end of the range is for predicted future program performance, the high end of the range is based on actual performance during the program start-up period.

contribution of each of these program features towards the high participation rate.

Published figures on participation rates in customer-based rebate programs offered by other utilities are generally not available. However, an informal survey of staff associated with programs offered by five other utilities indicates that the participation rate in the NEES customer-based rebate program is near the midpoint of participation rates for other programs of this type. Three other utility programs (those offered by Northeast Utilities, Boston Edison and Central Maine Power) had lower participation rates (typically 1% of eligible customers participating each year) while two utility programs (Pacific Gas and Electric and Wisconsin Electric) had higher participation rates (approximately 4% of eligible customers participating each year).[1] While a detailed analysis of these other programs was not undertaken for this paper, it appears that the higher participation rates were achieved by programs which were heavily marketed and which combined rebates for efficient lighting equipment with rebates for other energy saving measures.

The participation rate in the dealer-based rebate program has been growing steadily. After 5-1/2 months of operation, 1.4% of eligible customers had participated. After 9 months, participation had grown to 2.8% of eligible customers. Based on recent trends, it is likely that the participation rate after 12 months will top 4%. It is too early to determine the ultimate participation rate of the dealer-based program. However, the dealer-based approach is already achieving higher participation levels than the customer-based rebate approach.

The three programs also differed dramatically in average size of participating customers (as measured by annual electricity use). The average annual electricity consumption for participating customers ranged from 42,000 kWh for the small C&I oriented one-stop-shop program to 1,876,000 kWh for the dealer-based rebate program. The customer-based rebate program fell in between these two extremes (494,000 kWh/year). In general, for all three programs, average annual electricity consumption of participating customers was higher than average annual electricity consumption of all eligible customers.

While the relatively low consumption of one-stop-shop program participants is to be expected given that it was targeted to small C&I customers, the high average consumption of participants in the dealer-based rebate program is somewhat surprising. Based on discussions with dealers and customers, we surmise that two things are happening: (1) faced with time and staff constraints, dealers tend to submit rebate requests for large orders but not for small orders, and (2) larger customers are more likely to purchase energy-efficient lighting products than small customers.

FREE RIDERS

"Free riders" are program participants who would have purchased efficient products anyway, even if a utility incentive program were not offered. Free

riders contribute to program costs but do not provide any benefits to the utility. Participants in all three programs were surveyed in order to estimate the proportion of participants who are free riders. To guard against biases that are inherent in self-reports of behavior, the surveys contained several questions that directly and indirectly approached the free rider issue. For example a direct question might ask, "Would you have purchased this product if the rebate were not available?" An indirect series of questions would ask about previous and recent purchase decisions and explore reasons for changes in purchase behavior. By combining estimates of free riders made with these two approaches, a range of free riders for each program can be estimated. In addition to estimating free rider proportions using survey data, efforts are presently underway at NEES to estimate free riders using manufacturer sales data.

Results from the surveys undertaken indicate that the customer-based rebate program and the one-stop-shop program both had a low proportion of free riders. For both programs, free riders are estimated to represent between 10% and 20% of program participants. For the dealer-based rebate program, in the first six months, the proportion of free riders is estimated to represent between 60% and 80% of program participants. This high proportion of free riders was anticipated in the program planning process. During the program start-up period, many dealers are not yet "geared-up" to promote energy-efficient products. Instead, most of their rebate requests are for products they would have sold anyway, making free riders a large proportion of all rebates issued. As the program progresses and dealer promotion efforts increase, the proportion of free riders can be expected to decline. The ultimate level of free riders will vary from measure to measure, depending on general market acceptance of the product. Based on manufacturer and dealer sales data, we estimate that the proportion of free riders will ultimately drop to 45% for fluorescent lamps, and to lower levels for other products. We are closely monitoring free rider levels. In the event the free rider proportion does not decrease significantly, program modifications will be proposed.

DEMAND AND ENERGY SAVINGS

Demand savings for each program were estimated based on engineering data for the new equipment installed and the old equipment replaced. These estimates were adjusted to eliminate free riders from the savings estimates and to adjust for the fact that not all lights are on at the time of system peak (adjustment factors vary from product to product and are based on professional judgement, energy audit, and load research data). Energy savings were estimated based on demand savings and reported or estimated hours of operation of each participating customer. Efforts are now underway to directly estimate energy savings from customer billing data.

Savings estimates for each program are summarized in Table 1. For comparison purposes, the key figure is average percent saving per customer because this figure adjusts for differences between programs in number of eligible customers and average customer size.

The one-stop-shop program had the highest percent savings per customer at 13%. Savings from the customer-based rebate program were substantially lower (2.6%), while savings from the dealer-based program were lower still (0.2%). The high savings from the one-stop-shop program is to be expected, given the comprehensive nature of the retrofits involved.

The low savings, to date, from the dealer-based program appear to be due to several factors. First, the dealer-based program primarily affects regular purchases -- customers are encouraged to upgrade their purchases to efficient products, but they are not generally encouraged to purchase additional products. As the program progresses and more existing products are replaced, savings per customer can be expected to increase. Second, large customers who are heavily represented in the pool of dealer-based program participants use a lower proportion of their total electricity for lighting than smaller customers,[2] leaving less opportunities for high percent savings from lilghting measures. Third, percent savings for this program were estimated from aggregate data on energy use and savings for all participating customers. Since very large customers are disproportionately represented in the pool of participants, average energy use of participating customers is biased upwards, and, as a result, the percent savings estimate is biased downward (disaggregated data needed to correct this bias are not presently available). Fourth, the high proportion of free riders reduces average savings per participating customer and hence percent savings per participating customer. A key issue for the success of the dealer-based program is the degree to which savings per participating customer increases as the program progresses.

PROGRAM OPERATIONS

Each of the three programs have entailed different operational approaches. In general, the one-stop-shop program was the most difficult to administer while the customer-based rebate program was the easiest.

The customer-based rebate program was relatively simple to operate and operations generally proceeded smoothly. Energy audits were handled as part of the utility's existing commercial and industrial energy audit program. Administration of rebate requests was handled by a program manager who checked and processed rebate applications. Verifications were done by utility field representatives. The only significant problems encountered were customer confusion with the rebate application package, initial delays meeting demand for energy audits, and customers applying for rebates who did not receive an audit prior to the purchase of efficient lighting equipment.

The one-stop-shop program required coordination of marketing, energy auditing, preparing work orders, purchasing materials, installing measures, inspecting completed jobs, and issuing payments. Due to the quantity of work involved, work was divided between utility staff and two outside contractors. Utility staff marketed the program, conducted energy audits, and prepared work orders in select areas. The utility also arranged for bulk-purchase of materials and payment of all bills. One contractor was

responsible for marketing, energy audits and work orders in the remaining areas. Another contractor was responsible for measure installation in all areas. This contractor coordinated all work orders and hired local electrical contractors to conduct actual installations. Given the complexity of this process close coordination among the different parties and a computer tracking system were essential. In general this coordination and tracking went well -- the installation contractor and the lighting material supplier were particularly well organized and managed. Organization of the energy audit function was not as good -- there were initial delays delivering energy audits, and tracking of audit recipients, while adequate, could have been better. In addition, the audit devoted extensive time to non-lighting measures. Future programs of this type should consider substituting a simple walk-thru lighting audit for the full-scale energy audit.

The dealer-based rebate program has proven simple to administer in some ways and more difficult in other ways. Under this program the utility works closely with the dealer and has only limited contact with purchasers of lighting equipment. The dealer promotes efficient products to their customers. The utility's role is encouraging dealers to actively participate in the program, processing rebate applications, and spot-checking installations submitted for rebate requests. A secondary role for the utility is promoting efficient lighting products to customers. Marketing of the program is eased by the fact that there are only a limited number of dealers in NEES service territory (approximately 180) but because the dealers respond primarily to personal contact, repeated personal visits to each dealer are necessary. Dealers have their own concerns and agendas, making it difficult in some cases to enlist their participation. While the majority of dealers in our service territory are now participating in the program, many dealers only intermittently participate (participation varies depending on dealer work load, the size of the order and the particular salesperson taking the order) and a few dealers are actively opposed to the program, saying it disrupts their operations. The number of participating dealers and the number of rebate requests submitted by each dealer continues to grow each month. Payment of rebate requests has gone quickly and smoothly -- an important ingredient for maintaining dealer interest and participation.

CUSTOMER AND DEALER SATISFACTION

Customer and dealer satisfaction with the three programs was assessed with surveys. For the one-stop-shop program, 92% of participants indicated they were either very satisfied or somewhat satisfied with the program. This is a very high satisfaction rating; generally a combined "very satisfied" and "somewhat satisfied" rating above 80% is considered very good.[3] The only significant dissatisfaction expressed by customers was confusion and conern that the program would not replace lights with inadequate operating hours to pass the program's cost-effectiveness test. To improve customer relations, future programs of this type may either want to loosen the cost-effectiveness criteria so most customers can participate and/or allow customers to supplement utility payments for measures which just miss the cost-effectiveness target.

For the customer-based rebate program, customer satisfaction was measured with open-ended questions. Of the customer's surveyed, over 80% made positive statements about the program while only 25% made negative comments. Dissatisfaction was primarily linked to program restrictions such as ineligible products and the maximum rebate amount of $3000 per customer.

For the dealer-based rebate program, customer satisfaction has yet to be fully assessed. A survey of dealers indicated that 87% are either very satisfied or somewhat satisfied with the program. Dissatisfaction is primarily related to program administrative requirements.

COST AND BENEFITS

As part of all program evaluations, NEES analyzes the costs and benefits of each program using an in-house "least-cost model". This model analyzes the present worth of each program's costs and benefits, where benefits are valued at NEES' avoided marginal energy and capacity costs. Outputs from the model for each program include cost-benefit ratio and cost/kWh saved over the life of the program. Assumptions inherent in the model are numerous and will not be elaborated on in this paper.[4] All programs were evaluated using the same assumptions, allowing relative comparisons between programs to be made.

Cost-benefit ratios obtained from this model for the three programs are summarized in Table 1. The cost-benefit ratio for the customer-based rebate program is estimated to be .27 (benefits are over three times greater than costs) and the cost-benefit ratio for the one-stop-shop program is estimated to be .61. Costs/kWh are estimated to be 0.9¢ and 2.3¢ respectively (both are in 1987 dollars), reflecting only utility and not customer costs.

For the dealer-based rebate program, two scenarios were run projecting program costs and benefits for the five year scheduled life of the program. The first scenario assumed that projected program participation rates and free rider proportions will be achieved. These projections estimate that by the third year of the program, monthly participation rates will be approximately double participation rates achieved in early 1988 and that the proportion of free riders will decline by approximately 40% compared to the survey responses reported previously. The second scenario assumed participation rates and free rider proportions roughly similar to program results in early 1988. For scenario one, the cost-benefit ratio is .21 and the cost/kWh 0.7¢ (1987 dollars). For scenario two, the cost-benefit ratio is .50 and the cost/kWh 1.7¢ (1987 dollars).

OTHER FINDINGS

Evaluations of these three programs have produced a number of other findings. Among the most important are the following:

* Telemarketing and door to door canvassing were the most useful methods for promoting the one-stop-shop program. Response to mailings, despite the offer of free services, was disappointingly low.

* Many lighting dealers will change their sales habits in response to a dealer-based rebate program. Surveys of dealers and customers indicate that dealers are increasing efforts to promote energy-efficient lighting products including one-on-one education with customers and salesperson bonuses. 79% of dealers report that they pass on a proportion of the rebate to customers. On average, these dealers report that they pass on approximately 80% of the rebate.

CONCLUSIONS

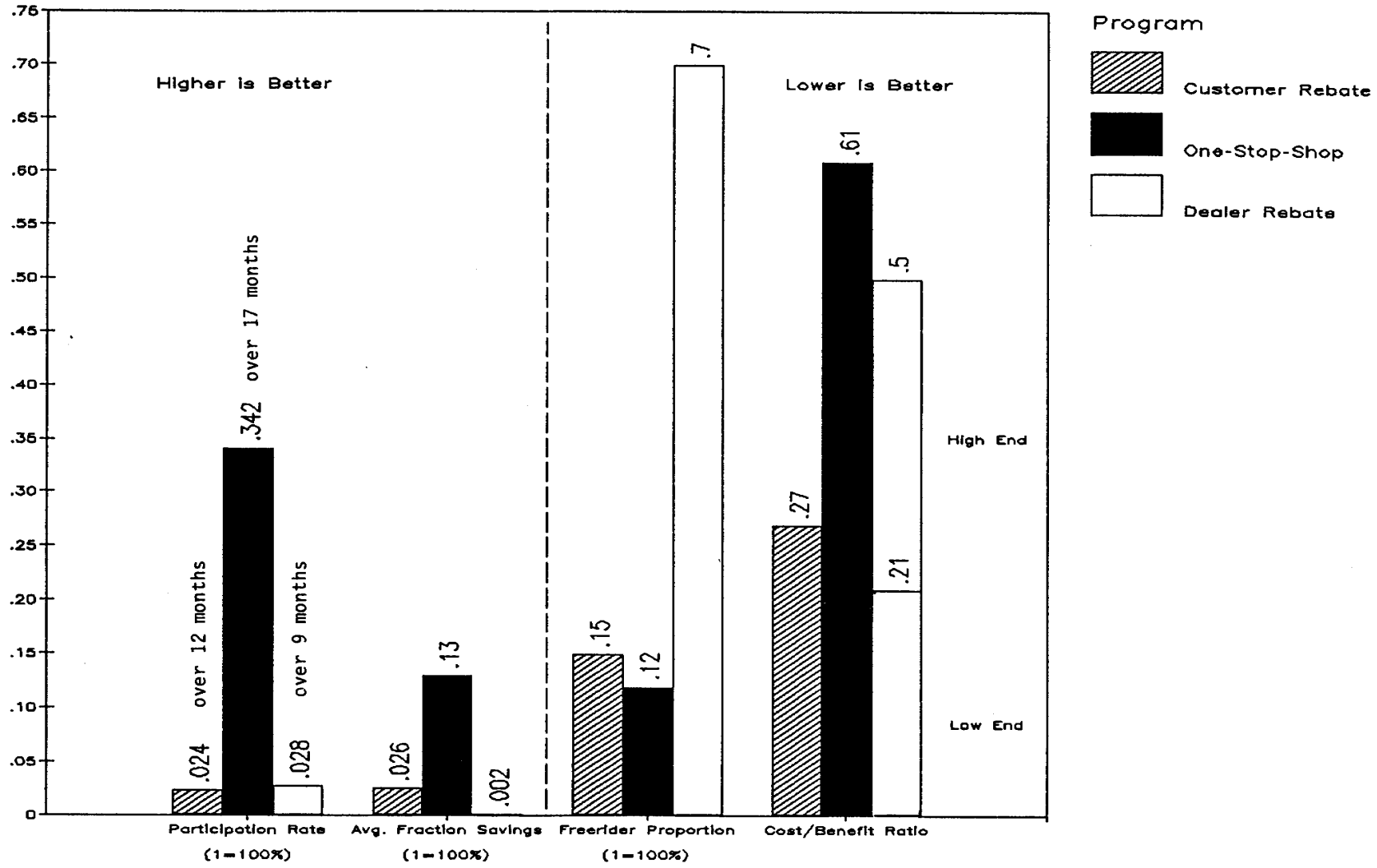
All three programs save energy, reduce peak demand, satisfy customers and/or dealers, and are cost-effective (cost-benefit ratio less than one). A comparison of key statistics for the three programs is contained in Figure 1.

The customer-based rebate program is the easiest to run of the three, has a low proportion of free riders and has a very good cost-benefit ratio. However, its participation rate was not as good as the other programs, and its percent savings per participating customer were small. While it is unclear what the participation rate would have been if the program were promoted more heavily, based on the experience of other utilities, it appears that low participation rates are often characteristic of this type of program. Based on our experience, this program approach appears to be well suited for utilities who are primarily concerned with program simplicity and cost-effectiveness and are not as concerned with achieving high participation rates or energy and demand savings.

The one-stop-shop program achieved noteworthy participation and percent savings per customer. This program had a low proportion of free riders and was cost-effective although its cost-benefit ratio was approximately double that of the customer-based rebate program. It was the most complex of the three to administer. Based on our experience, this program approach appears to be well suited for utilities who are primarily concerned with high participation rates and energy and demand savings and are willing to pay more, and do more work,
than is required for a customer-based rebate program.

The dealer-based rebate program is still in its start-up phase; it is too early for conclusions to be drawn. Based on experience to date, this program appears to result in higher participation rates than the customer-based rebate program, although probably not as high as the one-stop-shop program. The program has the highest free rider proportion of the three programs. While data on customer satisfaction is not available. it appears that this program approach, because of its emphasis on dealers, may engender less customer good-will than the other two aproaches. The program appears to be cost-effective, although, depending on future participation rates and free rider proportions, it may be the most cost-effective of the three programs or it may have a cost-benefit ratio approaching that of the one-stop-shop program. It will be at least another year before these questions can be answered.

Figure 1. Summary statistics on 3 NEES lighting programs.



All three programs can be improved. The customer-based rebate program would benefit from increased attention to program marketing. The list of eligible measures could be expanded, application forms and procedures simplified and the maximum rebate amount increased. The one-stop-shop program would benefit from increased attention to coordination among the different contractors and to tracking individual customers. The energy audit should be limited to a walk-through analysis focused on lighting. Additional lighting measures, such as fluorescent reflectors and lighting controls could be added to the program and cost-effectiveness requirements relaxed somewhat so more customers can participate. It is premature to recommend changes to the dealer-based program. Monitoring of participation rates, free rider proportion, and average savings per customer will determine what changes are needed. Based on experience thus far, it appears that continued attention must be devoted to working with dealers while additional attention should be devoted to working with customers. Only through a combination of utility and customer pressure will the dealers fully respond.

REFERENCES

1. Participation rates were calculated by the author for each program based on participation and total eligible customer numbers supplied by staff at each utility. Contact people for this data were as follows: Hank Werksema, Northeast Utilities, Hartford, CT; Linda Ecker, Central Maine Power, Augusta, ME; Ellyn Eder, Boston Edison, Boston, MA; Robin Calhoun, Pacific Gas and Electric, San Francisco, CA; William Kobs, Wisconsin Electric, Milwaukee, WI.

2. Based on unpublished energy audit data on participating customers in NEES customer-based lighting rebate program.

3. Piotroski, Susan, 1988, Decision Research Corp., Lexington, MA, personal communication.

4. For an explanation, see Hicks, Elizabeth, 1988, "Using the New England Electric System Least Cost Planning Model for Planning & Evaluating Conservation & Load Management Programs", published in the Proceedings of the ACEEE 1988 Summer Study on Energy Efficiency in Buildings (Washington, D.C.: American Council for an Energy-Efficient Economy).

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