Boston Edison
Small Commercial & Industrial
Profile #31, 1992

Executive Summary

Boston Edison Company's Small Commercial and Industrial Retrofit Program (Small C/I Program) was created to provide free technical assistance, analysis, and energy efficiency measure installations for nonresidential customers with peak demands of less than 150 kW. The program took off in 1990, thanks in large part to a collaborative effort between BECo and non-utility parties whereby the collaborative's independent consultants worked with BECo staff to design and develop the Small C/I Program as well as other DSM efforts at BECo.

While the earliest implementation of the program focused on the installation of energy-efficient lamps, since March of 1990 the program has continued to identify other cost-effective measures, including HVAC and water heating upgrades, and has added them to options available to customers at no charge. An added feature of the program introduced in 1991 is a "customer generated proposal" option which allows customers to submit applications for self-designed retrofits. Customers can use electrical contractors of their choice, a mechanism whereby electrical contractors market the Small C/I Program independently complementing BECo's marketing efforts.

To date, the Small C/I Program has resulted in total annual energy savings of 8,022 MWh, total cumulative energy savings of 10,544 MWh, and lifecycle energy savings of 120,337 MWh. In terms of capacity savings the program has resulted in cumulative summer peak coincident capacity savings of 1.83 MW and cumulative winter peak capacity savings of 1.57 MW. In 1990, annual energy savings per customer were 3,144 kWh and this increased to 6,005 kWh in 1991. Capacity savings per participant in 1990 were 0.79 kW for summer peak coincident and 0.72 kW for winter peak. In 1991 capacity savings increased to 1.3 kW per participant for summer peak and 1.1 kW for winter peak.

To date BECo has spent a total of $7,888,600 on the program with $2,114,700 spent in 1990 and $5,773,900 spent in 1991. The total costs include purchases of equipment, training, contractors, BECo labor, monitoring and evaluation, and "overhead and other costs". Boston Edison estimates that there are 76,000 eligible customers for the Small Commercial/ Industrial Program. In 1990 there were 802 participants, and an average cost per participant of $2,636.77. In 1991, there were 916 participants and the cost per participant was $6,303.39. Now that the program is up and running and has clearly been successful, BECo is planning a nominal cost share from customers. This is a key issue for the effective transfer of the program to other service territories.

Small C/I Program

Utility:	Boston Edison Company
Sector:	Commercial and Industrial
Measures:	Lighting, water efficiency, weatherization, HVAC.
Mechanism:	Direct installation
History:	Started in late 1989.

1991 Program Data

Energy savings:	5.5 GWh
Lifecycle energy savings:	82.5 GWh
Peak capacity savings:	1.20 MW Summer
	0.99 MW Winter
Cost:	$5,733,900

Cumulative Data (1990-1991)

Energy savings:	10.5 GWh
Lifecycle energy savings:	120.3 GWh
Capacity savings:	1.83 MW Summer
	1.57 MW Winter
Cost:	$7,888,600
Participation rate:	2.3%

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.

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 nearly 643,000 customers and employed more than 4,600 workers.

Electricity sales totaled $1.2 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 provide a site-finding service for companies looking to locate in the state.

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	¢/kW
Commercial	8.92	¢/kW
Industrial	7.90	¢/kW

[R#1,7]

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 a cumulative energy contribution of 467 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, expenditures increasing more than seven-fold, and actual annual energy savings rising from 10,705 MWh to well over 200,000 MWh.[R#1,12]

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]

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. The company's DSM programs in 1991 accounted for 95 GWh of annual energy savings and 72 MW of savings on summer peak capacity. 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

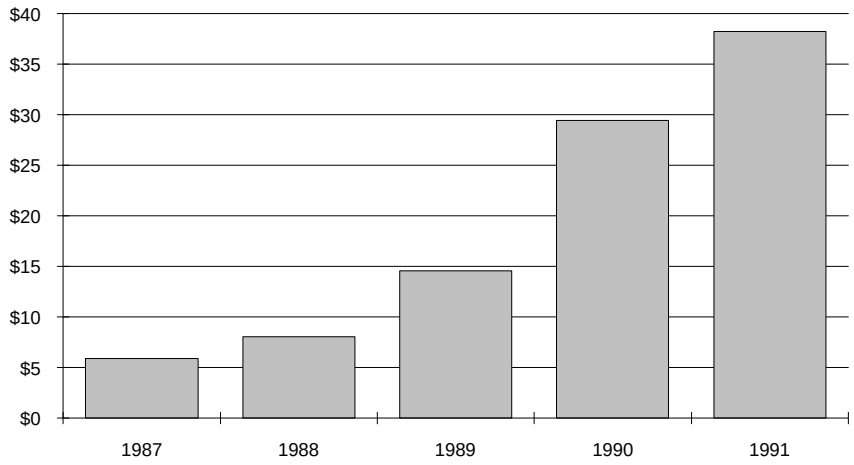
BEEC and GAP

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 15%.

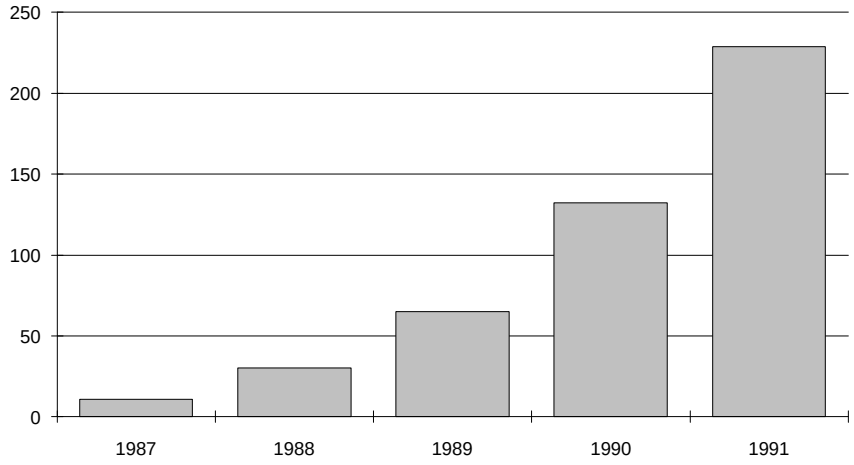
Participation in all DSM programs at BECo was 11.6% better than the target level for 1991. Peak summer demand savings for 1991 were 65.2% of target levels. Overall, Boston Edison has calculated that the energy saved from installations in 1991 was approximately 4% of the technical potential identified 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.

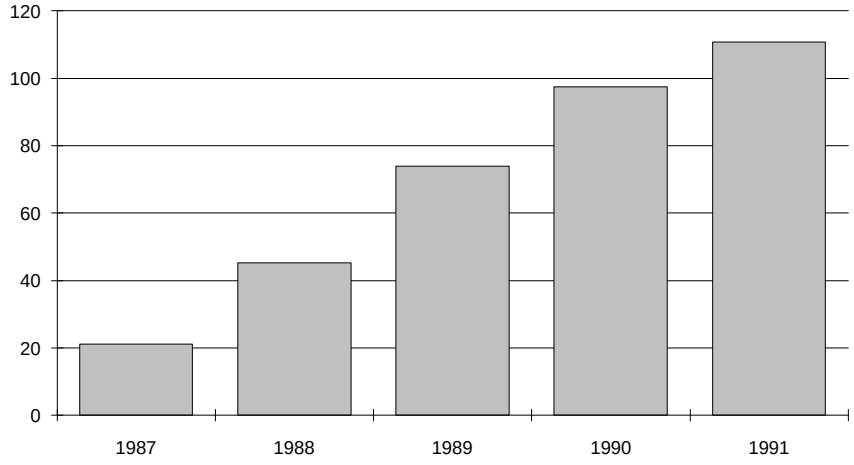
ANNUAL DSM EXPENDITURE ($1,000,000)



CUMULATIVE ENERGY SAVINGS (GWH)



CUMULATIVE CAPACITY SAVINGS (MW)



Program Overview

In 1989, Boston Edison Company's Small Commercial and Industrial Retrofit Program (Small C/I Program) was created to provide free technical assistance, analysis, and energy efficiency measure installations for nonresidential customers with peak demands of less than 150 kW.

The program was the product of a collaborative effort between BECo and a number of Non-Utility Partners (NUPs) including the Conservation Law Foundation, the Department of the Attorney General of Massachusetts, the Division of Energy Resources of the Executive Office of Consumer Affairs and Business Regulations of Massachusetts, and the Massachusetts Public Interest Research Group. Independent consultants from the NUPs worked with BECo staff to design and develop demand-side management programs.

The Small C/I Program was designed to address specific DSM needs and barriers unique to small commercial and industrial customers. Some of the unique aspects of small commercial and industrial businesses include: leased work-places, absence of capital for energy improvements, use of relatively simple energy-using systems, and general absence of qualified staff designated to oversee the implementation of energy-efficiency projects within the facility.

The 1989-1990 program focused on the installation of energy-efficient lamps. Since the completion of the second phase of the collaborative program with NUPs in March 1990, the program has continued to identify other cost-effective measures (such as energy HVAC upgrades, water efficiency measures, and weatherization measures) and has added them to options available to customers.[R#5]

MARKETING

As the Program Manager noted, "When you have a program that costs the customer nothing... it's not hard to have a backlog of participants." Currently, customers seeking to participate in the program are in a queue, and are handled on a first come-first serve basis.[R#6]

BECo's primary marketing mechanism for the Small Commercial / Industrial Program in 1990 and early 1991 was customer leads generated from the Commercial Conservation Services audit program. Its secondary target market has been comprised of customers who have contacted BECo with high bill complaints, or service requests. These two initial market groups were the first served by the program. Currently, BECo has more than enough ready and willing participants through indirect marketing based on word of mouth communication between customers and the utility's customer representatives.

The marketing of the Small C/I program is conducted by BECo staff with support from the corporate communications department. Annually since 1990, BECo staff has organized "Energy Day" in targeted growth-oriented communities to explain the various DSM programs offered by Boston Edison. BECo also developed two bill inserts that describe the Small C/I Program and provide a telephone information number. No new marketing efforts are planned since BECo and NUP contacts believe the program is obtaining an adequate response from customer referrals.

DELIVERY

Following a request by a customer who has heard of the program, BECo customer service engineers deliver the program by visiting the customer facility and performing an energy audit to identify measures for installation.

The pre-1991 program was delivered solely by BECo and its primary installation contractor. BECo staff made contact with the customer and performed the energy audit, and the contractor coordinated installation. After 1991, as a result of the increased complexity of retrofit measures, licensed electricians were added to the installation staff.

An added feature of the 1991 program was the customer generated proposal (CGP) which allows customers to submit applications for self-designed retrofits using an electrical contractor of their choice. This also allows electrical contractors to market the Small C/I Program themselves. BECo customer service engineers performed inspections on 10% of all completed jobs and 100% of all CGP projects.[R#5]

MEASURES INSTALLED

The 1991 program significantly expanded the list of installed as measures, and the average number of measures

BECo SMALL C/I RETROFIT ELIGIBLE MEASURES

- Weatherization
  - Caulking
  - Door sweeps
- Hot water heating improvements
  - Pipe insulation
  - Water heater tank wraps
  - Low flow showerheads and aerators
- HVAC
  - AC tune-up
  - Thermostat controls
- Lighting
  - Fluorescent lamps
  - Fluorescent lamps with ballasts
  - Ballasts only
  - Compact fluorescents
  - Halogen lamps
  - Elliptical reflectors
  - Exit signs
  - Fluorescent fixtures
  - Occupancy sensors
  - High-pressure sodium lamps
  - Metal halide lamps
  - High intensity discharge lamps
  - Fluorescent fixtures
- Refrigeration
  - Liquid pressure amplifier

rose from 344 in 1990 to 431 in 1991. The new measures include occupancy sensors, high pressure sodium lamps, metal halide lamps, A/C tune-up with thermostat control, ballast retrofits and reflector installations, as well as retrofits for the entire electric energy system including HVAC, motors, commercial refrigeration, and electric hot water heaters and cooking ranges.[R#5]

The 1991 program classified eligible retrofit measures as either Level 1 or Level 2. Level 1 measures are routine, (e.g. lighting, hot water retrofits, air conditioning tuneups), while Level 2 measures require site-specific analysis. (These measures typically are more complex and include energy management systems, motor installations, etc..) The Level 2 measures must be analyzed to determine cost effectiveness and savings potential. In 1991 BECo estimates that 10% of its Small C/I projects were Level 2.

The measures Boston Edison Small Commercial and Industrial Retrofit program will install are: Lamps, ballasts, reflectors, compact fluorescents, air conditioning tune-ups and thermostat controls, water heater efficiency measures, weatherization, HID lamps, lighting controls, energy management systems, and motors.[R#14]

STAFFING REQUIREMENTS

The Small C/I Retrofit Program includes BECo program staff, the primary installation contractor's staff, subcontractors to the primary contractor, independent contractors, and members of the collaborative process in a consulting capacity.

The Small C/I Program staff is a part of BECo's Commercial/Industrial Division in its Energy Management Department. BECo's program staff is made up of one program manager and four customer service engineers. The customer service engineer is a union position for an entry-level engineer. BECo staff are responsible for managing the program, conducting audits, providing oversight of independent contractors and the primary installation contractor, and implementing quality control procedures. Administrative staff assigned to the program assist in processing invoices. Approximately five full-time equivalents operate the program on a day in and day out basis coordinated by the program manager.

The primary contractor was selected through competitive bidding and maintains a staff of four including a program manager, an administrative assistant, a program coordinator, and a technical advisor. As BECo's main contractor, the company is responsible for providing administrative support, installing recommended measures, training the installers, managing subcontractors, and performing quality controls on completed jobs.[R#5]

In addition, BECo provides program planning support for the program and evaluation. In program planning, one research analyst spends a fraction of his time on the program, approximately 25%. One research analyst in BECo's evaluation unit spends 30-40% of her time evaluating the program, as she is responsible for both the Small C/I Program and the Large C/I Retrofit Program. Her supervisor also spends a small fraction of her time on the program. Consultants were retained to perform process and impact evaluations of the program for 1990 and 1991.

INSTALLATION CASE STUDY : THE DENNIS HALEY ELEMENTARY SCHOOL

One of the projects completed through the Small C/I Program was the retrofit of the Dennis Haley Elementary School, one of the Boston Public Schools, and one of the Small C/I Program's larger retrofits. This 38,935 square foot building was built in 1971. Four hundred and thirty-three 2x4 troffers (with four energy-saving lamps and two standard ballasts each) were replaced with brand new silver-lined 2x4 troffers (with two FO32 T-8 lamps and one electronic ballast each). Twenty-four energy saving two lamp wrap fixtures with one standard ballast were replaced with two FO32 T-8 lamps with one electronic ballast. Fifty-six 2x2 energy saving U-lamps with standard ballasts, were retrofitted with electronic ballasts. In addition, nine exit signs were retrofitted with compact fluorescent systems.

BECo's investment in the school was $50,000. The retrofit is providing annual energy savings of 91,520 kWh and 44 kW. The school will benefit from the retrofit in at least two ways. First, the retrofit will result in more than $7,000 worth of savings annually, while the utility pays for the entire retrofit, a retrofit with about a 7-year payback. Second, according to the school's principal, "It's amazing how much brighter the school is. It's as if we were sitting in a dark tunnel and someone has just led us out into the sun.... It's really a great feeling knowing that the "Big" companies also have generous hearts." Judith R. Prince, Principal, Dennis C. Haley School [R#6]

As part of its contract the program's primary installation contractor is responsible for maintaining a program database that contains information about each participant's facility and the products and services recommended, installed, and inspected through the program. The contractor also uses the database to track its costs, to generate monthly invoices for submittal to BECo, and as a quality check on subcontractor work. The following points present the goals for the database as well as the success of the database in meeting its objectives as outlined in the process evaluation discussed below:

1. The database serves to track the relationship between recommended and installed equipment. A key finding from the database's monitoring of the program is that it is easy to show a very high rate of installation after recommendation.

2. The database records customer information quite accurately but has been unable to handle multiple account numbers. Building characteristic data also needs improvement. BECo has found a need for consistent definitions for data such as square footage and end-use fuels. More data is needed on cooling systems.

3. The database provides a record of program savings that can be used for Boston Edison's cost recovery filing. More data on program savings is needed to make proper estimates. Data such as the true operating hours of the measure were not always available to calculate kWh savings.

4. The database tracks the dollars spent and the number of participants in the program. The database currently records only those costs associated with equipment installation. Other program administration and marketing costs are not included. The database should be linked to a cost accounting system that can capture all utility DSM costs.

5. The database feeds information to BECo's Monitoring and Evaluation Department for use in evaluations. Some information for impact evaluations, such as specific hours of operation, were not included for the affected end-uses or technologies. Information for the marketing and process evaluations was missing, for example, sources of awareness, customer satisfaction levels, and market segmentation group codes. Information on nonparticipants, such as those who were aware of the program but elected not to participate should also be included.

6. The database is used to verify monthly invoices. The database was originally designed for accounting purposes and received good ratings from Boston Edison staff in meeting these needs.

EVALUATION

To date the Small C/I Program has had both a process and an impact evaluation performed by an outside contractor. The key findings of these reports completed in early 1992 are presented throughout this profile.

The process evaluation for the Small C/I Program titled, "Process Evaluation for the Small Commercial and Industrial Retrofit Program" and dated May 6, 1992 [R#5], was based on interviews with staff, contractors, subcontractors, and non-utility parties (NUPs). The process evaluation involved database and document reviews. Data was collected from personal and group interviews with utility planning, implementation and evaluation staff, as well as with participating contractors. Site visits were also conducted to obtain information from participants, and telephone surveys of 310 participants and 300 non-participants were conducted to assess delivery and implementation.[R#3]

The key finding from the process evaluation is that the Small C/I Retrofit Program is seen as a clear success. Strengths are in implementation, meeting objectives for energy savings, delivery mechanism, staff and contractor interaction and customer satisfaction. There has also been a steady increase in the comprehensiveness of the measures installed since 1990 and the program has achieved its savings targets.[R#3]

The 1991 impact evaluation, titled "Implementation and Impact Evaluations of the Small Commercial and Industrial

Retrofit Program" [R#14] does not reflect a full year's worth of data. It contained only information from January 1990 - October 1991. (The analysis will be updated in 1992/1993 to reflect total participants for the year.) Its findings, in terms of energy savings, were used and prorated for the remainder of the year using a per participant savings value. As stated below, the implementation savings were found to be unusually high and were thus derated for the cost recovery filings presented to the DPU.

DATA QUALITY

Boston Edison's 1991 DSM Reconciliation Report contains savings estimates associated with implementation analysis, and gross and net billing analysis. The implementation savings estimates were calculated using engineering assumptions provided in the database. BECo chose to calculate impacts for this program using pre- and post-billing analysis for the participants and a control group.[R#11]

The savings estimates contained in the Implementation and Impact Report dated May 28, 1992 reflect the fact that the 1991 analysis is preliminary. The participant database and the billing data were available only through October 1991 at the time of the analysis. The savings estimates were then prorated to reflect a full year's worth of participation.[R#11]

The yearly implementation savings were then reduced by 30% to account for overstatement of hours of operation in the program database indicated by both the site visit report and the customer telephone surveys (from 19,306 kWh per participant to 13,514 kWh/participant). The implementation savings were then adjusted for the rate of removal of measures (to 11,757 kWh/participant), and for free riders (to 9,865 kWh/participant).[R#11]

The gross and net savings estimates reported in the 1991 DSM Reconciliation Report were adjusted to a percentage of the implementation savings. To calculate the percentage of gross and net bill impacts as a percentage of the implementation savings, estimates of the 1990 savings were used (79.5% and 44.4% respectively). These percentages were applied to the 1991 implementation energy and demand savings before the adjustment was made for rate of removal and free riders (13,514 kWh/participant) to obtain gross savings of 10,750 kWh per participant and net savings of 6,005 kWh per participant.[R#11]

BECo is currently in the process of conducting another implementation and impact evaluation using a full year's worth of data. The results from this evaluation will be filed with the Massachusetts DPU as part of the company's DSM Reconciliation filing during the second quarter of 1993.[R#11]

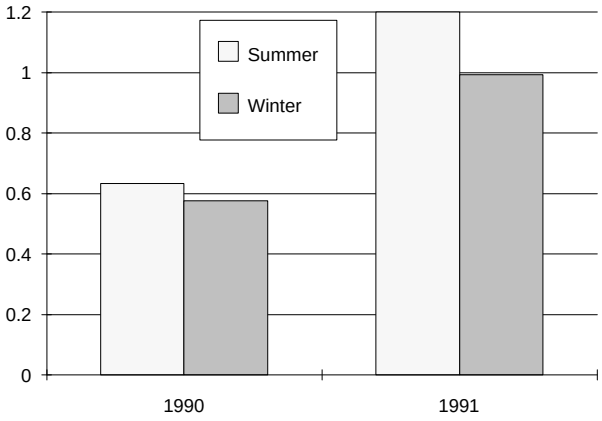
Program Savings

Savings Overview Table	Annual Energy Savings (MWh)	Cumulative Energy Savings (MWh)	Lifecycle Energy Savings (MWh)	Annual Summer Peak Capacity Savings (MW)	Cumulative Summer Peak Capacity Savings (MW)	Annual Winter Peak Capacity Savings (MW)	Cumulative Winter Peak Capacity Savings (MW)
1990	2,521	2,521	37,822	0.63	0.63	0.58	0.58
1991	5,501	8,022	82,515	1.20	1.83	0.99	1.57
Total	8,022	10,544	120,337	1.83		1.57	

[R# 11]

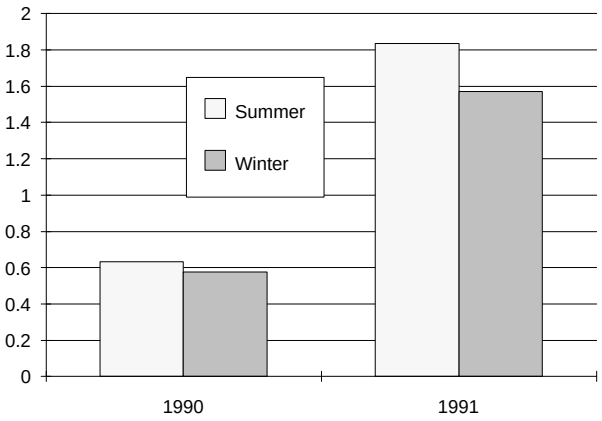
ANNUAL ENERGY SAVINGS (GWH)

ANNUAL PEAK CAPACITY SAVINGS (MW)



CUMULATIVE ENERGY SAVINGS (GWH)

CUMULATIVE PEAK CAPACITY SAVINGS (MW)

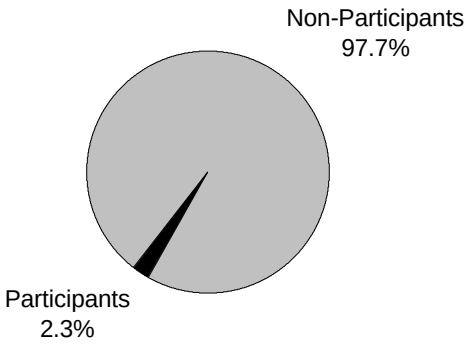


To date, the Small C/I Program has resulted in total annual energy savings of 8,022 MWh, total cumulative energy savings of 10,544 MWh, and lifecycle energy savings of 120,337 MWh. In terms of capacity savings the program has resulted in cumulative summer peak coincident capacity savings of 2.47 MW and cumulative winter peak capacity savings of 2.15 MW.[R#11]

In 1990, annual energy savings per customer were 3,144 kWh and this increased to 6,005 kWh in 1991 primarily due to the increase in measure comprehensiveness. Capacity savings per participant in 1990 were 0.79 kW for summer peak coincident and 0.72 kW for winter peak. In 1991 capacity savings increased to 1.0 kW per participant for summer peak and 0.8 kW for winter peak.[R#11]

PARTICIPATION RATES

There are 76,000 customers who are eligible to receive retrofits under the Small C/I program. To date 1,718 customers, or 2.3%, have participated in the program. Note that Small C/I Program customers are also eligible for two other BECo



programs: The Remodelling Program (which provides design review and technical assistance at the time of a major remodel), and the more standard Equipment Replacement Program.

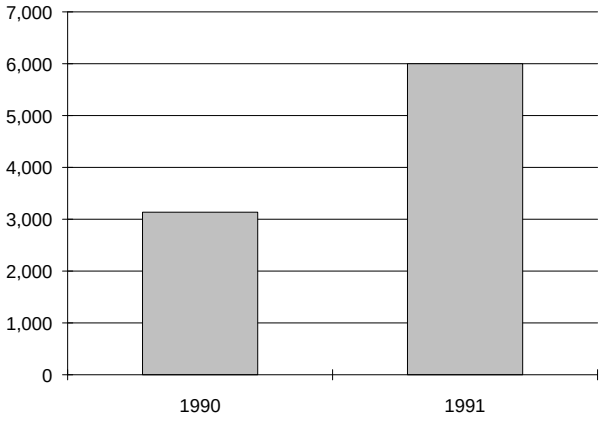
MEASURE LIFETIME

Though the Small C/I program installs a number of different measures with varying lifetimes, BECo assumes an average lifespan of 15 years which it uses as the basis of its lifecycle energy savings calculations.

PROJECTED SAVINGS

Boston Edison and its non-utility collaborative partners projected five-year participation targets for the Small C/I Program in 1989. These numbers have since been revised downward. The 1989 projection called for a total of 13,000 participants between 1990 and 1994, the program's first five years. The revised numbers call for a total of 7,852 participants over the same period. This downward shift accounts for limitations imposed by the amount of manpower available to implement the project and the increased comprehensiveness of the program. It also reflects the fact that BECo requested and received permission for a customer contribution in 1993.[R#6,11]

SAVINGS PER PARTICIPANT (kWh)



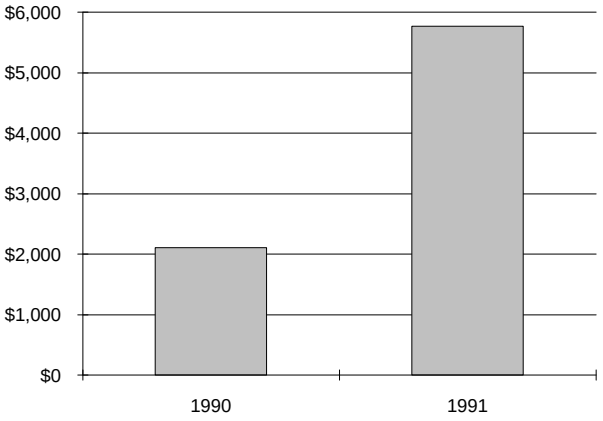
Savings Per Participant Table	Participants	Annual Energy Savings per Participant (kWh)
1990	802	3,144
1991	916	6,005
Total	1,718	

The projected program impacts for the years 1990 to 1994 call for total annual energy savings of 52,182 MWh; total annual capacity savings of 10.9 MW; unlevelized expenditures of $29.2 million; and 7,852 participants.[R#11]

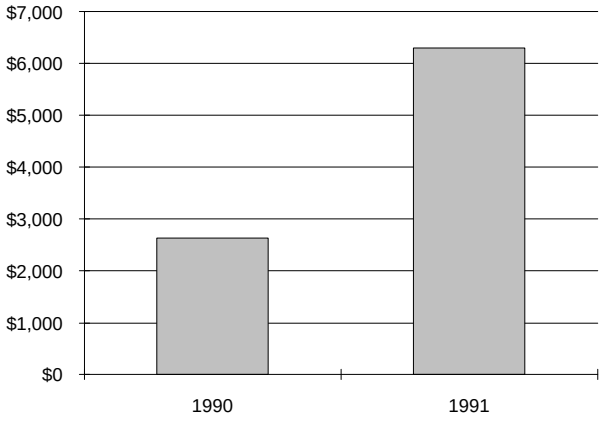
Cost of the Program

Costs Overview Table	Training, Contractors, Equipment, and BECo Labor (x1000)	Marketing Cost (x1000)	Monitoring and Evaluation (x1000)	Overhead and Other Costs (x1000)	Total Program Cost (x1000)	Cost per Participant
1990	$1,732,761.0	$142,757.0	$30,287.0	$208,882.0	$2,114,687.0	$2,636.77
1991	$5,338,553.9	$44,472.3	$7,349.2	$383,529.7	$5,773,905.0	$6,303.39
Total	$7,071,314.9	$187,229.3	$37,636.2	$592,411.7	$7,888,592.0	

TOTAL PROGRAM COST (x1,000)



COST PER PARTICIPANT



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COST PER PARTICIPANT

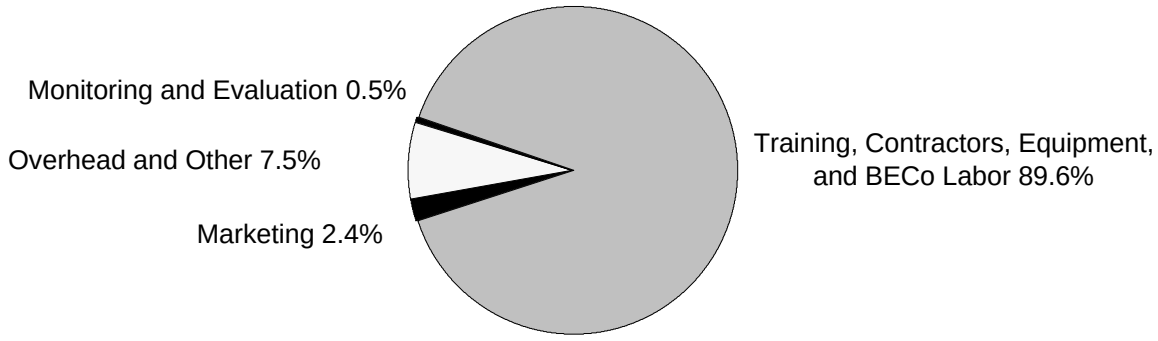
Boston Edison estimates that there are 76,000 eligible customers for the Small Commercial/Industrial Program. In 1990 there were 802 participants, and an annual program cost of $2,114,700. Thus the average cost per participant was $2,636.77. In 1991, there were 916 participants at a total program cost of $5,773,900. The cost per participant in 1991 was $6,303.39.

FREE RIDERSHIP

Less than 14% of the participants interviewed as part of the program's process evaluation of the Small C/I Program reported having plans to install energy-efficient lighting measures before joining the program. Less than 7% of participants had plans to install other measures. Nonparticipants surveyed indicated that they were more likely than participants to have installed energy-efficient equipment or to have plans to install such equipment. The survey indicated that 8% of nonparticipants had installed some energy-efficient measures at the time of the survey and 18% had plans to do so in the next twelve months. Boston Edison estimates total program free ridership to be 12%.[R#5]

COST COMPONENTS

To date 67.1% of the total program cost has been spent on training, contractors, and BECo labor. Equipment purchases have totaled $1.781 million or 22.6% of the total cost. Overhead and other expenses have accounted for 7.5% of the total, marketing 2.4%, and monitoring and evaluation only 0.5%.[R#3,12]



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%	22,733,000	539,000	109,000	11,000
B	10,000	1.20%	24,241,000	209,000	70,000	52,000
	Controlled Emissions					
A	9,400	2.50%	22,733,000	54,000	109,000	1,000
B	10,000	1.20%	24,241,000	21,000	70,000	3,000
C	10,000		24,241,000	139,000	70,000	3,000
	Atmospheric Fluidized Bed Combustion					
A	10,000	1.10%	24,241,000	64,000	35,000	17,000
B	9,400	2.50%	22,733,000	54,000	44,000	3,000
	Integrated Gasification Combined Cycle					
A	10,000	0.45%	24,241,000	43,000	7,000	17,000
B	9,010		21,805,000	16,000	5,000	1,000
Gas	**Steam**					
A	10,400		13,222,000	0	30,000	0
B	9,224		11,482,000	0	72,000	3,000
	Combined Cycle					
1. Existing	9,000		11,482,000	0	44,000	0
2. NSPS*	9,000		11,482,000	0	21,000	0
3. BACT*	9,000		11,482,000	0	3,000	0
Oil	**Steam--#6 Oil**					
A	9,840	2.00%	19,137,000	290,000	34,000	32,000
B	10,400	2.20%	20,297,000	288,000	43,000	21,000
C	10,400	1.00%	20,297,000	41,000	35,000	11,000
D	10,400	0.50%	20,297,000	121,000	43,000	7,000
	Combustion Turbine					
#2 Diesel	13,600	0.30%	25,400,000	51,000	79,000	4,000
Refuse Derived Fuel						
Conventional	15,000	0.20%	30,156,000	78,000	102,000	23,000

Avoided Emissions Based on 10,543,977 kWh Saved (1990-1991)

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 Small C/I 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

The most important conclusion from the program's May 1992 process evaluation is that the program is operating effectively, the contractors and program staff are enthusiastic about it, and the customers are satisfied. Additional recommendations from the report are listed below.[R#5]

1. The program is achieving its targets for estimated savings based on the engineering estimates in the database, but not its participation rates or preliminary estimated savings using a statistical billing analysis. BECo has been encouraged to increase program participation rates. Reliance on indirect marketing will probably be sufficient, but the creation of more detailed information on the program may be an additional market asset. The decision was made for the 1993 and 1994 program years to reduce the participation rates, since BECo will be requiring a customer contribution.[R#11]

2. Increased participation rates will warrant an increase in program staffing. BECo should also look for ways to reduce staff turnover and create two new positions for experienced customer service engineers within the Small C/I Program. (Note that Small C/I Program engineers are typically moved to the Large C/I Program as positions become available there.) The decision was made not to increase staff since the participation rates have been reduced. This is reflected in the revised projected savings figures for 1993 and 1994.[R#11]

3. BECo should develop educational materials, materials on equipment operations and maintenance, and information on where to purchase equipment that is comparable to that installed by the program. Customers with good information can be expected to maintain their equipment and replace it with comparable equipment. This information should be provided to customers during the installation. BECo is currently addressing this problem. Information sheets are being distributed to customers for the most common types of retrofit measures installed.[R#11]

4. A new "flexible" database should be designed to meet the needs for DSM program administration, monitoring, evaluation, quality control and reporting. This recommendation is currently being addressed. The paper forms used in the audits process are being replaced with a laptop PC-driven database that will enable the auditors to upload and download data into the program database.[R#3] The data base should be linked to the customer billing and account system and should increase the detail for field data such as hours of operation. The new database is scheduled for implementation in January of 1993. Many of the recommendations from this report were incorporated into the design of the new database.[R#11]

5. Auditors on site visits noticed that some customer storerooms contained inventories of inefficient equipment. As the efficient equipment installed as part of the program needs replacement, it is likely that customers will use old stock, thus BECo should examine the cost-effectiveness of replacing such inventory on a one-for-one basis. If cost effective, BECo should start such a program. BECo has examined the cost effectiveness of replacing store room inventory. As there are no savings associated with inventory replacement, the benefit/cost analysis does not support replacement.[R#11]

6. BECo should develop a procedure for noting the condition of HVAC and Level 2 equipment and a procedure by which installation crews notify BECo of difficulties in installing recommended measures. The new database will allow for the capture of problems encountered during the installation process as long as they are simple problems. The decision was made not to capture the condition of the equipment prior to or after installation. This is the result of the fact that there are not a large number of cost effective Level 2 retrofits in the program participant pool.[R#11]

7. In order to allow independent contractors into the Small C/I program but maintain BECo access control, the Customer Generated Proposal option should be converted into a component of the remodeling and equipment replacement program. Independent contractors who generate projects would only qualify for an incentive equal to the incremental cost of the more efficient equipment. Customers who are appropriate for the retrofit program would always need to obtain a BECo audit before program participation. If they wish to use their own contractor, they would be permitted to do so, and the program would still use independent contractors to install the Level 2 measures that BECo customer service engineers have identified. The introduction of independent contractors into the marketing process will increase program participation.[R#5]

Boston Edison has evaluated the role that independent contractors will assume in regard to this program. The Company has decided to continue working with independent contractors for the Customer Generated Proposal system under this program. BECo wants to maintain positive relationships with these independent contractors for the potential leads/relationships they bring to the Remodelling

and Equipment Replacement Programs. To help control the dollars spent on the CGP/independent contractor projects for this program, budget guidelines have been set.[R#11]

TRANSFERABILITY

BECo notes that a common response from independent contractors and trade allies is, "This program is a win/win situation; customers receive free equipment and save money on their monthly energy bills; we make money by installing the measures; and BECo gets its energy savings."[R#5]

The program development has been well documented to facilitate transferability. Specifically, the process evaluation has a tremendous amount of information regarding problems with the database and potential solutions.

The program manager notes that the program will include a cost share component in 1993 that will require a customer contribution equal to one year's savings, the equivalent of a one-year customer payback. This will help BECo identify customers who clearly see the value of the retrofits and are willing to pay part of the cost. These customers will likely maintain the installed equipment, providing BECo with a higher probability for durable savings.[R#6]

When other utilities design and implement similar programs there is an issue, or more accurately a choice, that can be made regarding eligibility. New England Electric System's Small C/I Program specifies that customers must use less than 50 kW to be eligible for the program. (See Profile #1) While BECo has no plans to reduce its eligibility requirements from its 150 kW cutoff point, the program manager notes than another approach that could be employed is to set up a tiered system. Customers under 25 kW, for example, the true mom and pop shops, might get the service for free. Customers whose demands range from 26-50 kW, for instance, might have to pay the first year energy savings (a one-year payback). Customers with a demand of 51-100 kW might be responsible for paying for two years worth of savings, etc. This approach, while slightly more complex, might get to the essence of customer's ability to cost share in the energy efficiency retrofits provided by the program.[R#6]

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 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]

References

1. Boston Edison Company, "1991 Annual Report".

2. Boston Edison Company, "Uniform Statistical Report" June, 1992.

3. Boston Edison Company, "First Annual DSM Program Reconciliation Report", May, 1992.

4. Boston Edison Company, "DSM Program Descriptions".

5. Barakat & Chamberlin, "Process Evaluation of the Boston Edison Small Commercial/Industrial Retrofit Program," May, 1992.

6. Mark Vandini, Program Manager, Small C/I Program, Boston Edison, personal communication, November - December 1992.

7. Boston Edison Company, "Demand-Side Management 1990 Annual Report", March, 1991.

8. Boston Edison Company, "Conservation and Load Management Filing for Year Ending December 31, 1991", September, 1992.

9. Boston Edison Company, "Demand-Side Management 1991 Annual Report", July, 1992.

10. National Association of Regulatory Utility Commissioners, "Incentives for Demand-Side Management," Committee on Energy Conservation, January 1992.

11. Janet Forman, Research Analyst, Monitoring and Evaluation Department, Boston Edison, personal communication, November - December 1992.

12. Michael Chiasson, Consulting Engineer, Monitoring and Evaluation Department, Boston Edison, personal communication, October - December 1992.

13. Theo MacGregor, Conservation Coordinator, Massachusetts Department of Public Utilities, personal communication, October - December 1992.

14. Boston Edison, "Implementation and Impact Evaluations of the Small Commercial and Industrial Retrofit Program", prepared for Boston Edison by Barakat & Chamberlin, May 28, 1992.

15. "The Power of Service Excellence: Energy Conservation in the 1990s, Results of the Second Collaborative Conservation Programs", Boston Edison, The Conservation Law Foundation of New England, Attorney General's Office, Division of Energy Resources, and the Massachusetts Public Interest Research Group, March 1990.

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