



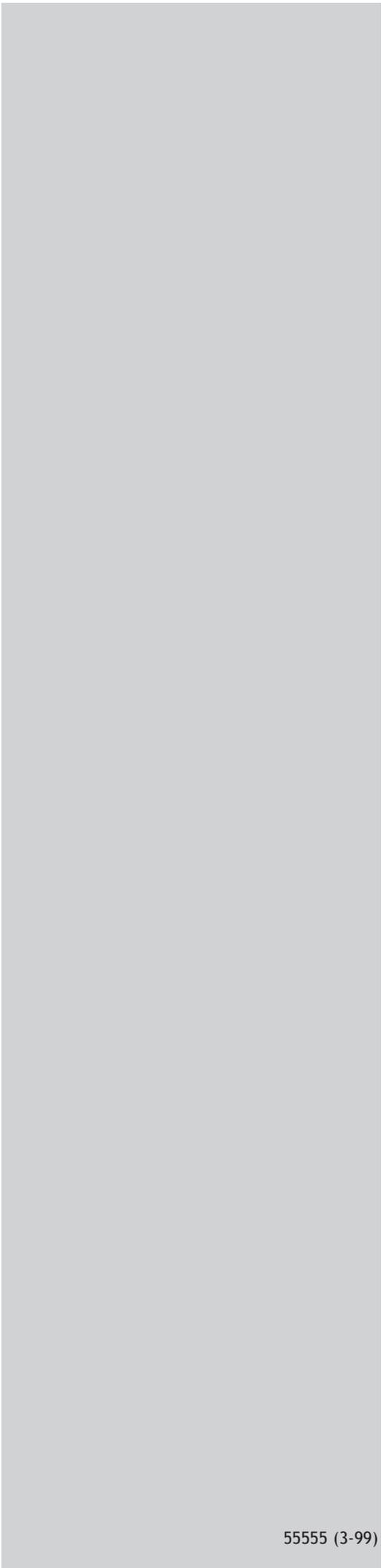
Cost-effectiveness of the Energy Smart Design Program

Evaluation Unit
Energy Management Services Division

March 1999



Seattle City Light



Seattle City Light

**Cost-effectiveness of the
Energy Smart Design Program**

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Seattle City Light

March, 1999

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Executive Summary

Seattle City Light's Energy Smart Design Program has provided financial incentives since 1991 to customers for installing energy conservation measures in commercial and industrial buildings. In one program option, Standard Incentives are available for installing lighting, motors, and HVAC measures in buildings. This option is similar to an Energy Rebate Option that was offered to customers during the years 1991-95. Customers can also participate in the Custom Incentives option for building envelope measures, energy management control systems, and other measures not funded in the Standard Incentives option. The Custom Incentive option is similar to the Site-based option that was available to customers during the 1991-95 period.

A study was conducted on the levelized costs for conservation measures installed through the Energy Smart Design Program during the years 1991-1997. The costs were analyzed by several program elements (e.g., type of measure) and four economic perspectives. The four perspectives were the Pacific Northwest region, the City Light service area, City Light as a business, and the customer. The program benefits were the projected energy savings for the measures, which were obtained from the program's tracking system. The measure life for the conservation measures was assumed to be 15 years. The costs of the conservation measures and City Light's incentives to the customers were gathered from the program tracking system. Bonneville Power Administration reimbursements to City Light for the incentives and administrative costs were obtained from program records.

For all program participants, low levelized costs were found from the service area (28 mills), utility (6 mills), and customer (35 mills) perspectives. These low levelized costs are primarily due to Bonneville Power Administration reimbursements to City Light for administrative costs and for customer incentives. A somewhat higher levelized cost, 43 mills, was found from the regional perspective, as this perspective includes both utility and customer costs for the conservation measures. This cost is substantially lower than the measure cost-effectiveness screen, 56 mills, used by Seattle City Light and the Bonneville Power Administration for the Custom Incentive and Site-based program options. The incentives paid to customers for conservation measures installed through the Standard Incentive and Energy Rebate program options were also designed to pass the cost-effectiveness screen, 56 mills. Thus, the ESD program is cost-effective when compared to the Bonneville Power Administration cost-effectiveness screen.

It was also found that there was variation in the levelized costs by the several program elements: conservation program, building type and status, conservation measure, and commercial sector. Lower than average levelized costs were found for participants in the Custom Incentive Program, industrial buildings, and three commercial sectors-- office, education, and utilities and communication. The levelized costs for each of these elements were at or below 3.4 mills per kilowatt-hour saved. These findings suggest that lower levelized costs for energy savings could be achieved by targeting these elements in future program activities.

Several program elements had substantially higher than average levelized costs. These elements include four types of conservation measures (building envelope, hot water, motors, and refrigeration) and three commercial sectors (retail nonfood, warehouse, and other). One implication of these findings is that considerable scrutiny should be given to the cost-effectiveness of future projects that include these sectors or measures.

Introduction

Program Description

Seattle City Light has operated the Energy Smart Design Program (ESD) in conjunction with the Bonneville Power Administration since 1988. In the first three years of the program, technical and financial assistance was provided to commercial building owners for designing energy efficient new and remodeled buildings. The building owners could install the conservation measures identified in these designs.

The Energy Smart Design Program was expanded in 1991 to include financial assistance for installing conservation measures in new, remodeled, and existing commercial buildings. In the first program option, Energy Rebate, fixed rebates were offered for the most common lighting, motor, and heating, ventilating, and air conditioning (HVAC) measures. Under the Site-based Incentive option, incentives were offered for conservation measures not on the rebate list.

The Energy Smart Design Program underwent additional changes in 1993, with two types of financial incentives offered to customers for installing conservation measures in their buildings. In the first option, Standard Incentives were available for lighting, motors, and HVAC measures. Customers could also participate in the Custom Incentive option for building envelope measures, energy management control systems, and other measures not funded in the Standard Incentives option.

Study Objectives

Electricity savings in the Energy Smart Design Program are the largest share of savings achieved to date for City Light's commercial and industrial customers. Through 1997, the Energy Smart Design savings are 57% of the total savings for these customers (Tachibana et al., 1998). Given the importance of these savings for conservation efforts at Seattle City Light, an earlier report (Coates, 1998) examined the relationship between the savings and several important elements of commercial conservation programs. These elements included program type, building type, building status (e.g., new), type of measure installed in the building, and commercial sector (e.g., office). The report also examined the extent to which the savings achieved through the Energy Smart Design Program had met the conservation goals for commercial buildings outlined in the 1992 **Conservation Implementation Plan** (Seattle City Light, 1992).

The present report expands upon the earlier report (Coates, 1998) by examining the relationship between the program elements (e.g., program type) and a second widely used measure of conservation program effectiveness. The second measure is levelized cost which relates the program delivery and administrative costs for the conservation measures to the electrical energy savings achieved with these costs. The levelized costs were done not only for each of the program elements described earlier, but also for each of four economic perspectives. These perspectives are the Pacific Northwest region, the City Light service area, City Light as a business, and the customer. A

description of how the levelized costs were calculated and the four economic perspectives is given in the next section.

Method

The cost-effectiveness test used for the Energy Smart Design Program was levelized program cost, which is the present value of program costs divided by the present value of the energy savings. The levelized costs were calculated from four economic perspectives: the Pacific Northwest region, City Light service area, City Light as a business, and customers who participated in the Energy Smart Design Program.

Program Benefits and Costs

For each of the economic perspectives (Table 1), the program benefits were the projected kilowatt-hour energy savings for Energy Smart Design participants. These savings were obtained from the Commercial/Industrial Management Tracking System, which is maintained in City Light's Energy Management Services Division. The measure life for the savings was assumed to be 15 years in the cost-effectiveness analysis. This measure life was used in an earlier evaluation of energy savings from conservation measures installed through the Energy Smart Design Program in 1991 and 1992 (Xenergy et al., 1996). In that evaluation, a weighted average measure life was calculated using the lifetime of each measure installed through the conservation program. The economic analysis also used a 3% real discount rate in discounting the energy savings to a present value. The 3% rate is the long-term discount rate used in economic analyses at Seattle City Light. The economic analysis from the customer perspective used a 10% discount rate.

All costs for the cost-effectiveness analysis were adjusted to 1997 dollars with the Consumer Price Index for the 1991-1997 period. Table 1 shows the method used in calculating the various costs for the analyses. From the regional perspective, the costs were the sum of the installation costs for the conservation measures and the administrative costs for Seattle City Light. Administrative costs for the Bonneville Power Administration were not available. From the City Light service area perspective, the costs were calculated by subtracting the Bonneville Power Administration incentive and administrative reimbursements to City Light from the total of the measure installation costs and the utility administrative costs. This service area calculation was also used for the City Light as a business perspective, except that the conservation measure costs for the customers were excluded from the calculation. In the fourth economic perspective, the costs were the customers' share of the measure costs.

**Table 1.
Benefits and Costs for the Levelized Cost Analysis**

| Perspective | Benefits | Costs |
|---------------------------------|---|--|
| Regional | Projected energy savings for program participants | Conservation measures and City Light's administrative costs |
| Seattle City Light service area | Projected energy savings for program participants | Conservation measures and City Light's administrative costs minus Bonneville Power Administration reimbursements |
| Seattle City Light | Projected energy savings for program participants | Incentive payments to customers and City Light's administrative costs minus Bonneville Power Administration reimbursements |
| Customers | Projected energy savings for program participants | Customers' share of the cost of conservation measures |

The costs used in the cost-effectiveness analyses were obtained from two sources. The costs of the conservation measures and City Light's incentive payments to customers were obtained from the Commercial/Industrial Management Tracking System. The Evaluation Unit's Accomplishments report (Tachibana et al., 1998) was the source of the Bonneville Power Administration reimbursements to City Light for measure incentives and for administrative costs. This report was also the source of information on City Light's administrative costs.

Results

Table 2 shows the Energy Smart Design Program energy savings and the associated administrative and program delivery costs during the years 1991 through 1997. In this table, the savings and costs are unadjusted; that is, they have not been adjusted to present values as was done in the cost-effectiveness analysis. As shown in the table, the energy savings for all Energy Smart Design projects during the 1991-1997 period total 230,168,739 kilowatt-hours. These savings, which result from installing the conservation measures in the buildings, cost \$90,593,578 for the measures and \$11,897,657 for City Light's administrative costs.

Table 2.
Costs and Energy Savings
for the Energy Smart Design Program

| City Light Incentive Payments¹ | BPA Payments to City Light | Customer Measure Costs | City Light Administrative Costs | Measure Installation Costs | Energy Savings (kWh) |
|--|-----------------------------------|-------------------------------|--|-----------------------------------|-----------------------------|
| \$42,822,695 | \$43,428,776 | \$47,770,883 | \$11,897,657 | \$90,593,578 | 230,168,739 |

Type of Program

Table 3 displays the levelized cost for the Energy Smart Design Program and each of its component programs by the four economic perspectives. As shown in the table, the total levelized regional cost was 43 mills per kilowatt-hour. Because of Bonneville Power Administration's reimbursements to City Light for incentive payments, this cost is higher than the levelized cost for the other three economic perspectives. The levelized costs for the customer and service area perspectives were similar, at 28 and 35 mills per kilowatt-hour respectively. The levelized cost from the utility perspective was quite low, 6 mills per kilowatt-hour.

Table 3 also shows that there was variation in the levelized cost among the components of the Energy Smart Design Program. Generally, across the four economic perspectives, levelized costs were higher for the Energy Rebate and Standard Incentive program components than for the Custom Incentive component. The regional levelized costs for the Energy Rebate and Standard Incentive program components were similar at about 50 mills per kilowatt-hour. For the Custom Incentive component, the regional levelized cost was 33 mills per kilowatt-hour. Levelized costs for the Commissioning Service were very low, but should be used with considerable caution, as there were only two commissioning projects during the 1991-97 period.

¹ All costs in Table 2 are in 1997 dollars.

**Table 3.
Levelized Program Costs (mills/kWh) by
Conservation Program and Economic Perspective**

| Program² | Regional | Service Area | Utility | Customer |
|----------------------------|-----------------|---------------------|----------------|-----------------|
| Commissioning | 5 | NA | 2 | NA |
| Rebate Option | 52 | 36 | 6 | 47 |
| Custom Incentive | 33 | 12 | 8 | 7 |
| Standard Incentive | 47 | 37 | 4 | 52 |
| Total | 43 | 28 | 6 | 35 |

Building Type and Status

Table 4 gives the levelized costs by building type and the economic perspectives. Given that most of the projects are in commercial buildings, the levelized costs for these buildings are similar to those for all buildings in the Energy Smart Design Program. For industrial buildings, however, the levelized costs from each of the perspectives were about one cent below the costs for all buildings. These levelized costs are for 68 industrial facilities that were served through the Energy Smart Design Program. Typically, these facilities had lighting measures installed in the office or other non-industrial portions of the facilities.

The levelized costs by two building status categories (i.e., new and existing) and the economic perspectives are presented in Table 5. The cost-effectiveness of conservation measures installed in new and existing buildings varied by the type of economic perspective. For the regional and utility perspectives, the levelized costs for new buildings were higher than the costs for existing buildings. For the service area and customer perspectives, however, the converse was found, as the levelized costs were higher for existing buildings than for new buildings.

² The number of cases for each type of Smart Design program are: Commissioning Service (n=2); Rebate Option (n=537); Customer Incentive (n=300); and Standard Incentive (n=609).

Table 4.
Levelized Program Cost (mills/kWh)
by Building Type and Economic Perspective

| Building Type³ | Regional | Service Area | Utility | Customer |
|----------------------------------|-----------------|---------------------|----------------|-----------------|
| Commercial | 44 | 28 | 6 | 35 |
| Industrial | 33 | 19 | 5 | 22 |
| Total | 43 | 28 | 6 | 35 |

Table 5.
Levelized Program Costs (mills/kWh)
by Building Status and Economic Perspective

| Building Status⁴ | Regional | Service Area | Utility | Customer |
|------------------------------------|-----------------|---------------------|----------------|-----------------|
| Missing | 12 | NA | 6 | NA |
| Existing | 43 | 29 | 5 | 38 |
| New | 49 | 21 | 10 | 16 |
| Total | 43 | 28 | 6 | 35 |

These findings for new and existing buildings are due to several cost differences between the buildings. The lower levelized costs for new buildings than for existing buildings from the service area and customer perspectives are due to the lower customer costs and higher BPA reimbursements to the service area for new buildings. From the regional and utility perspectives, the lower levelized costs for existing than for new buildings are due to the higher administrative costs and incentive payments for new buildings.

Measure Type

Table 6 shows the levelized costs by measure type and the economic perspectives. Figure 1 has the levelized costs for the regional perspective only. Relative to the average levelized cost, substantially lower costs across the regional, service area, and customer perspectives were found for lighting and HVAC measures. From the regional perspective, the levelized costs for the two measures were 37 mills (HVAC) and 39 mills (lighting). The two measures are the ones installed most frequently through the ESD program, with customers participating in 1,046 lighting projects and 234 HVAC projects. Thus, the program has successfully focused on the most cost-effective measures.

³ By building type the number of cases are: commercial (n=1377) and industrial (n=68).

⁴ The number of cases by building status are: missing (n=8); existing (n=1273); and new (n=164).

There were four measures which had substantially higher than average levelized costs for the regional, service area, and customer perspectives. These measures were for the following end-uses: building envelope, hot water, motors, and refrigeration. The regional levelized costs for these measures ranged from 59 to 181 mills per kilowatt-hour (Figure 1).⁵ The four measures were not installed frequently, with each measure being installed between 8 and 73 times during the study period.

Commercial Sector

The levelized costs by commercial sector and the economic perspectives are displayed in Table 7. Figure 2 shows the levelized costs for the regional perspective only. Three of the sectors had lower than average levelized costs from the regional, service area, and customer perspectives--office, education, and utilities and communication. The levelized costs for these sectors from the regional perspective ranged from 24 to 34 mills. In addition, three sectors had substantially higher than average costs from the regional, service area, and customer perspectives. These sectors, in which the regional levelized costs ranged from 52 to 81 mills, were retail nonfood, warehouse, and other.

One reason for the higher levelized costs in the retail nonfood, warehouse, and other sectors is that buildings in these sectors are generally smaller and have lower energy use than the remaining buildings served through the Energy Smart Design Program. This is particularly true for the smaller retail establishments which are found in both the retail nonfood and other sectors. In addition, the Energy Smart Design Program served the common area portions of multifamily buildings during 1991 and 1992. These common areas are included in the levelized costs for other buildings.

Year

An analysis was also done on the levelized costs for the Energy Smart Design Program by year, 1991-1997, and the four economic perspectives. As shown in Table 8 below and in Figure 3, levelized costs from the regional perspective declined sharply from 1991 to 1992, were relatively steady from 1992 through 1995, and then declined again during 1996 and 1997. The levelized costs for 1991 were above the average cost over the seven years, whereas the costs in 1996 and 1997 were well below the average costs.

⁵ The very high levelized costs for hot water measures may have occurred because of the small number of projects, eight, or errors in the measure savings or costs.

Figure 1.
Regional Levelized Costs by Measure Type

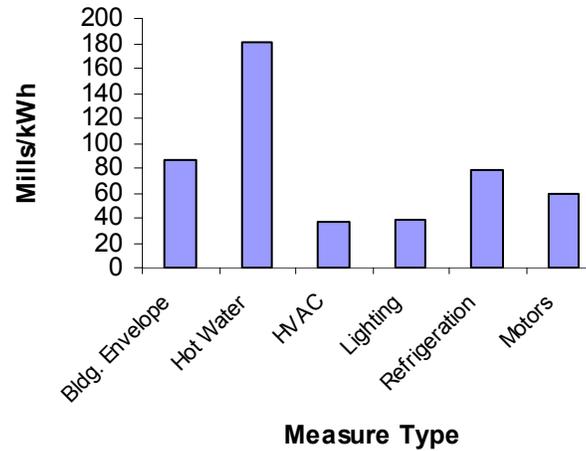
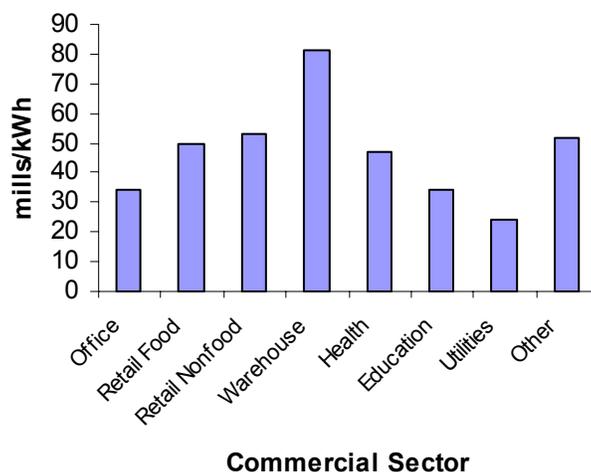


Table 6.
Levelized Program Costs (mills/kWh)
by Measure Type and Economic Perspective

| Measure Type ⁶ | Regional | Service Area | Utility | Customer |
|---------------------------|----------|--------------|---------|----------|
| Missing | 46 | 31 | 5 | 4 |
| Bldg. Envelope | 87 | 58 | 10 | 74 |
| Hot Water | 181 | 129 | 19 | 172 |
| HVAC | 37 | 22 | 5 | 26 |
| Lighting | 39 | 27 | 4 | 35 |
| Motors | 78 | 37 | 14 | 36 |
| Refrigeration | 59 | 29 | 11 | 29 |
| Grand Total | 43 | 28 | 6 | 35 |

⁶ For each measure type, the number of cases are: missing (n=39); building envelope (n=15); hot water (n=8); HVAC (n=234); lighting (n=1046); motors (n=73); and refrigeration (n=30).

**Figure 2.
Regional Levelized Costs by Commercial Sector**

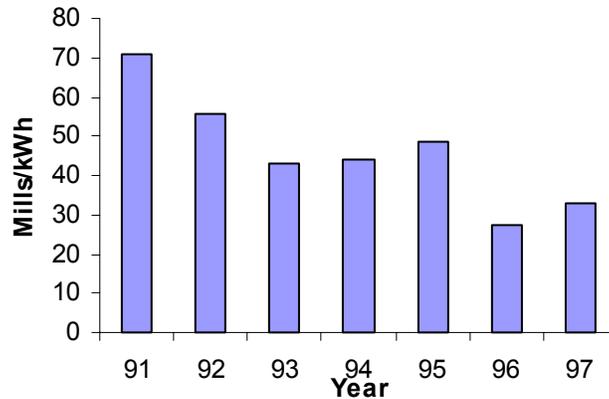


**Table 7.
Levelized Program Costs (mills/kWh)
by Commercial Sector and Economic Perspective**

| Sector ⁷ | Regional | Service Area | Utility | Customer |
|---------------------|----------|--------------|---------|----------|
| Office | 34 | 19 | 5 | 22 |
| Retail Food | 50 | 28 | 8 | 31 |
| Retail Nonfood | 53 | 44 | 3 | 65 |
| Warehouse | 81 | 65 | 6 | 92 |
| Health | 47 | 3 | 6 | 37 |
| Education | 34 | 16 | 7 | 14 |
| Util./Communic. | 24 | 17 | 3 | 23 |
| Other | 52 | 34 | 6 | 44 |
| Total | 43 | 28 | 6 | 34 |

⁷ The number of cases by commercial sector are as follows: office (n=368); retail food (n=152); retail nonfood (n=134); warehouse (n=34); health (n=81); education (n=71); utilities/communication (n=21); and other n=584).

**Figure 3.
Regional Levelized Costs by Year**



**Table 8.
Levelized Program Costs (mills/kWh)
by Year and Economic Perspective⁸**

| Year | Regional | Service Area | Utility | Customer |
|-----------|----------|--------------|---------|----------|
| 1991 | 71 | 58 | 4 | 84 |
| 1992 | 56 | 39 | 6 | 52 |
| 1993 | 43 | 26 | 6 | 30 |
| 1994 | 44 | 23 | 7 | 25 |
| 1995 | 49 | 37 | 4 | 51 |
| 1996 | 27 | 14 | 5 | 14 |
| 1997 | 33 | 23 | 4 | 30 |
| All Years | 43 | 28 | 6 | 35 |

Levelized costs in 1996 and 1997 were, respectively, 27 and 33 mills per kilowatt-hour. The pattern of low levelized costs during 1996 and 1997 were also found for the other three economic perspectives--service area, utility, and customer. The levelized costs during these two years were well below the average levelized costs across the years 1991-1997.

⁸ The 1998 levelized costs for the Energy Smart Design Program were calculated from the four economic perspectives. For 1998, the costs were: regional (45 mills); service area (38); utility (10); and customer (45).

Impact of Evaluation Findings

The projected energy savings used in developing the levelized costs for this report are higher than the savings found in two ESD evaluations (Coates et al., 1997; Xenergy et al., 1996). Xenergy et al. found that the evaluation savings for retrofitted Energy Smart Design buildings in the City Light service area were 95% of the projected savings. For new buildings the evaluation savings were a much lower percentage, with the savings being 49% of the projected savings. The percentage savings from the Xenergy et al. evaluation were applied to the projected energy savings for existing and new buildings. With these new savings estimates, the cost-effectiveness analyses were then redone from the four economic perspectives. The new levelized costs were about one-half cent per kilowatt-hour higher for the regional, service area, and customer perspectives, with the actual values for each perspective being: regional (50 mills), service area (39) and customer (32). For the utility perspective, the levelized costs did not change from the projected to the evaluation savings analysis.

Impact of Eliminating BPA Reimbursements

In 1997, the Bonneville Power Administration stopped providing reimbursements to City Light for measure incentives and administrative costs. Given this situation, additional analyses were done on the 1991-1997 ESD data assuming that City Light had paid the measure incentives to the customers. The results of these analyses from the utility and customer perspectives are shown in Table 9. As expected, transferring responsibility for the measure incentives from the Bonneville Power Administration to City Light increased the ESD levelized costs from both the utility and service area perspective. From the service area, the levelized costs increased from 28 to 43 mills per kilowatt-hour. This levelized cost finding, 43 mills, is identical to the regional levelized costs for the program, as the service area perspective is the same as the regional perspective used throughout this report when City Light pays the administrative and measure costs. From the utility perspective the increase in the levelized costs was from a very low 6 mills to 21 mills per kilowatt-hour saved.

Discussion

A study was conducted on the levelized costs for energy conservation measures installed in commercial buildings through the Energy Smart Design Program over a seven year period, 1991-1997. The costs were summarized by several program elements (e.g., commercial sector, type of conservation measures) and four economic perspectives. The economic perspectives were the Pacific Northwest region, the City Light service Area, City Light as a business, and the customer.

Table 9.
Levelized Program Costs (mills/kWh)
by Analysis Approach and Economic Perspective

| Analysis Approach | Service Area | Utility |
|---------------------------------------|--------------|---------|
| Actual | 28 | 6 |
| Incentives Paid by Seattle City Light | 43 | 21 |

Levelized Costs for all Program Participants

For all program participants, low levelized costs for conservation measures installed through the ESD program were found from the service area (28 mills), utility (6 mills), and customer (35 mills) perspectives. The low levelized costs for the service area and utility perspectives were primarily due to Bonneville Power Administration reimbursements to City Light for administrative costs and for incentives to customers for installing the conservation measures. These incentives to customers markedly reduced the costs of the measures for customers, thus resulting in low levelized costs for them.

A somewhat higher levelized cost was found from the regional perspective, as this perspective includes City Light's administrative costs and both utility and customer costs for the conservation measures. The levelized cost from the regional perspective was 43 mills per kilowatt-hour. This cost is significantly lower than the measure cost-effectiveness screen, 56 mills, used by Seattle City Light and the Bonneville Power Administration for the Site-based Incentive and Custom Incentive program options. The incentives paid to customers for conservation measures installed through the Energy Rebate and Standard Incentive program options were also designed to pass the cost-effectiveness screen, 56 mills. Thus, the ESD program is cost-effective when compared to the Bonneville Power Administration cost-effectiveness screen.

Additional evidence for the cost-effectiveness of the ESD program was found when the program's levelized costs were compared to recent estimates of City Light's marginal values of energy. Crane (1999) has developed marginal values of energy over the planning horizon, 1999 to 2020, which include both mid-Columbia (i.e., dams on the Columbia River) energy costs and the value of environmental benefits (e.g., sulfur dioxide reduction) from installing energy conservation measures in buildings. The marginal values are estimated for each of four costing periods: weekday high demand energy loads, Saturday high demand loads, Sunday high demand loads, and low demand on all days. The marginal values for these four costing periods, which range from 45.4 to 52.0 mills per kilowatt-hour in 1999, are all slightly above the regional levelized cost, 43 mills (45.2 mills in 1999 dollars) per kilowatt-hour, for the Energy Smart Design Program. Thus, the ESD program is also cost-effective when compared to recent estimates of City Light's marginal costs for energy (Crane, 1999).

The regional levelized costs for the ESD program, 43 mills, are consistent with the findings from other levelized cost analyses for commercial conservation programs. In an earlier analysis of the energy savings and costs for the ESD program, Xenergy et al. (1996) found that the total regional cost for the program was 40.7 mills (1992 dollars). In 1997 dollars, the CPI adjusted value is 47.6 mills. In a second study, Eto et al. (1994) compiled energy savings and costs for 20 utility-sponsored lighting efficiency programs in the commercial sector. They found that the average total resource cost for the 20 programs was 44 mills (1992 dollars). In 1997 dollars, the average levelized costs was 51 mills.

For Energy Smart Design conservation projects contracted in 1997 and thereafter, the Bonneville Power Administration no longer provides reimbursements to City Light for measure incentives and administrative costs. Given that City Light has to provide the incentives to the customers for the conservation measures, the most appropriate indicator of cost-effectiveness for the Energy Smart Design Program is now the service area perspective. When a supplemental analysis was done to determine what the levelized cost would be for 1991-97 ESD participants if City Light paid the incentives, the levelized service area cost, 43 mills, was identical to that obtained with the regional perspective.

The levelized costs for the Energy Smart Design Program are based in part on the projected program energy savings. These projected savings are somewhat higher than the savings found in two evaluation reports (Coates et al., 1997; Xenergy et al., 1996). When the projected energy savings were reduced by the percentage savings found in the Xenergy report, the levelized costs increased by about 5 mills per kilowatt-hour for the regional, service area, and customer perspective. For the utility perspective, the levelized costs did not change from the projected to the evaluation savings analysis.

Levelized Costs by Program Element

From the regional perspective, there was variation in the levelized cost by the several program elements: conservation program, building type and status, conservation measure, and commercial sector. Of particular interest for future program activities are those instances in which the levelized costs were substantially below the average cost. These lower levelized costs were found for participants in the Custom Incentive Program, industrial buildings, and three commercial sectors--office, education, and utilities and communication. The levelized costs for each of these elements were at or below 3.4 mills per kilowatt-hour saved.

These findings suggest that lower levelized costs for energy savings could be achieved by targeting each of these elements in future program activities. For example, 66 buildings participated in the Custom Incentive option during the years 1995-1997. Assuming that staff resources are available, a larger number of customers could be served in this program, thus lowering the overall cost of achieving savings through the Energy Smart Design Program.

It was also found in the study that several conservation program elements had substantially higher than average levelized costs. Those elements with higher than average costs include four types of conservation measures (building envelope, hot water, motors, and refrigeration) and three commercial sectors (retail nonfood, warehouse, and other). One implication of these findings is that considerable scrutiny should be given to the cost-effectiveness of future projects that include these sectors or conservation measures. Although customer equity and other concerns necessitate serving customers in all commercial sectors, attention to the cost-effectiveness of problematic projects will help ensure that the overall program cost-effectiveness is kept at a low level.

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