
Boston Edison

Residential Efficient Lighting Program

Profile #23, 1992

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Executive Summary

Boston Edison Company (BECo) has been encouraging the use of efficient lighting in homes in its service territory through mail-in rebates, "instant rebates", and special promotions since 1987. Through 1991, over 480,000 energy-efficient lamps have been distributed, of which 272,000 were OSRAM 15-watt compact fluorescent lamps which were sold by Lions Club members for \$3 each to 52,308 residential customers. The promotion's success stimulated over 95 print news stories in local and national newspapers, including The Wall Street Journal, USA Today, and the Boston Globe.

BECo's Residential Efficient Lighting Program (formerly called Lite Lights) has two primary long-term goals: to increase customer demand for energy-efficient lighting and to enhance the availability of efficient lighting technologies in retail markets in the Boston area. To accomplish these goals, The Residential Efficient Lighting Program has evolved significantly, thanks in large part to continual feedback and program adjustments and detailed process and impact evaluations.

BECo began the Residential Efficient Lighting Program in 1987 by offering mail-in rebates of \$1.50-5.00 on qualifying efficient lamps. Customers could also use a mail order service, coordinated by a contractor selected by BECo through competitive bid, to receive rebates on their purchases in the form of monthly electric bill deductions.

In 1989, "instant rebates" became available whereby customers could walk into BECo's Energy Centers (bill paying centers) and get instant rebates on the purchase of efficient lamps. At that time, compact fluorescents became eligible for rebates equal to 66% of the purchase price, and halogen rebates were 25% of the purchase price. Additionally, in 1991 instant rebates were introduced at a select number of retail stores.

Between 1987 and 1991, The Residential Efficient Lighting Program saved 19 GWh in annual energy savings, with 171 GWh lifecycle savings. Annual winter peak capacity savings have totalled more than 10 MW for the period 1987 to 1991, with summer peak capacity savings totalling about 2.1 MW. These savings are discounted to account for anticipated premature bulb removal as well as free riders.

Total utility costs of the program from 1987 to 1991 have totalled \$8,334,000. Expenditures increased significantly between 1989 and 1990, in part to accommodate the Lite for Sight promotion but also as a result of the New England Collaborative DSM program planning and design process. The 1990 expenditure of \$5,420,000 was fourteen times greater than the 1989 expenditure of \$392,000. In 1991, costs were \$2,028,000.

Residential Efficient Lighting

Utility: Boston Edison
Sector: Residential
Measures: Energy-efficient lamps and fixtures
Mechanism: Mail-in rebates, instant rebates, and special promotions
History: Started in 1987 with mail-in rebates; very successful Lions Club promotion in 1990

1991 Program Data

Energy savings: 5.6 GWh
Lifecycle energy savings: 50.1 GWh
Peak capacity savings: 0.951 MW Winter
0.036 MW Summer
Cost: \$2,028,000

Cumulative Data (1987 - 1991)

Energy savings: 33.3 GWh
Lifecycle energy savings: 171.1 GWh
Capacity savings: 10.7 MW Winter
2.1 MW Summer
Cost: \$8,334,000
Participation rate: ~14%

Conventions

For the entire 1992 profile series all dollar values have been adjusted to 1990 U.S. dollar levels unless otherwise specified. Inflation and exchange rates were derived from the U.S. Department of Labor's Consumer Price Index and the International Monetary Fund's International Financial Statistics Yearbook: 1991.

The Results Center uses three conventions for presenting program savings. **Annual savings** refer to the annualized value of increments of energy and capacity installed in a given year, or what might be best described as the first full-year effect of the measures installed in a given year. **Cumulative savings** represent the savings in a given year for all measures installed to date. **Lifecycle savings** are calculated by multiplying the annual savings by the assumed average measure lifetime. **Caution:** cumulative and lifecycle savings are theoretical values that usually represent only the technical measure lifetimes and are not adjusted for attrition unless specifically stated.

Utility Overview

Boston Edison (BECo) is a public utility which provides electricity to an area of approximately 590 square miles which includes the City of Boston, Massachusetts and 39 neighboring cities and towns. In 1991 Boston Edison served over 642,000 customers and employed more than 4,600 workers.

Electricity sales totaled \$1.3 billion for Boston Edison in 1991. Total energy sales for the year were 15,275 GWh. Total retail energy sales for the year were 12,478 GWh, with the commercial sector purchasing 7,132 GWh. Residential customers purchased 3,382 GWh while industrial customers bought 1,684 GWh. Streetlighting and railroads accounted for combined purchases of 279 GWh. Total retail sales for the year declined by 1.3%. This decline was in sharp contrast to the years 1988 to 1990 during which sales increased annually by at least 0.2% with a high of 4.8% in 1988. Declining sales in 1991 reflect the impact of the recession on New England.

Boston Edison generated 10,602 GWh of the total 1991 output from their own facilities. Of the utility generated power, 70% came from fossil fuels and 30% came from nuclear power generated at the Pilgrim Nuclear Station. Peak demand in 1991 was 3,311 MW at which time generating capacity was 3,695 MW.

Boston Edison created several new programs in 1991 which are designed to both improve energy efficiency and help strengthen the Massachusetts economy. The Economic Development Program offers new or expanding manufacturers in the Greater Boston area a four-year discount period and a 40% reduction off base rates during the first year. Boston Edison has also teamed with other Massachusetts utilities to

BECo 1991 STATISTICS

| | |
|-------------------------------|-----------------|
| Number of Customers | 642,967 |
| Energy Sales | 15,275 GWh |
| Energy Sales Revenue | \$1.264 billion |
| Peak Demand | 3,311 MW |
| Generating Capacity | 3,695 MW |
| Reserve Margin | 12 % |
| Average Electric Rates | |
| Residential | 10.51 ¢/kWh |
| Commercial | 8.92 ¢/kWh |
| Industrial | 7.90 ¢/kWh |

[R#1,7]

provide a site-finding service for companies looking to locate in the state.

With an eye toward the future Boston Edison is getting involved with electro-technologies such as electric vehicles. The utility bought two electric vans to test in 1992.

Hurricane Bob inflicted major damage in 1991 to the entire BECo system resulting in a great deal of unexpected repair work. Power was restored to 91% of the 150,000 customers who lost power within 24 hours. All affected customers regained power within three days.[R#1]

Utility DSM Overview

Boston Edison Company first began to explore demand-side management in 1981 with several conservation and load management pilot projects. Early initiatives included an air conditioner cycling program, water heater controls, and other audit conservation services.

The latest generation of DSM programs began in 1987. Since then Boston Edison has spent \$96.2 million, resulting in summer peak capacity savings of 111 MW and total annual energy contribution of 229 GWh through more than 244,000 participants. The programs have grown tremendously since their inception in 1987, with the number of participants more than tripling, and expenditures increasing more than seven-fold. [R#1,12]

Boston Edison implemented over twenty DSM programs during 1991. Total DSM-related expenditures of \$38.3 million were equal to 3% of the utility's total energy revenues. Over 59,000 customers participated in 1991 BECo DSM programs that installed high-efficiency lamps, ballasts, motors, variable speed drives, and other HVAC and process improvements.

CURRENT DSM PROGRAMS AT BECO

RESIDENTIAL

Residential Efficient Lighting

Energy Fitness

Multi-Family Electric Efficiency

Public Housing Authority

Residential New Construction

Residential High Use (Electric Heat)

Boston Housing Authority

Heat Pump and Central A/C Tune-up

Residential Top Efficiency HVAC

COMMERCIAL / INDUSTRIAL

Commercial / Industrial New Construction

Small Commercial / Industrial Retrofit

Large Commercial / Industrial Retrofit

Remodeling

Equipment Replacement

BEEC and GAP

| Utility DSM Overview Table | Annual DSM Expenditure (x1000) | Cumulative Energy Savings (GWh) | Cumulative Summer Capacity Savings (MW) |
|----------------------------|--------------------------------|---------------------------------|---|
| 1987 | \$5,928 | 10.71 | 21.10 |
| 1988 | \$8,053 | 30.17 | 45.27 |
| 1989 | \$14,543 | 64.81 | 73.84 |
| 1990 | \$29,472 | 132.25 | 97.40 |
| 1991 | \$38,271 | 228.78 | 110.69 |
| Total | \$96,266 | | |

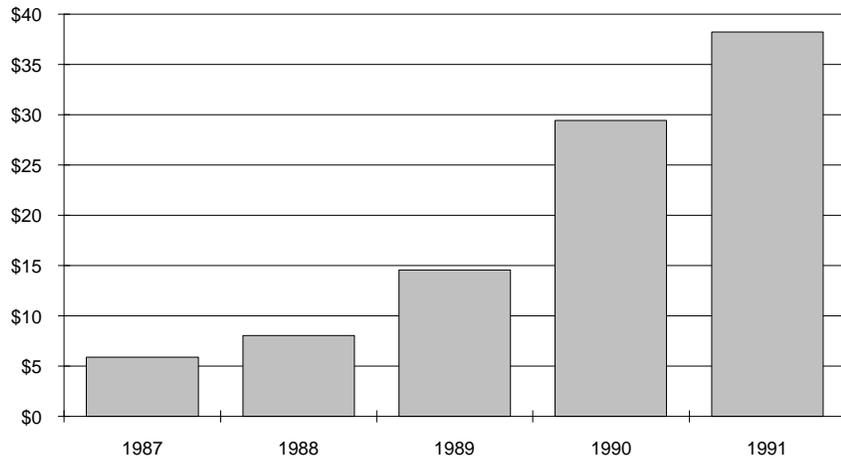
[R#9]

In BECo's 1989 rate case settlement, \$75 million was earmarked for expenditure on specific DSM programs as agreed upon by a group of organizations interested in promoting DSM. This group, called the Settlement Board, included BECo, the Massachusetts Attorney General, the Massachusetts Public Interest Research Group, and the Division of Energy Resources. The 1991 residential settlement board programs exceeded their targets for participation by 15%.

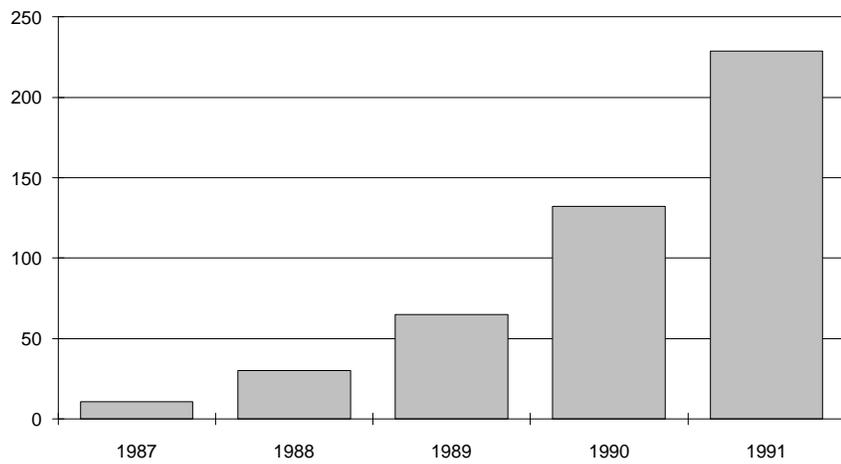
Participation in all DSM programs at BECo was 11.6% better than the target level for 1991. Peak summer demand savings for 1991 were 65.2% of target levels. Overall, Boston Edison has calculated that the energy saved from installations in 1991 was approximately 4% of the technical potential identified in the company's 1990 Conservation and Load Management filing with the Department of Public Utilities. [R#1]

One of BECo's largest programs is the Energy Efficiency Partnership program which encourages existing business customers to implement energy-efficient measures by providing rebates and incentives. By participating in the program, customers including a hospital and a major industrial complex were each able to reduce their energy usage by approximately 1.3 million kWh and save about \$100,000 a year. One of the colleges in the area saved 0.5 million kWh and \$36,000 from the same program.

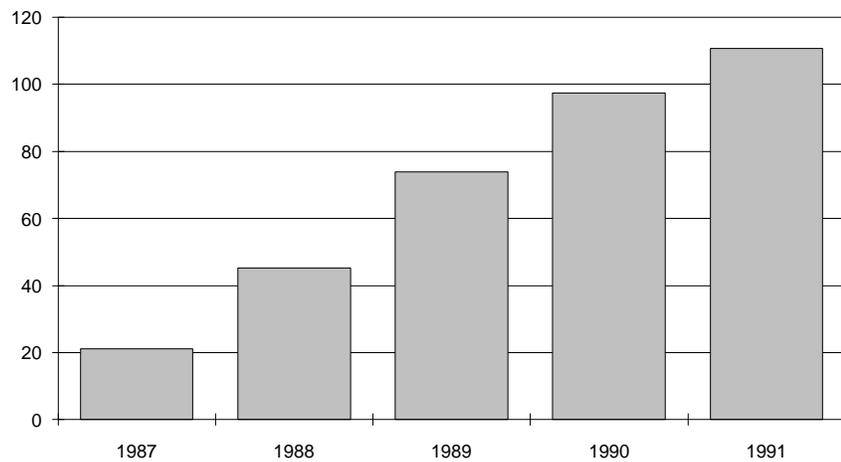
**ANNUAL DSM
EXPENDITURE
(\$1,000,000)**



**CUMULATIVE
ENERGY SAVINGS
(GWH)**



**CUMULATIVE
SUMMER CAPACITY
SAVINGS (MW)**



Program Overview

Since 1987, Boston Edison has been encouraging its residential customers to purchase and install efficient lighting technologies. Through mail-in rebates, instant rebates, installation of hardwire fixtures, and special promotions, over 480,000 energy-efficient lamps were distributed between 1987 and 1991. The program has two primary long-term goals: to enhance the availability of efficient lighting technologies in retail markets and to increase customer demand for such products thus encouraging the continued development of efficient lighting technologies. [R#4]

BECo began its residential efficient lighting programs with a mail-in rebate program called Lite Lights in 1987. At that time, residential customers who purchased any of four types of efficient lamps were eligible to receive a rebate from BECo. Customers completed rebate forms, which were available at various retail stores, and received rebates of \$1.50 to \$5.00. In 1989, four additional products were added, and "instant" rebates became available. Through instant rebates, customers could buy lamps at BECo's storefront bill paying centers (called Energy Centers) and via a mail order program. With these purchases, customers received immediate discounts simply by providing their billing or customer account number.

In 1990, the rebate levels were changed to a strict percentage of the purchase price. Compact fluorescents became eligible for rebates equal to 66% of the purchase price, and halogen rebates were 25% of the purchase price.

In 1991, instant rebates were introduced at selected retail stores in addition to the ongoing mail order and energy center programs. In 1992, BECo offered a three-bulb and harp adapter starter kit, and worked with manufacturers to offer instant rebates at grocery stores.

As part of the Residential Efficient Lighting program, BECo has sponsored several special promotions. The largest and most successful promotion was Lite for Sight, which was implemented during the Fall of 1990. In a program similar to those implemented by Central Maine Power in 1988 and 1989 (see Profile#19), Boston area Lions Club members sold 272,000 OSRAM 15 watt Dulux EL lamps to 52,308 residential customers for \$3 each. The lamps were sold to Lions Clubs for \$1 each, and the \$2 per lamp proceeds went to the Lions Eye Research Fund.

Other promotions have included the Neighborhood Night Light program, which distributed efficient outdoor lamps free of charge, the CAN Share promotion, which offered an efficient lamp in return for canned food donations for the needy, and a 2 for 1 promotion in which customers received another lamp each time they bought one. BECo also sold efficient lamps with a portion of each sale's proceeds being donated to POW charities. [R#3,4,5,6]

Implementation

MARKETING

The Residential Efficient Lighting Program is marketed through bill inserts, retailer promotions, newspaper ads, bill messages, and radio and television commercials.

Each of the special promotions have been marketed differently. One of the most well-publicized promotions was the Lions Club Light for Sight campaign. Bill inserts were included in two monthly billings, and two different advertisements were placed in 34 newspapers. Through these means, customers were provided with a list of the participating Lions Clubs, a mail-in coupon and a toll-free number. The program success stimulated over 95 print news stories in local and national newspapers, including The Wall Street Journal, USA Today, and the Boston Globe. Television and radio news stories were also prevalent.

DELIVERY

Customers can participate in BECo's program in three distinct ways: mail-in rebates, instant rebates, and special promotions.

Mail-In Rebates: Through mail-in rebates, customers purchase any of the qualifying lighting products at a local retail store and mail in a rebate form along with proof of purchase. Rebate forms and program brochures are provided to participating retailers by BECo, and the materials are generally displayed alongside the eligible products. Rebate checks are issued by BECo to the customer with a six to eight week lag time.

Instant Rebates: The instant rebates, in which the rebate amount is deducted at the point of purchase, have two different delivery mechanisms. First, customers can receive instant rebates at participating retail stores, which include

BECo's eight Energy and Environmental Centers, two electric supply outlets, as well as six independent retail outlets. When customers purchase lamps at one of the retail centers, the rebate amount is deducted at the cash register.

Second, customers can order lamps by phone or mail from a mail order distributor located in Natick, Massachusetts, which is within BECo's service territory. Customers call a toll-free number to place their order or request a mail-order form. The mail-order distributor was selected to provide services to BECo through a competitive bidding process. In addition to fulfilling mail and phone orders, the distributor supplies the lamps to BECo's Energy Centers. Through the toll-free number, the distributor also provides customer information on lamps and suggested uses.

Whether customers make their purchase through an Energy Center, a retailer or through the mail-order service, they must present their customer billing numbers to verify that they are BECo ratepayers. Bulbs may be returned up to thirty days after purchase.

Promotions: The Lite for Sight program was originally going to be delivered through door-to-door sales by Lions Club members. However, because demand was so large, Lions ended up taking orders by phone or mail, and then distributing the lamps at specific distribution centers. Other special promotions are delivered through the Energy Centers or through the local non-profit group which is benefiting from the promotion.

MEASURES INSTALLED

Since the program inception, a variety of energy-efficient lighting technologies have been available through BECo's Efficient Lighting Program. Primarily, the program offers compact fluorescent lamps. Most of the 480,000

Implementation (continued)

measures installed between 1987 and 1991 were the 272,000 OSRAM 15 watt Dulux EL lamps sold through the Lions Club Lite for Sight program. Not including the Lions Club promotion, 23,589, or 47.5%, of the 49,668 bulbs purchased between 1987 and 1990 were either all-in-one, twin- or quad-component compact fluorescents. Halogen bulbs and flood lights represented 29% of those sales, with the remainder of sales being for other types of fluorescent lamps, reflectors, and electronic ballasts. Interestingly, very few of the mail-in rebates were for halogen lamps. [R#6]

The program currently offers rebates as shown in the Rebate Amount Table.

BOSTON EDISON 1992 RESIDENTIAL EFFICIENT LIGHTING PROGRAM REBATE AMOUNTS

| | |
|--|-------------|
| LAMPS | |
| All-in-one compact fluorescents | \$7 - \$12 |
| Component compact fluorescents & screw in adapters | \$5 - \$15 |
| Circular fluorescents | \$5 - \$13 |
| Halogen floods | \$2 |
| Replacement lamps | \$2 - \$6 |
| Elliptical or ellipsoidal reflectors | \$1 |
| All-in-one reflectors | \$13 - \$15 |
| FIXTURES | |
| Indoor ceiling fixtures | \$11 - \$45 |
| Indoor recessed fixtures | \$25 - \$53 |
| Indoor wall fixtures | \$14 - \$30 |
| Exit sign kits | \$10 - \$11 |
| Outdoor wall fixtures | \$14 - \$60 |

STAFFING REQUIREMENTS

The Residential Efficient Lighting program is implemented by BECo's Energy Management Department. A program manager spends 50% of her time, and a program administrator and field monitor spend 100% of their time on the program. This includes administration, marketing, retailer communication, and training.

Other divisions within BECo involved with the Residential Efficient Lighting program include Demand Planning, Monitoring and Evaluation, Corporate Communications, General Accounting, and Customer Sources, which includes the Energy Center division.

There are two Energy Center coordinators, one of whom has primary responsibility for implementing the Residential Efficient Lighting program. Each Energy Center is staffed with a manager and several employees whose time is divided between credit and collection matters and light bulb sales.

In addition to BECo staff, approximately 10 FTE personnel at the mail-order distributor manage the program and deliver the products.

Monitoring and Evaluation

MONITORING

Up until 1992, the Residential Efficient Lighting program was tracked through three databases. The mail-order distributor, the Energy Centers, and the retail outlets each maintain different databases that contain information on customers and the types and quantities of bulbs sold. In 1992, the database was consolidated to standardize entries and facilitate data analysis.

EVALUATION

BECo has not conducted any end-use metering in conjunction with the Residential Efficient Lighting program. BECo is considering performing a billing analysis. Because variances in customers' billing are greater than the expected savings, however, it is not expected that savings from lighting efficiency would be detectable through such an analysis. [R#3]

Both an impact and process evaluation were completed in 1991. Through surveys and interviews with participants, non-participants, retail store personnel, utility staff, collaborative members, and implementation contractor staff, the program implementation and marketing were analyzed, and energy savings were estimated.

In interviews, participating customers indicated that they are generally satisfied with the program and the lamps they purchased through the program. Non-participants were deterred from the program by the high cost of the lamps and the appearance of the lamps. Non-participants did not have a clear understanding of the energy-saving benefits of the lamps.

The process evaluation determined that many retailers were willing to continue to stock qualifying products and to make the rebate forms available in their stores. However, most retailers expressed concern that BECo had not maintained regular contact with them regarding the program. The study also revealed that marketing has been limited, and that if increased program participation is desirable, then new marketing strategies would need to be pursued. The study recommended that BECo assess the cost-effectiveness of increased program marketing before embarking on any new advertising projects.

The evaluation found that the Lite for Sight promotion was successful in that it doubled the level of participation by low-income households, and reached an unprecedented number of customers. The Lite for Sight, however, required many resources, and the fact that the Lions Club and BECo

had different objectives for the promotion sometimes lessened the efficacy of this delivery method.

The report made specific recommendations regarding staffing levels, finding that staffing was being stretched to meet the growing and changing needs of the program. Additionally, the study found that the three databases for the three main program delivery mechanisms (mail order, Energy Center, and retail) were inconsistent and incomplete. As a result, BECo redesigned its database system and put the changes into operation in 1992. [R#6]

DATA QUALITY

Savings and cost data reported in this profile were provided by BECo, with numbers originating in their C&LM filings, BECo's 1991 DSM Reconciliation Report, and the evaluation of the Lite Lights program completed in July, 1991. [R#3,6,12,15,16,17,18,19]

In the Lite Lights evaluation, "gross" and "net" savings figures are calculated based on assumptions regarding the wattage of the bulb that each energy-efficient lamp replaces, the manufacturer's estimated lifetime of the new lamps, and an estimated 3.2 hours per day average use. The Lite Lights evaluation also includes a detailed examination of free-riders, free-drivers, and snapback.

For the Savings Overview Table in this profile, The Results Center presents net savings figures that have been adjusted by 16.2% for bulb removal and are further reduced by 10.7% for free-ridership. However, the savings due to the Lite for Sight promotion, which are included in the 1990 savings figures, have not been adjusted for free-ridership. [R#12]

The number of households participating in the program, as shown in the Participation Table, has not been adjusted for duplicate or repeat customers. The savings information for 1987 to 1990 (not including the Lite for Sight promotion) is based on 8,037 customers; data as presented in the Participation Table would reveal 8,278 customers for those years, not including the Lite for Sight participants. [R#12]

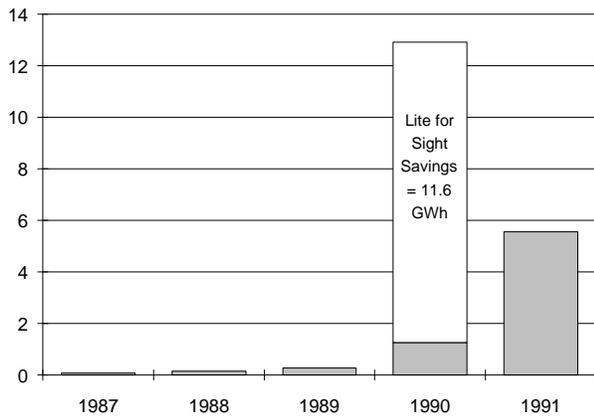
Costs for 1987 and 1988 were provided by BECo; no breakdowns were available for those years. Costs and breakdowns for 1989 through 1991 are from BECo's September, 1992 C&LM filing. [R#8] Rebate expenses for 1987 through 1991 are as reported in the Lite Lights evaluation. [R#6] Rebate expenses were subtracted from reported implementation costs for 1990 and 1991 to arrive at the implementation expense reported in the Cost Overview Table for those years.

Program Savings

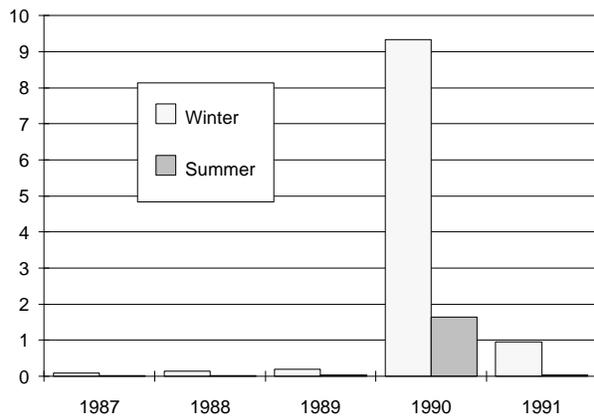
| Savings Overview Table | Annual Energy Savings (MWh) | Cumulative Energy Savings (MWh) | Lifecycle Energy Savings (MWh) | Annual Winter Peak Capacity Savings (MW) | Cumulative Winter Peak Capacity Savings (MW) | Annual Summer Peak Capacity Savings (MW) | Cumulative Summer Peak Capacity Savings (MW) |
|------------------------|-----------------------------|---------------------------------|--------------------------------|--|--|--|--|
| 1987 | 70 | 70 | 633 | 0.093 | 0.093 | 0.016 | 0.016 |
| 1988 | 168 | 238 | 1,509 | 0.150 | 0.243 | 0.026 | 0.042 |
| 1989 | 287 | 525 | 2,580 | 0.197 | 0.440 | 0.034 | 0.076 |
| 1990 | 12,919 | 13,444 | 116,274 | 9.331 | 9.771 | 1.648 | 1.724 |
| 1991 | 5,568 | 19,012 | 50,112 | 0.951 | 10.722 | 0.361 | 2.085 |
| Total | 19,012 | 33,289 | 171,107 | 10.722 | | 2.085 | |

[R#19]

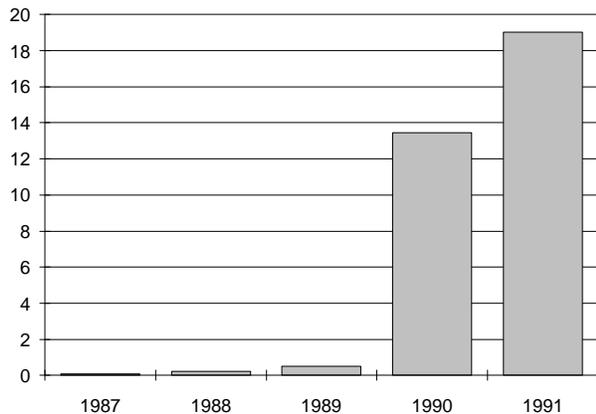
ANNUAL ENERGY SAVINGS (GWH)



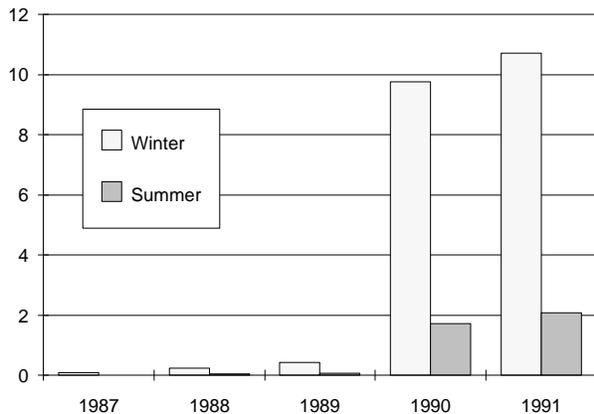
ANNUAL PEAK CAPACITY SAVINGS (MW)



CUMULATIVE ENERGY SAVINGS (GWH)



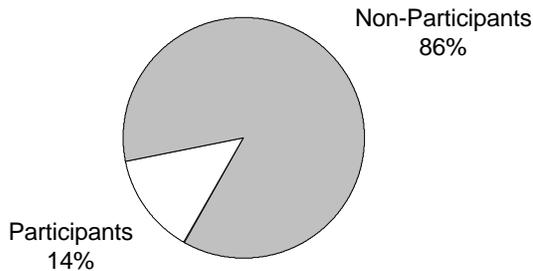
CUMULATIVE PEAK CAPACITY SAVINGS (MW)



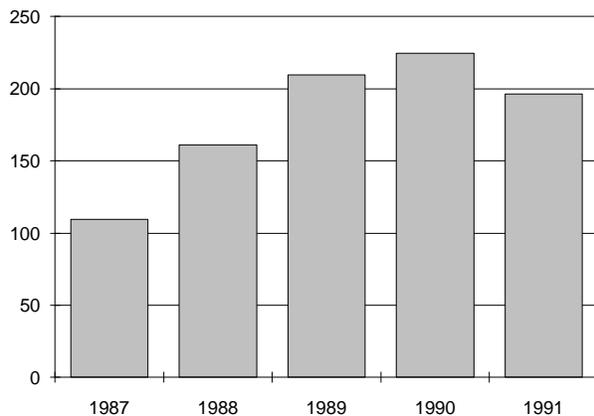
Between 1987 and 1991, the Residential Efficient Lighting program has saved 19 GWh in annual energy savings, with 171 GWh lifecycle savings. Annual winter peak capacity savings have totalled more than 10.7 MW for the period 1987 to 1991, with summer peak capacity savings totalling about 2.1 MW. These savings include a 16.2% reduction for bulb removal and a 10.7% reduction due to free ridership. The savings, however, do not include any changes due to snapback effects or free drivers, as explained in the data quality section.

PARTICIPATION RATES

Over 480,000 lamps have been purchased by more than 88,000 BECo residential customers through the Residential Efficient Lighting program. (Note that this figure has not been adjusted for duplicates or repeat customers – see the Data Quality section.) The Lions Club promotion had the highest



SAVINGS PER PARTICIPANT (KWH)



| Participation Table | Number of Lamps or Fixtures Purchased | Gross Number of Households Participating | Annual Net Energy Savings per Participating Household (kWh) |
|---------------------|---------------------------------------|--|---|
| 1987 | 1,544 | 643 | 109 |
| 1988 | 3,666 | 1,040 | 161 |
| 1989 | 7,828 | 1,369 | 209 |
| 1990 | 308,630 | 57,534 | 225 |
| 1991 | 160,182 | 28,343 | 196 |
| Total | 481,850 | 88,929 | |

[R#3,6]

participation rate, with 272,000 lamps being purchased by 52,308 households. BECo reported that instant rebates and mail-in rebates increased significantly in the Fall of 1990, apparently due to the heightened customer awareness that resulted from the Lions Club promotion. In 1991, BECo had 642,967 residential customers. Thus, participation in this program has been about 14%.

MEASURE LIFETIME

In calculating lifecycle savings, BECo had originally used 6 years for the years 1987 to 1990, and 9 years for 1991. A 9 year measure life is now assumed for lifetime savings for all years. The lifetimes are based on 3.2 hours of use per day, and the manufacturer supplied life of each bulb is used to determine the total lifetime of each bulb. The change in assumed measure lifetime was based on evaluation findings and the distribution of lamp types. [R#12]

PROJECTED SAVINGS

The lifecycle savings accumulated through 1991 total 171 GWh. BECo projects 39,382 new Efficient Lighting participants for 1992. These participants are expected to generate 3,651 MWh in incremental annualized savings and 32,863 MWh in lifecycle savings. In 1992, the program is projected to further reduce peak summer demand by 237 kW and peak winter demand by 531 kW. [R#16]

Projections for 1993 and 1994 are 30,054 new participants, 5,947 incremental annualized MWh savings, and 1,650 kW peak summer demand reduction in each of these two years.

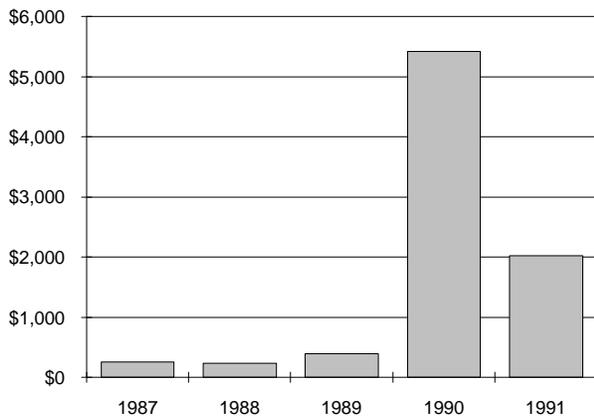
Cost of the Program

| Costs Overview Table | Rebate Expense (x1000) | Implementation (x1000) | Evaluation (x1000) | Administration (x1000) | Total Cost of Program (x1000) | Cost per Household Participant |
|-----------------------------|------------------------|------------------------|--------------------|------------------------|-------------------------------|--------------------------------|
| 1987 | \$7.1 | N/A | N/A | N/A | \$254 | \$395.61 |
| 1988 | \$18.1 | N/A | N/A | N/A | \$240 | \$231.16 |
| 1989 | \$30.6 | N/A | N/A | N/A | \$392 | \$286.41 |
| 1990 | \$324.6 | \$4,670 | \$63 | \$362 | \$5,420 | \$94.20 |
| 1991 | \$245.1 | \$1,462 | \$160 | \$161 | \$2,028 | \$71.55 |
| Total | \$625.5 | \$6,132 | \$223 | \$523 | \$8,334 | |

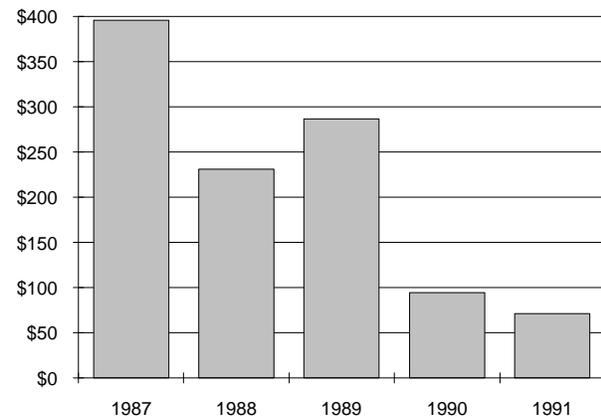
[R#3,6,8]

N/A = Not available

TOTAL PROGRAM COST (x1,000)



COST PER CUSTOMER



Total costs of the program from 1987 to 1991 have totalled \$8,334,000. Expenditures increased significantly between 1989 and 1990, in part to accommodate the Lite for Sight promotion. The 1990 expenditure of \$5,420,000 was fourteen times greater than the 1989 expenditure of \$392,000. In 1991, costs were \$2,028,000, about half the 1990 costs as there were no plans to implement a promotion as large as the Lite for Sight.

COST PER PARTICIPANT

The BECo cost per household participant has dropped each year of the program. The number of lamps purchased per customer remained fairly constant from 1989 to 1991, at about 5.5. Costs were comparatively high in the first three years of the program, however the costs dropped in 1990 and 1991 to \$94 in 1990 and \$72 in 1991.

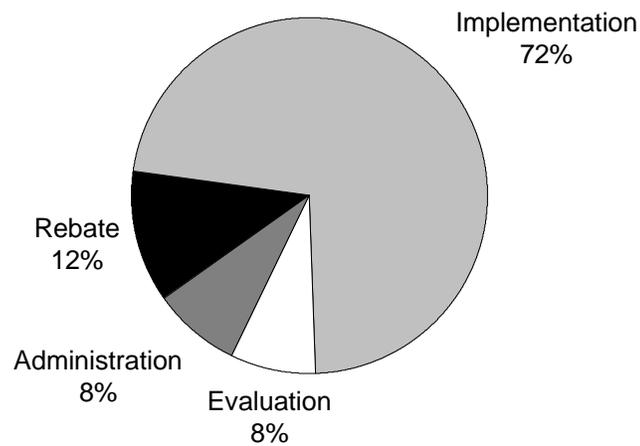
FREE RIDERSHIP

In its evaluation of the Residential Efficient Lighting program, BECo included a detailed analysis of free riders and

free drivers. The evaluation determined that 10.7% of the surveyed participants indicated that they had purchased a qualifying energy-efficient light bulb prior to their participation in the Residential Efficient Lighting program. However, the survey did not determine whether these participants would have continued to purchase efficient lamps in the absence of the program. The survey results also indicated 1% non-participant free-drivers. [R#6]

COST COMPONENTS

The majority of the program costs have been for program implementation. Rebate expenses have actually been just a small percentage of total annual expenditures, and marketing costs have been even less. The breakdown of costs for the 1991 expenditures is shown in the pie chart.



Environmental Benefit Statement

| Marginal Power Plant | Heat Rate BTU/kWh | % Sulfur in Fuel | CO2 (lbs) | SO2 (lbs) | NOx (lbs) | TSP* (lbs) |
|----------------------|-------------------|------------------|-----------|-----------|-----------|------------|
|----------------------|-------------------|------------------|-----------|-----------|-----------|------------|

Coal Uncontrolled Emissions

| | | | | | | |
|---|--------|-------|------------|-----------|---------|---------|
| A | 9,400 | 2.50% | 71,770,000 | 1,703,000 | 344,000 | 34,000 |
| B | 10,000 | 1.20% | 76,531,000 | 659,000 | 222,000 | 165,000 |

Controlled Emissions

| | | | | | | |
|---|--------|-------|------------|---------|---------|--------|
| A | 9,400 | 2.50% | 71,770,000 | 170,000 | 344,000 | 3,000 |
| B | 10,000 | 1.20% | 76,531,000 | 66,000 | 222,000 | 11,000 |
| C | 10,000 | | 76,531,000 | 439,000 | 220,000 | 11,000 |

Atmospheric Fluidized Bed Combustion

| | | | | | | |
|---|--------|-------|------------|---------|---------|--------|
| A | 10,000 | 1.10% | 76,531,000 | 201,000 | 110,000 | 55,000 |
| B | 9,400 | 2.50% | 71,770,000 | 170,000 | 138,000 | 10,000 |

Integrated Gasification Combined Cycle

| | | | | | | |
|---|--------|-------|------------|---------|--------|--------|
| A | 10,000 | 0.45% | 76,531,000 | 135,000 | 22,000 | 55,000 |
| B | 9,010 | | 68,841,000 | 49,000 | 17,000 | 3,000 |

Gas Steam

| | | | | | | |
|---|--------|--|------------|---|---------|--------|
| A | 10,400 | | 41,744,000 | 0 | 95,000 | 0 |
| B | 9,224 | | 36,251,000 | 0 | 227,000 | 11,000 |

Combined Cycle

| | | | | | | |
|-------------|-------|--|------------|---|---------|---|
| 1. Existing | 9,000 | | 36,251,000 | 0 | 139,000 | 0 |
| 2. NSPS* | 9,000 | | 36,251,000 | 0 | 66,000 | 0 |
| 3. BACT* | 9,000 | | 36,251,000 | 0 | 9,000 | 0 |

Oil Steam--#6 Oil

| | | | | | | |
|---|--------|-------|------------|---------|---------|---------|
| A | 9,840 | 2.00% | 60,419,000 | 915,000 | 108,000 | 103,000 |
| B | 10,400 | 2.20% | 64,081,000 | 908,000 | 136,000 | 66,000 |
| C | 10,400 | 1.00% | 64,081,000 | 130,000 | 109,000 | 34,000 |
| D | 10,400 | 0.50% | 64,081,000 | 381,000 | 136,000 | 21,000 |

Combustion Turbine

| | | | | | | |
|-----------|--------|-------|------------|---------|---------|--------|
| #2 Diesel | 13,600 | 0.30% | 80,192,000 | 160,000 | 248,000 | 14,000 |
|-----------|--------|-------|------------|---------|---------|--------|

Refuse Derived Fuel

| | | | | | | |
|--------------|--------|-------|------------|---------|---------|--------|
| Conventional | 15,000 | 0.20% | 95,206,000 | 245,000 | 323,000 | 72,000 |
|--------------|--------|-------|------------|---------|---------|--------|

Avoided Emissions Based on 33,288,677 kWh Saved (1987-1991)

In addition to the traditional costs and benefits there are several hidden environmental costs of electricity use that are incurred when one considers the whole system of electrical generation from the mine-mouth to the wall outlet. These costs, which to date have been considered externalities, are real and have profound long term effects and are borne by society as a whole. Some environmental costs are beginning to be factored into utility resource planning. Because energy efficiency programs present the opportunity for utilities to avoid environmental damages, environmental considerations can be considered a benefit in addition to the direct dollar savings to customers from reduced electricity use.

The environmental benefits of energy efficiency programs can include avoided pollution of the air, the land, and the water. Because of immediate concerns about urban air quality, acid deposition, and global warming, the first step in calculating the environmental benefit of a particular DSM program focuses on avoided air pollution. Within this domain we have limited our presentation to the emission of carbon dioxide, sulfur dioxide, nitrous oxides, and particulates. (Dollar values for environmental benefits are not presented given the variety of values currently being used in various states.)

HOW TO USE THE TABLE

1. The purpose of the previous page is to allow any user of this profile to apply Boston Edison's level of avoided emissions saved through its Residential Efficient Lighting Program to a particular situation. Simply move down the left-hand column to your marginal power plant type, and then read across the page to determine the values for avoided emissions that you will accrue should you implement this DSM program. Note that several generic power plants (labelled A, B, C,...) are presented which reflect differences in heat rate and fuel sulfur content.

2. All of the values for avoided emissions presented in both tables includes a 10% credit for DSM savings to reflect the avoided transmission and distribution losses associated with supply-side resources.

3. Various forms of power generation create specific pollutants. Coal-fired generation, for example, creates bottom ash (a solid waste issue) and methane, while garbage-burning plants release toxic airborne emissions including dioxin and furans and solid wastes which contain an array of heavy metals. We recommend that when calculating the environmental benefit for a particular program that credit is taken for the air pollutants listed below, plus air pollutants unique to a form of marginal generation, plus key land and water pollutants for a particular form of marginal power generation.

4. All the values presented represent approximations and were drawn largely from "The Environmental Costs of Electricity" (Ottinger et al, Oceana Publications, 1990). The coefficients used in the formulas that determine the values in the tables presented are drawn from a variety of government and independent sources.

* Acronyms used in the table

TSP = Total Suspended Particulates

NSPS = New Source Performance Standards

BACT = Best Available Control Technology

Lessons Learned / Transferability

The Residential Efficient Lighting program has evolved significantly from the program that was introduced in 1987. New delivery mechanisms have been introduced, and special promotions have been highly successful. BECo has responded promptly to identified trends in program implementation, and the program, which was lagging in 1989, was quickly strengthened through well thought out strategies.

The comprehensive evaluation of the program completed in 1991 has proven to be a priceless tool for BECo in implementing the Residential Efficient Lighting program. BECo instituted several program changes as a direct result of the recommendations of the evaluation. More dealers were recruited to participate in the program, and the participation process was made easier for very large retail outlets. Additionally, the database for the Residential Efficient Lighting program was consolidated as recommended in the evaluation report.

Many lessons were learned from the Lite for Sight promotion. Combined with those learned by CMP (see Profile#19) in their Lions Club promotion, any utility desiring to implement such a promotion should be able to do so effectively. The process evaluation recommended the following changes for future Lions type promotions:

1. The utility should offer some incentive to the Lions for turning in properly filled out tracking and inventory forms.
2. Communication between each Lions Club and the utility should be facilitated by appointment of a Lite for Sight chairperson in each club.

3. If Energy Centers are to be included in the promotion, they must be included in the pre-program planning efforts.

4. The bulb exchange/turn-in process should be made easier by allowing customers to return their bulbs to the Energy Centers or directly to the mail-order fulfillment house.

5. Lamp distribution centers should be identified prior to the promotion, and should be selected to accommodate different customers' needs.

6. Bulb delivery to the Lions Clubs could be made easier with direct delivery from the manufacturer or by insuring that the bulbs are delivered in containers that will fit into Lions Club members' cars!

7. A different bulb should be introduced in subsequent promotions, to avoid saturating the market with one particular bulb type, and to enhance the educational value of the promotion by introducing customers to products that they have not seen before.

8. Advertising on television could achieve greater customer awareness of the program and serve to inform customers about how the products should be used.

Regulatory Incentives and Shareholder Returns

In August of 1988 the Massachusetts Department of Public Utilities (DPU) instituted a collaborative process among utilities and intervenors for the design of utility DSM programs. Subsequent orders in 1988, 1989, and finalized in 1990 established an integrated resource planning process based on competitive all-source bidding. Utilities are required to submit annual resource plans to the DPU that consider DSM programs on a level playing field with supply-side resources. [R#10,13]

The DPU has eliminated almost all financial barriers to utility investment in DSM by allowing all utilities in the state to recover DSM program costs, approving a mechanism for lost base revenue recovery, and addressing incentives in a number of ways to further reward DSM program success. (See also Profile#1) Like other states, the Massachusetts mechanisms for removing the disincentives for utility investment in DSM, and creating incentives to do so aggressively and effectively, are still in transition. [R#10,12,13]

DSM COST RECOVERY

Utilities in Massachusetts may expense or capitalize DSM expenditures. Each utility must propose to the DPU the specific treatment that it prefers. Beginning in mid-1991 the DPU ordered each electric company to institute a separate class-specific Conservation Charge to collect DSM-related costs including incentives and lost base revenues, on a rate class specific basis, that can be reconciled based on actual expenditures and measured savings. [R#13]

The Conservation Charge is the sum of the Direct Program Costs, Lost Base Revenues, and Financial Incentives. It is connected as a surcharge to the energy charge on all kilowatt-hours sold.

The commission expects that after sufficient time to gain experience in designing, implementing, and monitoring conservation and load management programs, the utilities

will be encouraged to move toward a performance-based cost recovery system. In such a scheme, the cost recovery would be based on the actual savings accrued.

BOSTON EDISON'S INCENTIVE MECHANISM

The incentive mechanism available for BECo's DSM programs is based on the savings that the programs produce for ratepayers. The Massachusetts Department of Public Utilities (DPU) approved an incentive structure for 1991 based upon the idea that an "incentive bonus should not be based only on dollars spent since this rewards the Company for spending money rather than producing savings, and an incentive should encourage a company to maximize program benefits and minimize costs." The Massachusetts DPU, therefore, allowed BECo to collect an incentive based upon measured energy and capacity savings. The incentive was equal to 5% of the net benefits of the program after achieving at least 50% of the savings. (Net benefit is defined as the difference between total cost, including customer cost, and total benefits, and does factor in environmental externalities which are based on the company's proxy power plant which drives avoided cost.)

For 1992, 1993, and 1994, through a negotiated settlement process, BECo agreed that a base incentive of 5% of net benefits was still appropriate and will continue to be based on achievements of at least 50% of actual savings. However, this base can rise to 6% if BECo exceeds 80% of projected savings on lost opportunity programs or can drop to 4% if achievement in these programs falls below 70% of projected savings. Similarly there is a ratchet up or down in the residential sector. [R#13]

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