# New England Electric System
# Residential Electric Space Heat
## Profile #36, 1992

# Executive Summary

The New England Electric System's (NEES) Residential Electric Space Heat program (RESH) is a direct installation program that provides energy efficiency improvement measures and information at no cost or low cost to residential customers with electric space heat. Of NEES's 1.1 million residential accounts served by three retail companies, just 5% are moderate and high-use electric heat customers. The RESH program was designed to capture energy savings for these customers who live in one to four-family buildings.

The system-wide program's design and implementation was built on experience gained from a demonstration project in Northhampton, Massachusetts in which 213 electric space heat customers with annual usage above 10,000 kWh were served with efficiency measures in 1988 and 1989. The full-scale implementation of RESH began in the fall of 1990, targeting high-use electric space heat customers.[R#6]

RESH is administered by NEES staff, who perform program planning, evaluation, and daily oversight, while contracted energy service companies deliver the program to customers. These companies promote the program, do followup telemarketing, install the measures, and are responsible for one-on-one customer relations. Approximately 96% of the program budget flows to the contractors for labor and supplies.

During 1991, 3,177 customers participated in RESH resulting in annual energy savings of 5,597 MWh, or 1,762 kWh per customer, about 5% of the average homes' electricity use. By the end of 1992, NEES anticipates that it will have reached 13% of the target market. The program is planned to run through the year 2000; at that point NEES hopes to have served 67% of the Massachusetts market, 65% of the Rhode Island market, and 69% of the New Hampshire market.[R#7,9]

NEES has spent an average of $887 per customer in implementing the program in 1991. There is no spending limit per household, and NEES will install whatever cost-effective measures are appropriate, as determined by a Technical Assessment. At the time of the technical assesment, contractors provide energy-efficiency information (including information regarding appliances), compact flourescents are installed, blower door tests are performed, air sealing measures are performed, and water heating efficiency improvements are made. If cost effective, contractors return to install hardwired efficient lighting fixtures; attic, basement and wall insulation; and window and door improvements.

### Residential Electric Space Heat

| | |
|---|---|
| Utility: | New England Electric System |
| Sector: | Residential |
| Measures: | Lighting, water heating, other home energy-efficiency improvements |
| Mechanism: | Direct installation |
| History: | Pilot program in 1988 and 1989, full program began in Fall 1990. |

**1991 Program Data**

| | |
|---|---|
| Energy savings: | 5.6 GWh |
| Lifecycle energy savings: | 101.3 GWh |
| Peak capacity savings: | 0.26 MW Summer |
| | 2.6 MW Winter |
| Cost: | $2,817,200 |

**Cumulative Data (1990-1991)**

| | |
|---|---|
| Energy savings: | 5.6 GWh |
| LIfecycle energy savings: | 101.4 GWh |
| Peak capacity savings: | 0.26 MW Summer |
| | 2.6 MW Winter |
| Cost: | $2,852,200 |
| Participation rate: | 12% |

### 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

The New England Electric System (NEES) is a public utility holding company with several subsidiaries including three retail operating companies, Massachusetts Electric Company, Narragansett Electric Company located in Rhode Island, and Granite State Electric Company in New Hampshire. (In this report the operating companies of NEES are collectively referred to as the "NEES Companies" or the "retail companies.") In aggregate, the NEES service territory includes about one-half of Massachusetts, most of Rhode Island, and a small fraction of New Hampshire. Another subsidiary, New England Power Service Company (NEPSCO), develops and manages DSM programs for the three retail utilities which are then implemented by conservation and load management personnel in each service territory. (Of the three retail companies Massachusetts Electric is the largest by far, serving 906,000 customers in 1990, followed by Narragansett Electric Company (317,000 customers), and Granite State Electric (34,000 customers).

NEES owns two wholesale generating companies (the New England Power Company which operates 21 generating stations and Narragansett Energy Resources Company which owns 20% of the Ocean States Power Project, a gas-fired plant in Rhode Island), three transmission service companies, and a service company, New England Power Service. It is through the latter that DSM programs are coordinated for the entire system.

**NEES 1991 STATISTICS**

| | | |
|---|---|---|
| Number of Customers | 1,256,656 | |
| Energy Sales | 20,470 | GWh |
| Energy Sales Revenue | $1.838 | billion |
| Summer Peak Demand | 4,250 | MW |
| Generating Capacity | 5,645 | MW |
| Reserve Margin | 32.82% | |
| **Average Electric Rates** | | |
| Residential | 9.10 | ¢/kWh |
| Commercial | 8.38 | ¢/kWh |
| Industrial | 7.62 | ¢/kWh |

In 1990 and 1991 NEES experienced a decline in electricity sales of 0.1% and 1.2%, respectively. This was in sharp contrast to a 5.9% positive growth rate in 1988 and a 3.0% positive growth rate in 1989 and was significantly lower than the average 3.2% load growth the system had experienced for the past five years. The negative growth, or decline, was primarily due to the recession which hit New England early and particularly hard. The negative load growth was expressed for both energy and capacity.

# Utility DSM Overview

NEES formally entered the business of demand-side management in January of 1987 with the introduction of a set of programs called "Partners in Energy Planning". Since then NEES has quickly become recognized as one of the leading DSM utilities in the United States. Later, during the rate case proceedings of 1987, the now famous New England Collaborative Process was born. By the end of 1989 NEES was working with the Conservation Law Foundation to implement a dozen DSM programs. Between 1987 and 1990 NEES invested over $150 million in DSM resulting in savings of 175 MW in installed capacity. Furthermore, NEES was spending a total of about $75 per customer for energy efficiency, about double the expenditure levels of many of the large U.S. utilities with progressive DSM programs. By the end of 1991 the utility had invested a total of $221.5 million in DSM for a total summer peak capacity reduction of 303 MW and 499.8 GWh.[R#2] (Note that one of the goals of the Partners in Energy Planning programs was to reduce approximately 1,000 tons/year of SO2.)[R#3]

For the commercial and industrial customers the "Energy Initiative" DSM program was introduced in 1989 to promote the installation of a broad array of efficiency measures in existing buildings. Design 2000 constitutes the companion program for new construction and major renovations. Most commercial and industrial customers' construction projects are eligible for one of these two programs. The Small C/I Program (see Profile#6) was added to ensure that small businesses are well served by the NEES DSM effort.

### DSM PROGRAMS FUNDED BY NEES

**RESIDENTIAL**

Appliance Recycling

Energy Crafted Homes

Energy Fitness

Home Energy Management

Multi-Family Retrofit

Residential Lighting

**Residential Electric Space Heat**

Water Heater Rebate

**COMMERCIAL / INDUSTRIAL**

Design 2000

Energy Initiative

Small C/I Program

Cooperative Interruptible Service

Standby Generation

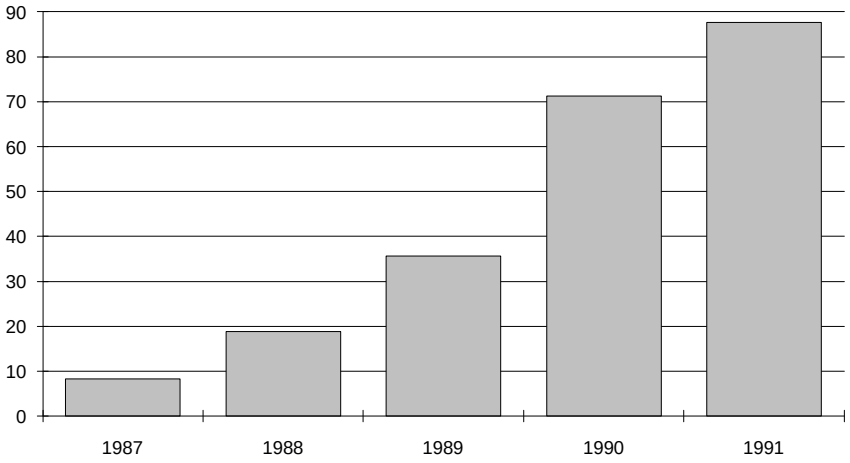
| **Utility DSM Overview Table** | Annual DSM Expenditure (x1000) | Annual Energy Savings (GWh) | Annual Summer Capacity Savings (MW) |
|---|---|---|---|
| 1987 | $8,287 | 14.2 | 36.00 |
| 1988 | $18,791 | 58.0 | 93.00 |
| 1989 | $35,571 | 100.0 | 65.00 |
| 1990 | $71,243 | 147.0 | 49.60 |
| 1991 | $87,597 | 180.6 | 59.68 |
| Total | $221,489 | 499.8 | 303.28 |

In 1990, Massachusetts and New Hampshire regulators joined Rhode Island in allowing an incentive to be earned on DSM activities, clearing the way for a full utility commitment to DSM. Thus NEES budgeted a record $85 million, and spent $87.6 million, for conservation and load management programs in 1991. (The 1991 program expenditure represented 5% of gross utility sales.) By the year 2000 NEES projects to save 460 MW of summer capacity and annual savings of ~1,800 GWh.[R#1] NEES DSM programs are forecasted to reduce summer peak demand by ~10% by the year 2000.[R#1]

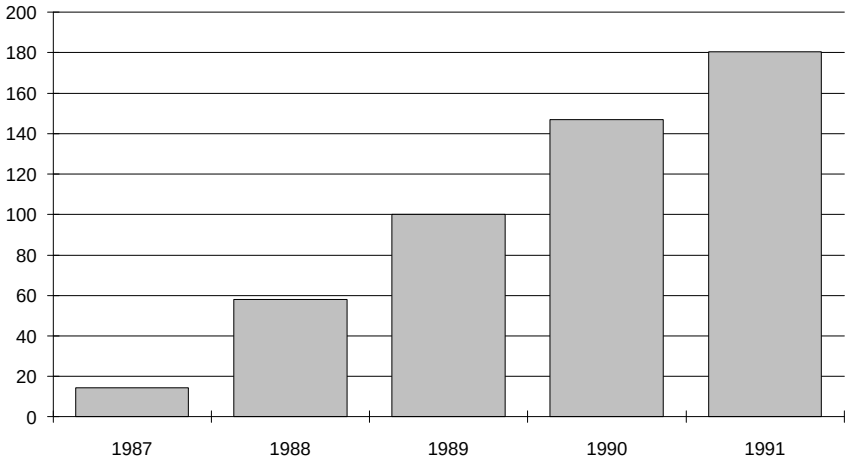
Over the next twenty years — by the year 2010 — NEES projects to fulfill 39% of required generation level peak capacity through conservation and load management programs for a total of 1,094 MW of summer peak reduction.[R#1] By the year 2000, NEES programs are forecasted to reduce summer peak demand by approximately 12.3%.[R#1]

To complement its efforts, and state its intent to be an environmental leader as well as to continue to be one of the nation's leading DSM utilities, in 1991 NEES announced NEESPLAN-3, a far-reaching environmental initiative that can only be accomplished in parallel with a highly successful energy efficiency initiative. NEESPLAN-3 calls for reducing projected greenhouse gas emissions from its operations by 45% in the 1990s, 9% of this (or 4% overall) will come from conservation and load management activities. NEESPLAN-3 provides a blueprint of the utility's commitments to reduce environmental impact, maintain stable, competitive prices, and maintain a diverse, competitively-procured power supply.

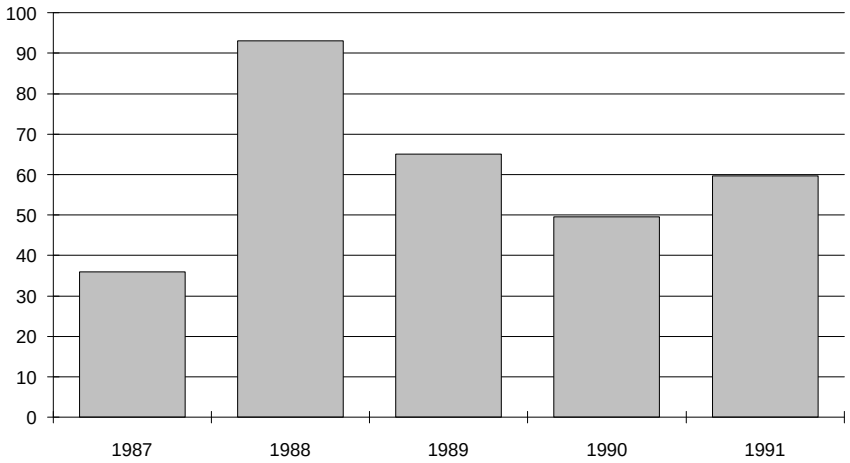
**ANNUAL DSM EXPENDITURE ($1,000,000)**




**ANNUAL ENERGY SAVINGS (GWH)**




**ANNUAL SUMMER CAPACITY SAVINGS (MW)**



# Program Overview

The NEES Residential Electric Space Heat program (RESH) is a direct installation program that provides energy efficiency improvement measures and information at no cost or low cost to residential customers. The program was designed to capture the electricity conservation potential of residential customers who live in electrically-heated, existing one to four-family buildings.

The system-wide program's design and implementation were built on experience gained from the Partners in Energy Planning Demonstration project in Northhampton, Massachusetts in which 213 electric space heat customers with annual usage above 10,000 kWh were served with efficiency measures in 1988 and 1989.

The full-scale implementation of RESH began in the fall of 1990, after the program design had been approved by each of the three regulatory commissions with jurisdiction in the states in which the program is implemented — Massachusetts, New Hampshire, and Rhode Island. As a result of the differing regulatory requirements, there are variations in the way that the program is implemented in each of the three states. In Rhode Island and New Hampshire, the program is offered to any residential customer with space heating electricity use of at least 6,000 kWh per year. In Massachusetts, this limit does not apply, however space heating must be primarily electric in order for the customer to participate in the program. The program is offered at no cost to the customers in Massachusetts and New Hampshire, but Rhode Island customers are required to pay a nominal fee — $25 for the technical assessment and $50 for retrofit costs.

Residential customers with moderate to high electricity use who rely primarily on electricity for their space heating needs are eligible to participate in the program. While the RESH program was designed with low-income customers in mind, few of NEES's low income customers have electric heat. Low income customers in NEES's service area tend to live in urban areas, where gas and oil heating systems are predominant, or in rural areas where many depend on wood heat. In 1991 6% of the homes receiving energy-efficiency improvements through RESH were occupied by customers whose incomes were less than 200% of the federal poverty level.

## MARKETING AND DELIVERY

RESH is marketed and delivered by different entities in each of the three states where the program is offered. In Massachusetts and Rhode Island, weatherization contractors provide program marketing and implementation. In Massachusetts, where most program activity occurs, Conservation Services Group (CSG) is the energy service contractor; in Rhode Island the contractor is Kemper Management Services.

In New Hampshire the program's implementation is shared among three community action programs (CAPs): Southern New Hampshire Services, Rockingham County Community Action, and Southwestern Community Services. These three groups are designated by the State of New Hampshire as low income agencies. In addition to implementing RESH, the New Hampshire groups administer fuel assistance and other low income services such as the DOE's weatherization program.

NEES provides the program implementation contractors in each state with target customer lists and direct-mail marketing materials. Initially, program participants were predominantly high-use customers. Later, the program was expanded to include both high and moderate residential electric heat users in the marketing strategy. An attempt is made to ensure that only eligible customers receive the mailing. Changes in monthly electricity use, as determined from billing histories, are helpful in determining whether customers rely on electricity for their space heating needs.

The contractor prepares and sends out the direct mail piece, which includes an "announcement and invitation" letter from a representative of the contractor, a toll-free number, and a return postcard, addressed to NEES. Customers may initiate participation in the program either by calling the toll-free number or by returning the postcard to NEES. The vendor schedules appointments with all respondents and follows up on all non-respondents with a second letter and/or phone call. Contractors try to verify that the customer uses electricity for space heating before scheduling the appointment. However, sometimes the use of wood heat does not become apparent until the contractor visits the site. [R#7,8,9]

After customer interest and eligibility are confirmed, NEES releases customer billing history to the vendor. This information is used as a second check on customer eligibility, and is entered into the data collection form by the contractor. The energy analysis, or Technical Assessment (TA) is performed and all cost-effective energy saving opportunities are identified. Eligible measures are pre-determined by NEES from modelling studies and the impact evaluation which was completed in 1991. For example, if a home has R-22 attic insulation then an upgrade to R-38 or 44 would be prescribed.

At the time of the initial appointment, the contractor also installs compact fluorescent lights in up to 8 locations in each home, installs a hot water conservation package if one is not already in place, performs a blower door test and installs air sealing measures. The contractor then makes arrangements for the installation of any other measures indicated by the technical assessment (like insulation upgrades) to be completed at a later date.

All program services are generally provided within sixty days after the initial contact with a participant. The contractor is responsible for quality control inspections of all subcontracted installations. The contractors provide their own staff training, overseen by the RESH Program Manager. Each contractor has a technical field person who performs site visits, troubleshoots problems encountered on site, and ensures that measure installation is occurring according to specifications. In addition, inspections of approximately 5% of all installations are performed by an independent contractor to NEES.

## MEASURES INSTALLED

The contractor provides several services at the time of the initial visit:

- Energy-efficiency information, emphasizing the effects of household electricity usage patterns, is provided;
- Appliance information is provided, and proper equipment operation methods are suggested;
- Compact fluorescent lamps may be installed;
- Blower door directed air sealing is performed; and
- Water heating efficiency improvements such as tank and pipe insulation, high-efficiency showerheads, and aerators are installed.

If cost-effective, the following measures may also be installed:

- Hard-wired fixtures;
- Attic, basement, and wall insulation upgrades; and
- Window and door improvements.

## STAFFING REQUIREMENTS

At NEES, Program Manager Laura McNaughton estimates that approximately 2.5 full-time equivalents (FTE) administer the program. This includes her own full time effort, about 25% of the time of program evaluator Chris Granda, about 80% of the time of a data entry clerk, 20% of the time of an administrative assistant, about 25% of the time of another program manager, and management oversight.[R#9]

Approximately 50 FTEs are employed by the implementation contractors who operate the program and perform the installations of efficiency measures. About 18, two-person crews actually perform the installations. In addition, each contractor has management staff, telemarketers, schedulers, and, in some cases, full time contract managers who manage the subtrades.

In addition to the NEES staff and the contractors, a number of independent inspectors are also involved in the program.[R#9]

# Monitoring and Evaluation

## MONITORING

The energy service companies that actually perform the retrofits use paper forms to record data regarding installations. The forms are submitted to NEES, and the data is entered manually into a PC-based tracking system at NEES. In this manner, NEES has control over the quality of the data.[R#9] The system accepts inputs of customer account and billing data, as well as information regarding measure installations. NEES develops monthly summary reports for internal use and submits status reports to the regulatory commissions in each of the three states twice a year.

## EVALUATION

Impact evaluations of RESH were performed in 1991 and 1992 on the 1990 and 1991 program years. The 1992 impact evaluation included a weather corrected billing analysis comparing a twelve month pre-installation period to a twelve month post-installation period for a 251 member participant group and a 155 member comparison group. Energy Economics of Design Options (EEDO) software was used to divide total net kWh savings per household up amongst classes of delivered energy conservation measures. EEDO is a variable-based, degree day model that produces weather normalized end-use and total building energy consumption estimates.[R#10]

A process evaluation for the program was completed in October 1991. The evaluation was based on telephone surveys of 352 participants and 130 non-participants; additionally, personal interviews were conducted with three of the weatherization contractors and three NEES program staff. Twelve vendor subcontractors were interviewed by telephone. The process evaluation focussed on the program's database and marketing materials, determined levels of customer satisfaction, and analyzed the effectiveness of program implementation.[R#7]

The database and tracking system were found to be comprehensive, and some recommendations were made to improve the flow of information from vendor to NEES. Recommendations were made for improvement of marketing techniques, even though the marketing strategy was found to be effective. Most customers (62%) remembered finding out about the RESH program through the direct mail letter. The vendors and subcontractors agreed that if the envelope were more inviting, the customers would be more likely to open it and respond.

The process evaluation revealed that overall, customers were pleased with the RESH Program. Seventy-seven percent of the participants surveyed had only favorable comments about the initial TA (technical assessment), and 96% were satisfied with all measures installed during the initial visit; 98% to 100% were satisfied with the insulation measures installed after the TA. Only hard-wired lighting fixtures had a lower satisfaction rate (82%) with most dissatisfaction due to perceived poor quality of light.[R#8] The program staff and three vendors were also satisfied with the delivery of services, including the TA and the comprehensiveness of measures installed. A number of respondents called for more measures and materials to be evaluated for possible inclusion in the program. In particular, the contractors indicated that they would like to install more air sealing measures.

In the area of measure persistence, the participant surveys found that 13% of the respondents receiving fluorescent lights had removed one or more of them, and 4% of those receiving water heating measures had removed one or more showerheads. "Snapback", or increased use of higher efficiency measures, appeared minimal based on survey results. Two percent of the respondents reported setting their thermostats higher, 4% took longer showers, 8% left their lights on longer and 10% set their air conditioner at a cooler setting or ran it longer.

## DATA QUALITY

Overall NEES's data quality for this and other programs is exceptional, with the only fault being that no NEES programs have a particularly long track record. Note that we present two years of data, but that the data from the first year is scant due to the few participants completed in 1990. (Participation is presented for 1992, and includes the period January 1 to early November, 1992).

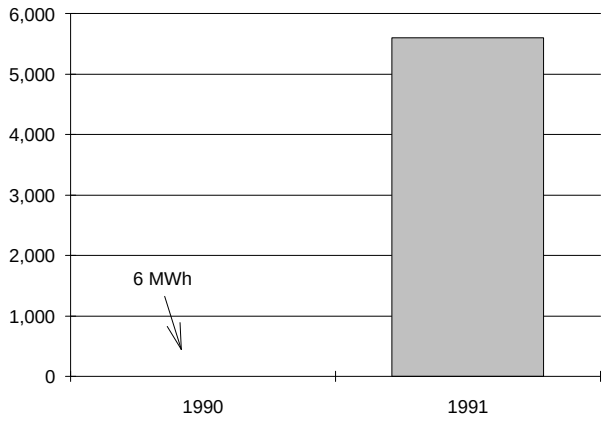
Unlike several similar programs at other utilities, where savings are based on engineering estimates, the RESH program relies upon billing analysis to report savings. The Results Center reports RESH program savings as shown in NEES's "1991-92 Demand Side Management Report".[R#6] The savings reported are corrected to reflect 20 year average weather conditions. Savings attributable to particular end-uses are determined by comparison to standard engineering estimates performed using the EEDO software.

# Program Savings

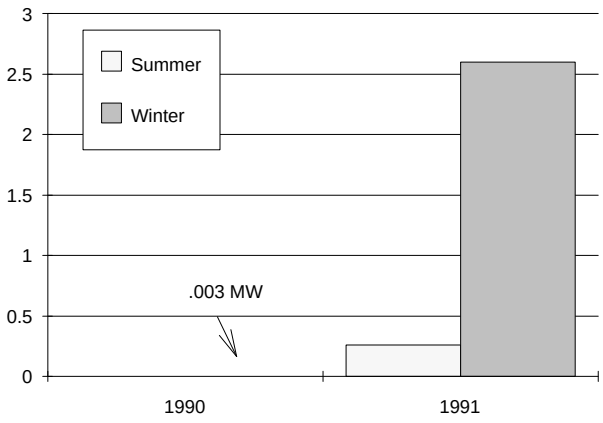
| Savings Overview Table | Annual Energy Savings (MWh) | Cumulative Energy Savings (MWh) | Lifecycle Energy Savings (MWh) | Annual Winter Peak Demand Savings (MW) | Cumulative Winter Peak Demand Savings (MW) | Annual Summer Peak Demand Savings (MW) | Cumulative Summer Peak Demand Savings (MW) |
|---|---|---|---|---|---|---|---|
| 1990 | 6 | 6 | 109 | 0.003 | 0.003 | 0.000 | 0.000 |
| 1991 | 5,597 | 5,603 | 101,276 | 2.598 | 2.601 | 0.260 | 0.260 |
| Total | 5,603 | 5,609 | 101,385 | 2.601 | | 0.260 | |

[R#6,7]

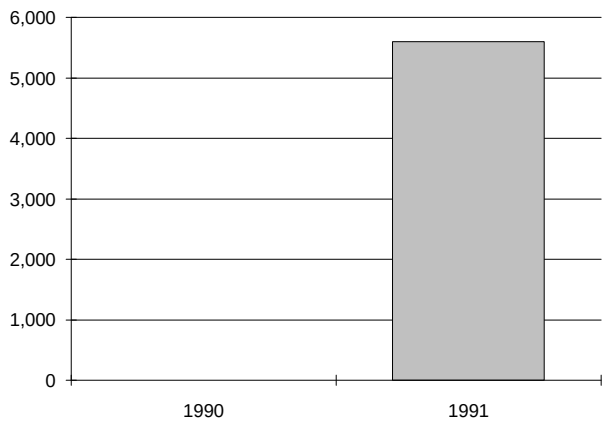
**ANNUAL ENERGY SAVINGS (MWH)**



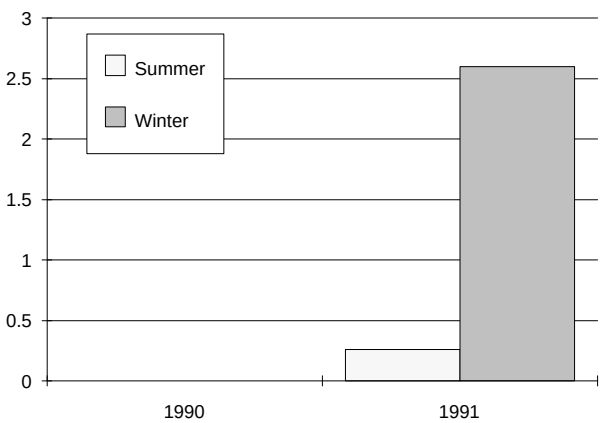

**ANNUAL PEAK CAPACITY SAVINGS (MW)**




**CUMULATIVE ENERGY SAVINGS (MWH)**




**CUMULATIVE PEAK CAPACITY SAVINGS (MW)**

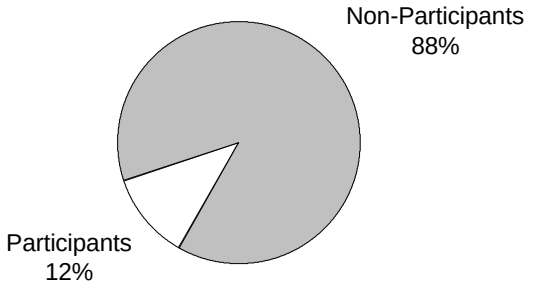


The RESH program generated annual energy savings of 5,603 MWh in the time between the program start in late 1990 and the end of its first full year in 1991. Total lifecycle energy savings in that period were 101,385 MWh. Annual winter peak demand reductions for the 1990 to 1991 period totalled 2.601 MW, with summer peak demand reductions totalling 0.26 MW. These savings have been accrued through the retrofit of 3,186 homes.

Already in 1992 the program has exceeded its goals for kW and kWh saved, and for number of homes served. As of early November, 1992, 308 homes in New Hampshire, 538 homes in Rhode Island, and 2,515 homes in Massachusetts have been weatherized. The total for 1992 for the period January to early November is thus 3,361.

## PARTICIPATION RATES

Since the RESH Program began in late 1990, over 6,500 customers have participated. There were nine participants in

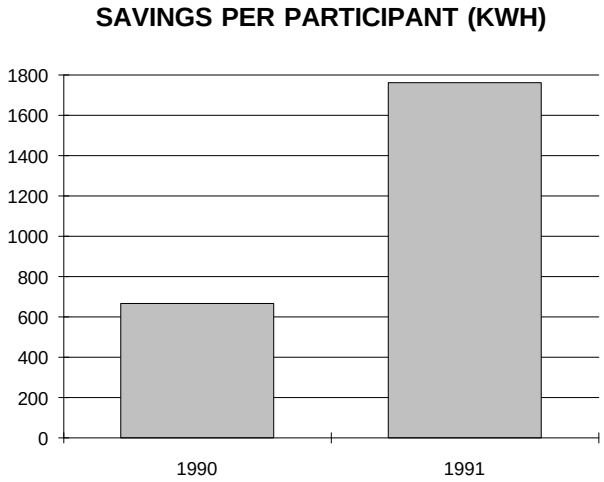



the program in 1990, and 3,177 homes were weatherized in the program's first full year: 1991. While the NEES total residential market is made up of approximately 1,126,000 accounts, 55,893 customers, or just under 5% of the total, are eligible to participate in the program. By the end of 1992 NEES projects that it will have served a total of 4,100 new customers bringing the total served from 1989-1992 to 7,300, 13% of the eligible population.[R#9] From program start to early November, 1992, the program has reached 12% of the eligible market.

By the year 2000 NEES expects that the RESH program will have served 67% of the total eligible market in Massachusetts, 65% in Rhode Island, and 69% in New Hampshire.[R#9]

| **Savings Per Participant Table** | Participants (Number of Homes with Measures Installed) | Annual Energy Savings per Participant (kWh) |
|---|---|---|
| 1990 | 9 | 667 |
| 1991 | 3,177 | 1,762 |
| 1992* | 3,361 | N/A |
| Total | 6,547 | |

[R#6,9] *1992 figures are from Jan. 1 to early Nov.




## MEASURE LIFETIME

The lifetime of installed measures varies from 6 to 30 years. NEES assumes that lighting retrofits have a lifetime of six years; hot water heater and pipe insulation, and air sealing measures have assumed lifetimes of 15 years; insulation measures lifetimes are 30 years; and showerheads and faucet aerators lifetimes are 7 years. For the purpose of calculating lifecycle savings, and for The Results Center's calculation of the cost of saved energy, NEES calculated a composite lifetime of 18.1 years based on the weighted average of the various measure categories.[R#7,9]

## PROJECTED SAVINGS

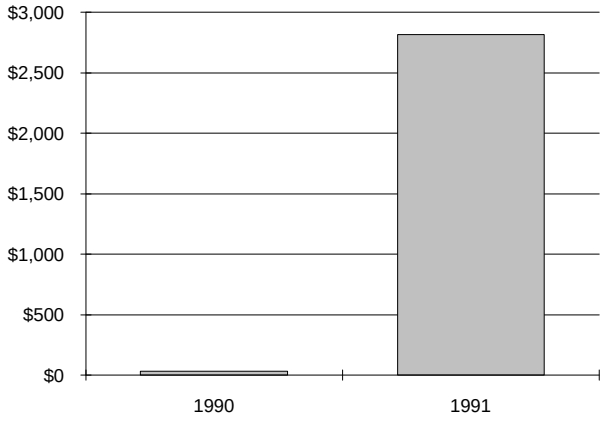
The long-term projected saving for the RESH program from 1992 through the year 2000 is 48,687 MWh annually. Predictions for installed winter peak savings reaching 21,870 kW and summer peak capacity savings of 4,170 kW. This is based on penetrating 65-69% of the electrically heated market in each of the three retail companies' service territories.[R#6]

# Cost of the Program

| Costs Overview Table | Administration (x1000) | Materials, Contractors, Implementation (x1000) | Total Program Cost (x1000) | Cost per Participant |
|---|---|---|---|---|
| 1990 | $2.1 | $32.9 | $35.0 | $3,888.89 |
| 1991 | $169.0 | $2,648.2 | $2,817.2 | $886.76 |
| Total | $171.1 | $2,681.1 | $2,852.2 | |

[R#6]

**TOTAL PROGRAM COST (x1,000)**




**COST PER PARTICIPANT**


| Cost of Saved Energy Table (¢/kWh) | Discount Rates | | | | | | |
|---|---|---|---|---|---|---|---|
| | 3% | 4% | 5% | 6% | 7% | 8% | 9% |
| 1991 | 3.65 | 3.96 | 4.29 | 4.64 | 4.99 | 5.36 | 5.74 |

The total cost for the Space Heat program for 1990 and 1991 was $2.852 million, of which $35,000 was spent in 1990 and $2.817 million was spent in 1991.[R#6]

## COST EFFECTIVENESS

The Results Center calculated the 1991 cost of saved energy as shown in the Cost of Saved Energy Table. The costs range from 3.65 cents/kWh to 5.74 cents/kWh depending upon the discount rate used.

## COST PER PARTICIPANT

The Results Center calculated the cost per participant for the RESH program as shown in the Costs Overview Table. Between 1990 and 1991, there were 3,186 participants at a cost of $2,852,000. The cost per participant for that period is thus $895. For 1990, the total NEES cost per home, including program startup costs, was nearly $4,000, primarily due to expenditures for program start-up. The 1991 cost per participant was $887.

NEES will implement all identified cost-effective measures. For example, if a home has no insulation whatsoever, (eg a summer home converted to year-round use), then installation of insulation would be cost-effective, even though the overall costs would be high. In cases such as these, the cost per home might be as high as $2,000.[R#9]

## FREE RIDERSHIP

Free-ridership was assessed in the process evaluation completed in 1991. Surprisingly, 10-14% of the 352 RESH participants surveyed responded that, "Everything they did I would have done anyway." However, many of these 10 to 14% also indicated that they wouldn't have installed the measures due to lack of money, or because they did not know that the measure was necessary. Discounting these respondents, the rate of free-ridership could be as low as 4% to 9%.[R#8]

## COST COMPONENTS

Of the total program costs, 94% have been spent on "direct" program costs, the other 6% were spent on NEES's administrative costs — largely staff time and printing forms and other promotional materials. Of the 94%, 85% have been spent on weatherization and energy efficiency materials, installation of the measures, and the fees that NEES pays to the vendors for their time in customers' homes explaining the program, obtaining survey data, and the like. The remaining "direct" costs have been spent on contractor administration and software management.[R#9]

# 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% | 12,093,000 | 287,000 | 58,000 | 6,000 |
| B | 10,000 | 1.20% | 12,895,000 | 111,000 | 37,000 | 28,000 |
| | **Controlled Emissions** | | | | | |
| A | 9,400 | 2.50% | 12,093,000 | 29,000 | 58,000 | 0 |
| B | 10,000 | 1.20% | 12,895,000 | 11,000 | 37,000 | 2,000 |
| C | 10,000 | | 12,895,000 | 74,000 | 37,000 | 2,000 |
| | **Atmospheric Fluidized Bed Combustion** | | | | | |
| A | 10,000 | 1.10% | 12,895,000 | 34,000 | 19,000 | 9,000 |
| B | 9,400 | 2.50% | 12,093,000 | 29,000 | 23,000 | 2,000 |
| | **Integrated Gasification Combined Cycle** | | | | | |
| A | 10,000 | 0.45% | 12,895,000 | 23,000 | 4,000 | 9,000 |
| B | 9,010 | | 11,599,000 | 8,000 | 3,000 | 1,000 |
| **Gas** | **Steam** | | | | | |
| A | 10,400 | | 7,034,000 | 0 | 16,000 | 0 |
| B | 9,224 | | 6,108,000 | 0 | 38,000 | 2,000 |
| | **Combined Cycle** | | | | | |
| 1. Existing | 9,000 | | 6,108,000 | 0 | 23,000 | 0 |
| 2. NSPS* | 9,000 | | 6,108,000 | 0 | 11,000 | 0 |
| 3. BACT* | 9,000 | | 6,108,000 | 0 | 2,000 | 0 |
| **Oil** | **Steam--#6 Oil** | | | | | |
| A | 9,840 | 2.00% | 10,180,000 | 154,000 | 18,000 | 17,000 |
| B | 10,400 | 2.20% | 10,797,000 | 153,000 | 23,000 | 11,000 |
| C | 10,400 | 1.00% | 10,797,000 | 22,000 | 18,000 | 6,000 |
| D | 10,400 | 0.50% | 10,797,000 | 64,000 | 23,000 | 4,000 |
| | **Combustion Turbine** | | | | | |
| #2 Diesel | 13,600 | 0.30% | 13,512,000 | 27,000 | 42,000 | 2,000 |
| **Refuse Derived Fuel** | | | | | | |
| Conventional | 15,000 | 0.20% | 16,042,000 | 41,000 | 54,000 | 12,000 |

**Avoided Emissions Based on 5,609,000 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 NEES's level of avoided emissions saved through its Residential Electric Space Heat 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.

## NEES AVOIDED EMISSIONS

New England Electric System is a utility at the forefront of integrating environmental concerns with its operations. The company's plan for the 1990s, NEESPLAN-3, Environment, Economy, and Energy, has three basic goals: To continuously reduce the environmental impact of its electric service, to maintain the competitiveness of its electricity prices, and to enhance its diversity and competitively procured power supply. To accomplish its environmental objectives NEES plans to reduce net air emissions from its operations by an estimated 45% by the year 2000, "continue the nation's leading energy conservation program", and to purchase renewable energy and emissions offsets.[R#11]

New England Electric has been able to defer some construction and purchase of additional generating capacity due in part to its energy efficiency initiatives. Currently, the New England Electric System's marginal power plant, or "proxy" power plant, is a gas-fired steam turbine. (New England Power, the generation division of NEES, has filed this plant with the Federal Energy Regulatory Commission, and the plant has also been presented before each of the three state regulatory commissions to determine avoided costs.)

*** Acronyms used in the table**

TSP = Total Suspended Particulates
NSPS = New Source Performance Standards
BACT = Best Available Control Technology

## LESSONS LEARNED

The RESH program has been effective in reducing customer electricity use in its target market. The program has been especially successful in reducing the high electric bills of low income customers who live in electric space heated dwellings that are under-insulated.

The RESH program evaluations are based upon actual billing analyses, and this technique enhances the reliability of the data on the program savings. For this reason, NEES must be very strict about installing measures only in eligible homes. That is, if a contractor makes a visit to a home that has electric heat installed, but that clearly relies primarily on wood heat, then even though the potential for electricity savings exists, the contractor cannot install most measures. If extensive measures were installed in a wood-heated home, expected savings would not show up during billing analysis, and the RESH program would not achieve its energy-saving goals.

In 1992, NEES implemented several changes to the RESH program in an effort to improve participation rates, measure retention rates, and to facilitate program implementation and tracking. Many of these changes were initiated as a result of the recommendations made in the process evaluation completed in 1991.[R#8]

In 1992, the direct mail piece was redesigned to make the envelope more inviting and clarify the text of the letter, emphasizing end benefits to the customer. RESH staff believe that these changes will help to increase the number of responses to the mailing.

NEES is also reevaluating the customer contribution element that is in effect in Rhode Island. The cost share was implemented after negotiation with the Rhode Island Public Utility Commission to address concerns about cost-effectiveness. However, the $25 fee for the Technical Assessment is adversely affecting participation rates in Rhode Island. As a result, NEES is reviewing the cost share requirement.

As many other utilities implementing energy-efficient lighting technologies have found, NEES's customers who are unfamiliar with compact fluorescent lamps are sometimes unhappy with the new products. NEES has taken several steps to discourage premature removal of the lamps. First, the equivalency table used by contractors in replacing incandescent bulbs was modified to prescribe slightly brighter compact fluorescent lamps. Additionally, NEES is going to be using the verified test results of each manufacturer's lamps in later modifications of the equivalency tables. Customers are also informed that there may be a slight delay before the magnetic-ballasted lamps start, and that they do not start at full brightness. The process evaluation recommended that vendors take foot-candle readings before and after compact fluorescent lamps have been installed, thus demonstrating to the customer that any perceived differences in brightness may not be real. However, because most installations occur during daylight hours, the usefulness of this technique would be compromised, so NEES has not pursued it.

The RESH program had a difficult start-up period in the New Hampshire service area. A large initial mailing resulted in a very high response rate which had not been anticipated by the Community Action Programs which were implementing the program in New Hampshire. Many customers were unhappy with the backlog, and the New Hampshire group has learned to do smaller mailings in the future.

## TRANSFERABILITY

Naturally programs similar to the Residential Space Heat program are most applicable to areas with high concentrations of electric space heating, but as NEES has shown, can be effectively deployed in areas where gas and oil space heating is the norm.

The program will ultimately be best transferred to areas where both the prevailing costs of electricity and the marginal costs are high. In Massachusetts, for example, environmental externalities are included in the calculations of avoided costs. As such, more comprehensive measures can be cost-effectively installed.

An important consideration for utilities is to try to provide comprehensive services. Laura McNaughton notes that in any program where the number of measures included is limited by cost-effectiveness, some opportunities for improving efficiency can be lost. Once a utility enlists the participation of a customer, it is advantageous to install all appropriate efficiency measures in one discrete time period. Such a strategy avoids the need for a utility to have to revisit certain customers in the future, when the utility's avoided costs increase and new measures fall within the cost-effectiveness limit. Such comprehensive weatherization programs have been successful in Hood River and Espanola, as well as at NEES. (See Profile#12 and Profile#16.)

# Regulatory Incentives and Shareholder Returns

Note: Most of the following information was prepared by NEPSCO Rate Analyst, Monica Bushnell, except where specifically referenced to another source. [R#5]

While the principal beneficiaries of NEES's RESH Program are certainly those customers served with energy efficiency upgrades, one of the striking aspects of NEES's rise in prominence in the DSM arena has been the utility's commitment to developing incentives so that NEES shareholders earn a favorable return on their DSM investments. NEES has been a pioneer with incentives for DSM and has worked out equitable incentive packages with not one, but three, utility commissions. In 1989, NEES, along with the Conservation Law Foundation of New England, filed their 1990 DSM program plans for approval with the regulatory commissions of Massachusetts, Rhode Island, and New Hampshire. Each of the three retail utility companies put forth a method by which it could earn a DSM-related incentive. The objectives of the incentive approach were to:

- Guarantee that customers are not negatively impacted by incentives paid to shareholders;
- Share the avoided costs savings in a fair manner, with the majority going to the customers; and
- Ensure that the company would be paid only for performance.

Prior to 1990, conservation and load management programs for Narraganset Electric, Massachusetts Electric and Granite State Electric were designed and implemented by New England Power (NEPSCO), the system's wholesale electric generating and transmission company.

NEPSCO's costs associated with these programs were recovered from each of the retail utility companies through NEPSCO's wholesale rates, and the retail companies were reimbursed by assessing customers through their respective Purchased Power Adjustment mechanism. No financial incentives structures at NEPSCO or the retail utility company level were in place at the time.

In the fall of 1989 each of the System's three retail utility companies filed separate C&LM programs with their respective commissions for the 1990 program year. Included in those filings were mechanisms for the collection of financial incentives. Decisions made by each of the three state commissions made the NEES Companies among the first in the country to be allowed incentives for DSM program performance. All three commissions allowed the program costs to be expensed and recovered in the rates the year they occur.

In Rhode Island and New Hampshire, the commissions approved a shared-savings approach which based each company's incentive on the value created by the C&LM programs. In both jurisdictions the utility companies were able to earn a Maximizing Incentive equal to 5% of the value created (adjusted for customer direct costs and evaluation costs). In addition, the retail companies could earn an Efficiency Incentive equal to 10% of the net value (the difference between the value created and the costs of the DSM program including the maximizing incentive). The remaining savings would flow to customers. In Rhode Island, however, the Commission adopted a minimum performance threshold, resulting in Narraganset Electric earning an incentive on savings above a base value specified by the Commission.

The Department of Public Utilities (DPU) in Massachusetts adopted a different approach. Rather than basing Massachusetts Electric's incentive on a shared-savings mechanism, the DPU established a per kW and kWh bounty for each kW and kWh saved above minimum performance thresholds for kW and kWh. For example, if the utility does not attain 50% of the projected energy savings, no incentive kWh is paid.

For the 1991 program year, the Massachusetts and Rhode Island incentive mechanisms remained virtually unchanged. However, the New Hampshire Public Utilities Commission added a minimum performance threshold.

NEES's 1990 DSM results produced approximately $161 million in savings (or value) for customers. In the same year NEES spent $71 million to procure DSM resources. The $71 million was recovered through a "current recovery" mechanism with the cost of the program spread across all kWh sales. In 1990, NEES shareholders earned an estimated $8.4 million return on investment (ROI) from DSM program investments. The retail companies earned between 12-28% on their DSM investments. (The Massachusetts portion of the incentive has not yet been finalized and will be subject to a second evaluation.)

### SIMPLE SUMMARY OF 1990 DSM INCENTIVES

| | |
|---|---|
| Total generated value | $161.0 million |
| DSM program cost | $71.0 million |
| Net benefit to customers | $80.0 million |
| C&LM earned incentive | $8.4 million |

[R#4]

In its 1991 annual report to shareholders NEES reported that its DSM incentives contributed 7 cents per share to its consolidated earnings. [R#12]

As stated above the incentive paid to shareholders is based on energy and capacity savings. Nevertheless, the overall incentive value can be used to calculate the one-year return on investment (ROI) that shareholders receive for the DSM investments. The following table is presented as a guide to expenditures, incentives, and the one-year ROI received for each retail company's DSM spending.

Notes: The different overall ROI levels indicate the influence and variation of DSM policies in each of the three states. Second, the total expenditures stated below do not add up to the expenditures listed in the table above. The difference represents NEPSCO's DSM costs which are recovered using a current recovery methodology. These costs, approximately $15 million in 1990, are recovered through wholesale electricity rates to the retail companies under the regulation of the Federal Energy Regulatory Commission.

### RETURN ON 1990 DSM INVESTMENTS

| | Expenditure | Incentive |
|---|---|---|
| Massachusetts Electric | $40,309,500 | $4,986,461 |
| Narragansett Electric | $14,317,698 | $2,891,748 |
| Granite State Electric | $1,690,360 | $480,419 |

[R#5]

### 1992 INCENTIVE MODIFICATIONS

All three retail utility companies recently entered into settlements and received approval from their respective commissions for their 1992 programs. There were some changes from the 1991 programs. For example, Granite State will now be required to establish and meet certain thresholds for its residential, commercial, and industrial customer classes. In addition, the Maximizing Incentive for C/I programs was dropped from 5% to 3.5% of value created.

Massachusetts Electric's 1992 C&LM incentive structure has also been changed significantly. For 1992, a two-part mechanism is in place. This mechanism rewards the utility company based on the size and the efficiency of the savings achieved. The Maximizing Incentive will be calculated in essentially the same manner as Massachusetts Electric's current incentive is determined with the exception that it will only represent half of the expected bonus. In addition, the threshold will no longer be fixed, but rather will adjust according to the level of actual spending. The second component, or Efficiency Incentive, will be based on the efficiency of the overall program. Massachusetts Electric will earn the other half of its target bonus if the target benefit/cost ratio is achieved. The actual Efficiency Incentive earned will increase if the target benefit/cost ratio is improved, and decrease if the target ratio is not met. In addition, a penalty will be imposed if the actual customer value created by the overall program is less than the total expenditures. If this should occur, Mass Electric's cost recovery will be limited to the customer value created.

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Special thanks to Laura McNaughton and Chris Granda for their help in the preparation of this profile.