PROCESS AND IMPACT EVALUATIONS OF A
SMALL COMMERCIAL LIGHTING PROGRAM

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Introduction

In 1994, Seattle City Light's Energy Management Services Division developed plans for implementing a lighting retrofit program to save electrical energy in small businesses. Customers were eligible for the program if they were on City Light's rate structure for small commercial buildings, and were located in the Fremont area of Seattle. This area, which lies near the Ship Canal in the north-central part of Seattle, had approximately 350 businesses that could participate under the program criteria.

The $mart Business Pilot Program ($BPP) offered financial incentives to Fremont businesses for installing lighting conservation measures in their facilities. Several types of measures were installed, including: T-8 luminaries with electronic ballasts; compact fluorescent luminaries; high pressure sodium fixtures; and metal halide fixtures. Eighty percent of the installed measure costs were paid for by Seattle City Light, with the remaining 20 percent of the costs being borne by the customers. Financing of the measures was dependent on the levelized costs for each measure category being below 64 mills.

The $BPP was operated through an experienced energy conservation contractor, The Demand Management Company (DMC). Under their contract with Seattle City Light, DMC was authorized to perform administrative functions for the program; solicit the participation of small Fremont businesses; conduct energy audits; install energy efficient lighting measures; keep program records; and write a final report. DMC subcontracted a small portion of the lighting audits and all of the lighting measure installations.

The overall goal of the process and impact evaluations was to inform the choices for any future small business direct install programs at Seattle City Light. In the process evaluation, surveys were conducted to determine customer knowledge of and satisfaction with the program, satisfaction with the lighting measures, barriers and motivators to program participation, free ridership, and program strengths and weaknesses. The surveys were conducted with three groups of customers, including those who had energy conservation measures installed through the program, had a building lighting audit but declined to have measures installed, or were nonparticipants.

The impact evaluation had two purposes. The first purpose was to assess the energy savings for the 137 program participants. This assessment was done by obtaining conservation measure operating hours from lighting loggers installed in a sample of 40 buildings, using these hours to revise the projected energy savings for the sample, and then extending the savings to the population of $mart Business buildings. Levelized cost and net present value analyses were then performed from four economic perspectives to determine the cost-effectiveness of the savings. The perspectives were the Pacific Northwest region, Seattle City Light service area, City Light as a business, and program participants.

Interviews with Program Participants and Nonparticipants

Method

Trained, professional interviewers telephoned businesses targeted by the $mart Business program and asked them to participate in the survey. DMC's program database provided lists for three separate customer groups: full participants - businesses which had completed the program, audit only participants - businesses which dropped out after receiving an audit, and nonparticipants - businesses which were solicited but which did not choose to have an audit. The number of interviews completed in the three groups were: full participants (87 interviews), audit participants (52), and nonparticipants (30). Except for nonparticipants, the number of interviews completed was consistent with pre-survey expectations. Nonparticipants, however, proved to be especially difficult and time consuming to reach, and had a fairly high refusal rate as well; given these problems, interviews were completed with 30 nonparticipants, although 18 other nonparticipants were willing to provide the reason(s) why they did not participate in $mart Business.

Results

Initial Response to $mart Business. All respondents were asked questions about their initial understanding and interest in $mart Business. When asked to describe the services of $mart Business, the full, audit, and nonparticipants recalled the program somewhat differently. Full and audit participants had a much fuller understanding of the program than nonparticipants, with both participant groups reporting the program's focus as installation of energy efficient lighting. Full participants were more likely to see the program in terms of financial and new lighting services, while more audit participants saw the free audit as the

primary program service. Nonparticipants tended to have a much vaguer understanding of the program, with most of them knowing only that $mart Business had "something to do with lighting."

All respondents were asked, "When you first found out about $mart Business, how interested were you in participating?" Table 1 indicates that, even from the start, full participants (69%) were the most interested in participating. Notably, 24% of audit participants and 43% of nonparticipants stated that they were already disinterested in participating in $mart Business at this early stage.

Participants' Response to Program Elements. This section covers the reasons for full and audit participants having their business audited, the reasons for audit participants dropping out of the program following the audit, and the degree of satisfaction with the lighting audit, measure installation, and the installed lighting for both audit and full participants.

Full and audit participants were asked "What convinced you to take the next step and have your business audited?" Notable differences in motivations appeared between these two groups. As Table 2 shows, full participants were primarily motivated by financial factors and, secondarily, by the need for new lighting; they were much less interested in the free audit than audit participants. Audit participants were less likely to be motivated by financial factors, even though this was the single largest category, with an almost equal proportion being motivated by the offer of a free audit; they appear not to be as motivated by a need for new lighting.

Audit participants were also asked to explain their reasons for dropping out of the $mart Business program. Responses show that many of the most important reasons for audit participants dropping out of $mart Business were not directly related to factors under control of the program. These included: not being responsible for the electric bill, business moving/being sold, and savings not significant enough.

The most important programmatic barriers to participation included: poor follow through by $mart Business staff, discrepancy in audit, and program information inadequate or unclear. The other main barriers to participation were either programmatic or personal, depending on each individual situation. These included: special lighting needs, couldn't afford upfront costs or customer share, didn't meet program requirements or deadline, just not interested, and too complicated/too much trouble.

Full and audit participants were asked a number of questions to gauge their satisfaction with their lighting audit. Table 3 shows that the majority of full and audit participants were satisfied with their audit. However, a significant percentage of full participants and some audit participants were dissatisfied with their audit. Participants who were dissatisfied with the audit indicated that the contractor's work was somewhat disorganized or inaccurate (e.g., audits had to be re-done).

Full participants were asked several questions about their satisfaction with the new lighting and its installation. As Table 3 shows, when asked to rate their overall satisfaction with the installation, the majority of full participants rated themselves satisfied, while a small minority (15%) were dissatisfied. When asked to explain their ratings, some respondents noted that the installation went well or praised the installers for being responsive if problems occurred. Still, even though most of full participants rated themselves satisfied, many had complaints about the installation process (e.g., scheduling problems, installation mistakes, and billing problems).

As Table 3 shows, when full participants were asked "How satisfied are you with your new lighting?", 89% were satisfied and 11% were dissatisfied. When asked to explain their ratings, respondents who gave positive ratings most often simply said that their new lighting was equivalent to or better than their old lighting. Some specifically noted that the lighting level was better than before, or that it upgraded the building. Respondents who were dissatisfied with their new lighting most often complained that it was too dim for their business or safety needs. Lighting problems which were less frequently mentioned were: poor color, buzzing, and long warm-up time.

Nonparticipants' Response to Program. The 21 nonparticipants who had heard of $mart Business were asked "What is the single most important reason why you decided not to participate in the program?" The interviewers also spoke briefly with 18 more nonparticipants who refused the survey, but explained their main reason for not participating in the program. Nonparticipants had many different reasons for not participating, most of which were unrelated to the program. Examples of these reasons included: moving or selling the business, having minimal lighting needs or low electric bill, being too busy, and already having energy efficient lighting.

Table 1
Initial Interest in the $mart Business Program

	Full Participants	Audit Participants	Non-Participants
Very Interested	69%	24%	24%
Interested	22	50	14
Disinterested	9	22	24
Very Disinterested	-	2	19
Don't know / No answer	-	2	19

Table 2
Reasons for Auditing Business

	Full Participants	Audit Participants
Savings / payback / rebate	91%	44%
Free audit	9	36
Need for new lighting	23	6
Energy savings / conservation ethic	16	18
Encouraged by landlord or business associate / canvasser's visit	3	14
Other	24	22

Table 3
Degree of Satisfaction with Program Services
for Full and Audit Participants

	Lighting Audit	Lighting Installation	New Lighting
Very Satisfied	23%	55%	68%
Satisfied	61	30	21
Dissatisfied	10	13	9
Very Dissatisfied	1	2	2
Don't know / No answer	5	-	-

Impact Evaluation

Method

Energy Savings. One purpose of the impact evaluation was to assess the energy savings for 137 program participants. This assessment was done by obtaining conservation measure operating hours from lighting loggers installed in a stratified sample of 40 buildings, using these hours to revise the projected energy savings for the sample, and then extending the savings to the population of program participants. The stratified sample consisted of three strata--small, medium, and large--chosen on the basis of the projected energy savings for the buildings. Projected energy savings in the smallest strata was less than 5,000 annual kilowatt-hours, with the projected energy savings being 5,000 to 20,000 annual kilowatt-hours in the medium strata and greater than 20,000 kilowatt-hours in the largest strata. A Neyman allocation procedure was used to produce an optimum sampling fraction for each of the stratum. The number of participants in each strata was: small (8), medium (13), and large (19).

To obtain the operating hours for each building, 107 lighting loggers were installed in the 40 buildings for a three to four week period. With these new operating hours, the savings for each building were then calculated using the hours and the wattage difference between the original lighting and the lighting installed through the $mart Business Program. The new savings were then aggregated to the group level for the three sample groups and compared to the projected energy savings from the original building audit. Ratio estimators were then calculated on the relationship between the projected and evaluation savings for the sample buildings, and the ratios were used to extend the savings from the sample to the population of 137 buildings.

Cost-effectiveness. Two types of cost-effectiveness analyses, levelized cost and net present value, were performed for the $mart Business Pilot Program. Both of these analyses were performed from the perspectives of four stakeholders in the program: Pacific Northwest region, Seattle City Light service area, City Light as a business, and program participants. The regional cost-effectiveness test considers the direct program level costs and benefits to all participants, including the Bonneville Power Administration, Seattle City Light, and the participating $mart Business Program customers. The service area test considers the net program costs and benefits to both City Light and program participants and nonparticipants within the service area. The utility cost test considers direct program implementation and administrative costs and program benefits to City Light. It also considers City Light's lost revenue from lower electricity sales to customers who install conservation measures. The participant test includes all customer contributions to the measure costs and benefits to customers from reduced electricity bills.

The levelized cost analysis approach distributes the appropriate program implementation costs over the life of the program's lighting measures, and is presented in constant year cents per kilowatt-hour saved over the life of the program. The net present value analysis includes the net present value of program benefits over the expected life of the program's savings and a program benefit/cost ratio for each of the four stakeholder perspectives.

Results

Sample and Program Level Energy Savings. The sample population's annual energy savings for each of the small, medium, and large savings groups are shown in Ta-

ble 4. As shown in the table, the savings for the three groups are 91.9%, 94.2%, and 100.7% of the audit savings estimate. Overall, across the monitored sample population of 40 participants, the savings were 97.3% of the audit savings.

The ratios of the sample savings to the audit savings for each group were then used to extend the sample savings to the population of $mart Business buildings. The population savings for each of the groups are shown in Table 4. This table also shows that the total program savings is 1.57 million kWh per year (or approximately 179.3 kW_{avg}),. These savings represent a realization rate of 97%, based upon the original projected energy savings from the buildings audit.

Net Present Value. The results of the net present value analysis from the four perspectives are shown in Table 5. From a regional perspective, there was a significant negative net present value of $251,183 and the program benefit-to-cost ratio is a negative 0.56. In many ways, this is the most important test as it includes the costs and benefits from the perspective of the entire program.

For the City Light service area test, which include $426,359 in BPA reimbursements to SCL and customer contributions of $85,146, the benefit-to-cost ratio improves to 2.2 while the present value of net program benefits improves to $175,177. Therefore, the program as implemented in its pilot phase can be considered successful from the joint perspective of SCL and its customers on a purely economic basis.

For the City Light as a business test, the costs are not only SCL's net program administrative and implementation costs of $61,857, but also include, as a subtrac-

tion on the benefit side, the lost revenue from customers using less electricity. Given the magnitude of the benefits from the program energy savings and the substantial impact of lost revenue on the cost-effectiveness results, the net present value is a minus $262,868. The benefit-to-cost ratio is also a negative number, minus 3.3.

The final net present value test, the participant perspective, includes the participant's direct program costs and bill savings benefits over the life of the conservation measures. The bill impacts are based on City Light's recent *Small General Service* rate forecast of retail prices through 2002. The participant electric bill impacts were discounted at a 20% discount rate and, as shown in Table 5, the benefit-to-cost ratio is 3.8. The net program benefits for all customers in the program at this level is estimated at $234,358. This represents an average net benefit of $1,710 per customer, while the average investment was $621 per customer.

Levelized Cost. The results of the levelized cost analysis are summarized in Table 5. As shown in the table, the program's levelized cost from the regional level was 54 mills. Consistent with the prior NPV analyses, the levelized-cost results for the service area and participant tests are low, ranging from 8.0 to 14.4 mills per kWh. In contrast, the levelized cost results for SCL as a business are much lower, 5.8 mills, than for the NPV analysis. This difference in the results of the two tests for the utility perspective is primarily due to the levelized cost test not including the lost revenue experienced by City Light from customers installing conservation measures in their businesses.

Table 4
Sample and Population Kilowatt-Hour Energy Savings by Group

| Group | Sample | | Population | | |
	Audit	Evaluation	Audit	Evaluation	Realization Rate
Small	14,119	12,981	138,212	127,069	91.9%
Medium	144,607	136,291	670,410	631,859	94.2%
Large	476,619	480,183	805,335	811,358	100.7%
Total	635,345	629,455	1,613,957	1,570,287	97.3%

Table 5
Net Present Values and Levelized Costs
from Four Economic Perspectives

Perspective	Net Present Value	Benefit/Cost Ratio	Levelized Cost
Regional	-$251,183	- 0.56	$ .054
Service Area	$175,177	2.19	$ .014
Utility	-$262,868	- 3.25	$ .006
Participant	$234,358	3.76	$ .014

Discussion

On the basis of the findings from the process and impact evaluations, six recommendations were made for program planners and operators to both improve and inform the choices for future small commercial direct install programs at Seattle City Light. These recommendations are given below, along with a brief discussion of the reasons for the recommendation. The presentation of the recommendations highlights significant issues with the $mart Business Pilot Program and suggestions on future program directions.

Recommendations

Implement a direct install lighting program for small commercial customers in 1997. The $mart Business Pilot Program has been a pilot program during its first two years, 1995 and 1996. On the basis of the positive findings in the initial pilot effort, it was recommended that City Light implement a direct install lighting program for small commercial customers in 1997. These positive findings include: (1) 39% of the Fremont businesses participated in the pilot program (Honeywell DMC, 1996); (2) energy savings were 97% of the projected savings for the lighting measures; and (3) with some exceptions, participants were generally satisfied with both program services and the financial incentive offered to them.

Redesign the small commercial lighting program to improve program cost-effectiveness. In the evaluation, it was found that the $mart Business Pilot Program was very cost-effective from the standpoint of the City Light service area, City Light as a business, and the participating customer. Higher levelized costs, 54 mills, were found for the program from the regional perspective. Nevertheless, this regional levelized cost was consistent with the planning estimate of 50 to 60 mills (King and Dethman, 1994).

The regional levelized cost target for the $mart Business Pilot Program was radically lowered in 1996.

The cost target for this year, 30 to 40 mills, could only be met through substantial program redesign. This redesign, which City Light did as the current evaluation was being completed, was implemented in a second pilot program during 1996. In the redesigned program, City Light's conservation division did the program marketing, lighting audits, and measure inspections. Contractors continued to install the lighting measures in participants' buildings. Program cost-effectiveness was improved by offering the program only to businesses which had high lighting operating hours and electrical usage in their building. Screening was done so that measure financing could only occur if the measure passed a 50 mill cost screen.

Implement a checklist of questions for deciding which customers should be offered full installation services through a small commercial lighting program. In the evaluation, it was found that full and audit participants differed significantly in both their initial interest in the $mart Business program and in the motivational reasons behind their program interest. Full participants, who had lighting measures installed in their buildings, were more motivated than audit participants by the City Light rebate, the money saved through conserved energy, and the prospect of having new lighting installed in their buildings. Given these differences between those who had an audit and those who actually had conservation measures installed, it was recommended to program operators that a list of questions be developed to screen participants on their interest in the program and the likelihood of participating. For example, customers could be asked how interested they were in having new lighting installed in their business. They could also be asked if they were planning to move or sell their business in the next year.

Improve customer satisfaction with the program by developing high quality services in each program component--lighting audits, audit sales presentation, lighting measure installation, inspections, and administrative procedures. Although most of the program participants were satisfied with program services, a consistent minority, usually about 15% to 20%, were dissatisfied with these services. This dissatisfaction was most evident with the lighting audit and measure installation. Given these problems in customer service, it was recommended that City Light both study ways to improve these services and take steps to enhance them. A few of the ways in which the services could be improved are listed here. One possibility would be to have City Light fund training for auditors on the best ways to conduct lighting audits and techniques for selling lighting jobs. Other possibilities include hiring only the most qualified installers to install program funded measures, and having the program administered in-house by City Light staff.

Continue to offer full program services to the very smallest commercial customers. One implication of the evaluation findings is that future lighting programs should serve customers at all levels of kilowatt-hour usage. In the impact evaluation, energy savings for 40 sample buildings

were evaluated separately within three projected savings groups and then aggregated across the groups to produce an average savings for the sample. Similar savings were found for the three groups when the savings are expressed as a percentage of the projected savings.

In their report on the $mart Business Pilot Program, DMC compared the energy savings and levelized measure cost for the smallest program participants, defined as using less than 25,000 kilowatt-hours in a year, with all program participants (Honeywell DMC, 1996). Not surprisingly, this comparison revealed that small participants saved less than all program participants. Less obvious, however, was the finding that the levelized cost for the conservation measures were similar in the two groups. In other words, energy savings for small customers' lighting measures were just as cost-effective as the savings for the larger customers.

Consider offering nonlighting measures to small commercial businesses. This recommendation was based on the small commercial program design used at other utilities and the responses of $mart Business participants to a survey question on the conservation potential in their buildings. King and Dethman (1994) reviewed 17 direct install programs for small commercial customers at utilities throughout the United States. Slightly more than half of the utilities had nonlighting measures in their programs. Several programs offered a variety of heating, ventilating, and air conditioning measures, and four of them had water conservation measures.

In the survey (Coates et al., 1996), 52% of full participants and 60% of audit participants said "yes" to a question on whether there were any additional energy savings steps that could be taken in their businesses. Measures identified most often by both groups were for the heating, ventilating, and air conditioning system; windows; and building envelope insulation.

References

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