
United Illuminating Energy Opportunities

Profile #63

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Executive Summary

Despite the fact that United Illuminating will likely not need additional generating capacity for at least ten years, the utility has been aggressively pursuing demand-side management as an economic development imperative, using energy efficiency as a means of retaining customers and providing them with a competitive advantage despite quite high rates for electricity. To this end Energy Opportunities is a multi-faceted program designed to help UI's commercial and industrial customers identify and implement energy efficiency measures in existing facilities. Energy Opportunities is a companion program to Energy Blueprint, UI's incentive program for commercial and industrial new construction. (See The Results Center Profile #50.)

Energy Opportunities was first implemented in 1990 and has five distinct components: free audits, free energy pricing reviews, co-funding for advanced energy engineering, cash incentives for installing qualifying measures, and turn-key installation services whereby UI provides all services necessary to implement conservation and load management measures. The first two components build awareness of the potentials for energy efficiency. Advanced energy engineering builds upon the audit component and cash incentives functionally buy-down customers' payback periods for measures installed. Turn-key services provide the means for customers that can't allocate time and resources to planning and implementing retrofits to do so with minimum involvement. In addition, UI has unveiled a Small Business component for the program to focus specifically on retrofitting small businesses with peak demands of less than 50 kW.

One of the unique features of the Energy Opportunities program is that different rebate levels are used based on a number of factors. For instance, measures with longer payback periods bear higher incentive levels. Small business customers are currently eligible for maximum incentives of 70% of the project cost, plus interest free financing for up to nine months, while this threshold is lower for state facilities at 50% of total costs. Finally, manufacturing customers are entitled to higher rebate schedules than commercial customers. Another feature of the program is that UI retains the right to perform post installation inspections and to require participants to guarantee that measures installed will provide savings for a minimum of ten years. Although rarely done, the utility can require participants to enter into service contracts with approved vendors to assure savings over a ten year lifetime.

To date, Energy Opportunities has significantly exceeded its energy and capacity savings goals in each year that it has been run. In 1992 it reached 151% of its energy goal and 178% of its capacity goal. The program is expected to continue in its present form and to provide 22% of UI's peak reductions in the year 2000 and to provide 49% of all conservation and load management energy reductions in 2000.

Energy Opportunities Program

Utility: United Illuminating
Sector: Commercial and industrial retrofits

Measures: Lighting, HVAC, water heating improvements, cooking and refrigeration equipment, motors, and process improvements

Mechanism: Audits, energy pricing reviews, co-funding for advanced energy engineering, cash incentives for qualifying measures, and turn-key installation services

History: Started in 1990

1992 Program Data

Energy savings: 24.1 GWh
Lifecycle energy savings: 241.0 GWh
Peak capacity savings: 5.4 MW
Cost: \$4,153,300

Cumulative Data (1990 - 1992)

Energy savings: 100.0 GWh
Lifecycle energy savings: 545.3 GWh
Peak capacity savings: 11.51 MW
Cost: \$9,052,800

Conventions

For the entire 1993 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 U.S. Federal Reserve's foreign exchange rates.

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

United Illuminating (UI) provides electricity to 17 communities in southwestern Connecticut serving a total of 305,159 customers. The utility has 273,936 residential customers, 28,848 commercial, 1,017 industrial, and 1,358 other accounts.[R#1]

UI's service territory is located in the southern portion of the state and includes about one fourth of Connecticut's coastline along Long Island Sound. Average temperatures for the State of Connecticut during the winter months are usually above freezing and summers average between 70° and 75° F. Coastal areas, however, typically have warmer winters and cooler summers than the state as a whole. Precipitation, on the other hand, is usually evenly distributed throughout the state and averages about three to four inches per month.

The major cities in the UI service territory are Bridgeport and New Haven. UI serves eight universities including Yale University, and several major shopping malls and six major hospitals. Industrial customers include a number of defense industry contractors, manufacturers, brass foundries, architectural hardware fabricators, and printing companies. UI's service area has several large and small industries involved in the production of helicopters, airplane jet engines, transportation equipment, electrical equipment, firearms, chemicals, and pharmaceuticals.

The United Illuminating Company is a diversified investor-owned utility with four wholly-owned subsidiaries.

- Bridgeport Electric Company is a single purpose corporation which owns and leases the Bridgeport Harbor Station generating plant to UI.
- Research Center Inc. participates in the development of power production ventures and may be used in the future for independent power production and cogeneration facilities.
- United Energy International Inc. was formed to participate in a proposed joint venture of power production plants in other countries.
- United Resources Inc. serves as a parent company for UI's unregulated businesses which include Thermal Energy Inc., Precision Power Inc., Southwest Conn Prop Inc., and American Payment System.

UI 1992 STATISTICS

Number of Customers	305,159
Energy Sales	5,153 GWh
Retail Sales Revenue	\$546 million
Summer Peak Demand	1,034 MW
Generating Capacity	1,403 MW
Reserve Margin	35.6 %
Average Electric Rates	10.60 ¢/kWh
Residential	11.69 ¢/kWh
Commercial	10.22 ¢/kWh
Industrial	9.04 ¢/kWh

Given UI's 17.5% ownership of Seabrook Unit 1, its capacity situation changed significantly after the Seabrook nuclear power plant came on line in 1990. When this capacity became available UI went from a position of being in a capacity crunch to a position of surplus capacity. UI currently has a reserve margin of 35.6% and is not expected to need additional capacity for at least ten years.

In 1992, UI had 1,403 MW of generating capacity comprised of coal (34%), nuclear (35%), oil (17%), refuse-derived fuel (8%), gas (1%), and hydroelectricity purchased from Quebec (5%).[R#1] In terms of energy sales, UI sold a total of 5,153 GWh in 1992 with 35% sold to residential, 45% to commercial, and 20% to industrial and other customers. This split between customer classes, coupled with high commercial and industrial rates, has prompted the utility to focus a good deal of its customer services on C/I customers in order to retain these critical customers in the service territory as an economic development imperative. ■

Utility DSM Overview

United Illuminating began its DSM effort in 1980 when it participated in Conn Save, a statewide program in which residential energy audits were performed by an outside contractor. UI's involvement with Conn Save was at least partially in response to a Connecticut Department of Public Utilities requirement that the State's utilities fund energy audit programs. Energy savings that resulted from Conn Save, however, were primarily oil and gas savings due to the low penetration of electric space heating (6.7%) and electric water heating (13%) in the UI service area.

In 1984, UI began implementing DSM programs with its in-house staff. In 1989, UI entered into a three-year collaborative development effort with the Connecticut Department of Public Utility Control, the Connecticut Office of Consumer Counsel, the Connecticut Office of Policy and Management, and the Conservation Law Foundation. The collaborative designed UI's comprehensive conservation plan which has been implemented in conjunction with two load management programs. In 1992, the plan included 11 programs for residential customers, four for commercial and industrial customers, and

DSM Overview	<i>Annual DSM Expenditure (x1000)</i>	<i>Annual Energy Savings (GWh)</i>	<i>Annual Summer Capacity Savings (MW)</i>
Pre 1984	\$7,106	8.6	1.58
1984	\$2,074	13.0	2.64
1985	\$2,915	10.7	2.16
1986	\$3,288	10.9	3.40
1987	\$4,244	16.0	13.09
1988	\$4,090	11.7	13.97
1989	\$3,902	8.9	13.05
1990	\$6,439	26.8	12.74
1991	\$10,405	44.3	12.81
1992	\$11,509	55.6	17.48
Total	\$55,973	206.5	92.92

UNITED ILLUMINATING DSM PROGRAMS

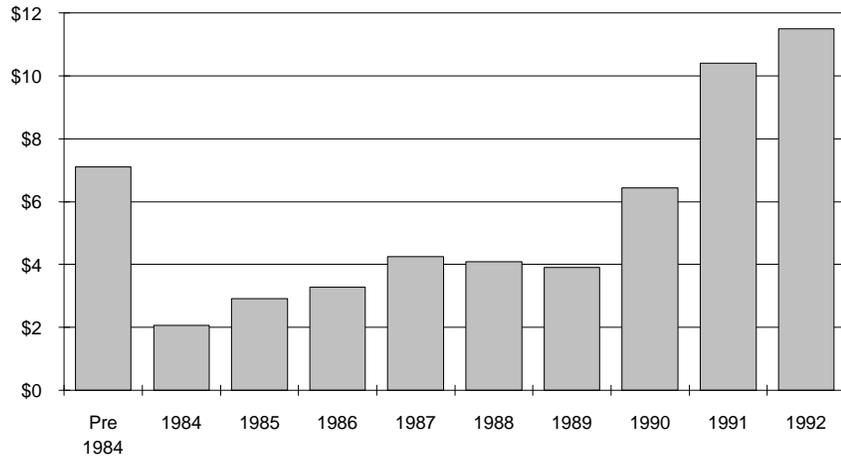
- A) RESIDENTIAL
 - Central Air Conditioning Tune-Ups
 - Good Cents Homes
 - Great CoverUp
 - Efficient Water Heating
 - The Few, The Proud, and The Cool
 - Appliance Pick-Up
 - Smart Energy
 - Homeworks
 - Better Bulb
 - Energy Conservation Loan
 - Residential Conservation Service Audits
- B) COMMERCIAL / INDUSTRIAL
 - Cool Storage
 - Energy Blueprint
 - Energy Opportunities**
 - Standby Generation
- C) OTHER
 - Streetlighting Program

a streetlighting program. The residential programs include the highly-acclaimed Homeworks program, a low-income direct installation retrofit program implemented in conjunction with local gas and water utilities. (See The Results Center Profile #15.)

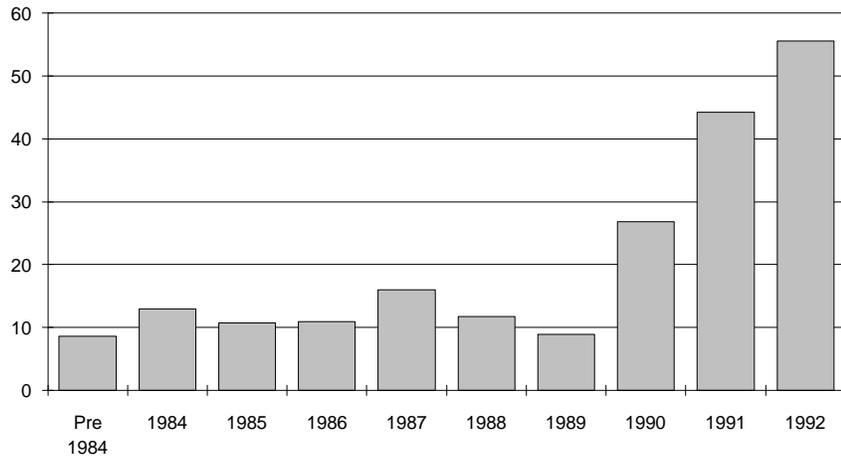
The focus of UI's DSM programs has changed as its utility rates have increased. Programs that specifically appeal to commercial and industrial customers have been implemented in an attempt to maintain these customers who might be struggling to stay in business, seeking to relocate, or be looking at alternative energy sources. The Energy Opportunities Program for energy efficiency retrofits in existing buildings is the subject of this profile. Energy Opportunities and its companion program for new buildings and renovations, Energy Blueprint (see The Results Center Profile #50), were both initiated in 1990 in response to this necessary shift in DSM focus.

In more than ten years of DSM, UI has spent \$60 million and achieved a total of 206.5 GWh in total annual energy savings, and 92.92 MW in total annual demand reductions. UI's 1992 budget for Conservation and Load Management was \$11.5 million or 2.1% of the utility's \$546 million retail energy sales revenue. [R#1,4] ■

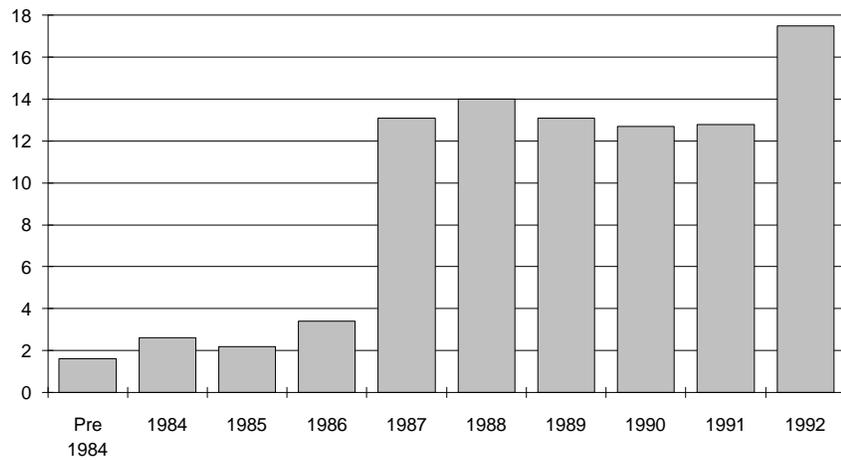
**ANNUAL DSM
EXPENDITURE
(\$1,000,000)**



**ANNUAL
ENERGY
SAVINGS
(GWH)**



**ANNUAL
CAPACITY
SAVINGS
(MW)**



Program Overview

Energy Opportunities is a multi-faceted program designed to help UI's commercial and industrial customers identify and implement energy efficiency measures in existing facilities. By offering a variety of program services, Energy Opportunities seeks to break down barriers that typically prevent customers from installing energy efficiency measures. Energy Opportunities is a companion program to Energy Blueprint, UI's incentive program for commercial and industrial new construction. (See The Results Center Profile #50.)

Energy Opportunities was a collaboratively designed program that grew out of UI's audit program for commercial and industrial customers. The program was first implemented in 1990. Energy Opportunities has five distinct components:

- 1) free audits, (single measure thru comprehensive audits)
- 2) free energy pricing reviews,
- 3) co-funding for advanced energy engineering,
- 4) cash incentives for installing qualifying measures, and
- 5) "Turn-Key Installation Service" whereby UI provides all services necessary to implement conservation and load management measures.

UI has addressed the barriers to implementation of energy-efficiency measures through these program components. First, the energy audits and energy pricing reviews build awareness of energy efficiency alternatives and the potential savings that can be realized through conservation. Second, by co-funding advanced energy engineering, UI encourages participation by customers who may doubt the effectiveness of the extra expense of incorporating efficient measures into their facilities. Third, the Turn-Key Installation Service encourages participation by customers who feel they don't have enough time to dedicate to overseeing and implementing energy-efficiency improvements. Finally, the cash incentives component seeks to reduce the payback period for energy-efficiency measures, thus lowering the financial barrier to installation of energy-efficiency measures.

One of the unique attributes of Energy Opportunities is the rebate schedule for the incentives component of the program. The rebate schedule assumes that in the absence of incentives, measures with longer payback peri-

ods would be implemented less frequently than those with short paybacks. Thus, incentives are based on the payback period of the measures installed; measures with longer payback periods are encouraged with higher incentives.

Originally, measures with paybacks of less than two years were not eligible for incentives at all. However, this was changed to provide incentives for all electric efficiency improvements in the 1991 program.[R#3] In the 1993 program, qualified customers are eligible for 10% to 50% of the measure cost, up to 15 ¢/kWh or 30 ¢/kWh, depending upon the length of the payback period and whether the customer is a commercial or manufacturing customer. (Manufacturing customers are eligible for larger rebates than commercial customers.)

In the 1990 and 1991 programs, incentive levels were the same for all customer types. In 1992 small business customers with peak demand less than 50 kW were eligible for a flat 70% of project costs, while state facilities could receive a flat 50% of project costs.

Starting in 1993, small business customers became eligible for additional incentives through the Energy Opportunities Small Business program. While small commercial customers have been participating in the program, UI felt that penetration of the market was not strong enough. Thus, UI designed a targeted program for small commercial customers. Energy Opportunities Small Business will be available to commercial customers with peak demands less than 50 kW. The program is implemented by a contractor to UI who provides all program services under the supervision of UI. Like its parent program, Energy Opportunities Small Business will provide audits, price reviews, and implementation project management to eligible customers. In addition, incentives are provided to cover up to 70% of the cost of measure installation. Through Energy Opportunities Small Business, participants can receive interest free financing for up to 9 months. This financing usually provides a neutral to positive cash flow.[R#5] ■

MARKETING AND DELIVERY

Marketing for the Energy Opportunities Program (EOP) is done by the customer field services group which emphasizes personal attention by identifying customer needs and cultivating relationships between UI and target customers. Many of the initial program contacts are made by telephone and personal visits. UI also has a marketing strategy called Excel (not to be confused with the spreadsheet software!) through which UI establishes relationships with top executives at the largest companies that UI serves.

EOP is also marketed through presentations at trade shows and community events, and print advertising and bill inserts are also occasionally used. UI publishes a quarterly newsletter called “Power Planner” for commercial and industrial customers and trade allies which includes information about ongoing projects and programs, as well as energy management technologies. While trade allies have been successful in promoting the program, UI prefers to initiate projects itself and thus focuses its marketing efforts on the personal, one-on-one approach.

The program’s process evaluation completed in 1993 determined how 287 program participants had heard about the Energy Opportunities Program. The evaluation found that 47% of the participants had heard about EOP from UI-initiated sources, including personal contact, mailings, bill inserts, and other company programs. Nineteen percent of the sources were customer-initiated – either a customer had complained about a high bill or had asked for information and was referred to the program. Twenty-five percent had heard about the program from a third-party source, either a trade person, a friend or business contact, or some other third party. (Nine percent did not remember or did not respond to the question.) [R#8]

DELIVERY: THE STEP BY STEP PROCESS

THE AUDIT AND OPTIMUM ENERGY PRICING REVIEW

The first step for participants in the Energy Opportunities Program is usually an energy audit or what is called an “Energy Evaluation” by program staff. During this audit energy efficiency opportunities are identified. Secondly, customers’ rate schedules are reviewed as part of the program’s “Optimum Energy Pricing Review” component.

UI has chosen to include rate reviews for customers to make sure they are aware of how to make effective use of the time-of-use rates, demand structures, and know of the difference between “average cost per kWh” and the “true value” of conservation measures. Rarely are customers on incorrect rates. When UI first looked into offering incentives, it was found that contractors and vendors were the predominant drivers in the market, and they rarely quoted the true dollar savings from reducing a customer’s energy consumption. These quotes of savings almost always use the total bill divided by the total kWh consumption for an average kWh cost. This includes basic service charges, demand charges, and fuel cost adjustments. UI sought to formalize the review process to both assure customers of the correctness of the rates and to offer the opportunity to help customers make the most of off-peak rates. [R#10]

If the audit identifies measures which require detailed design or engineering analysis prior to implementation, then UI will co-fund the design analysis through the “Co-funded Advanced Energy Engineering” component of Energy Opportunities.

Note: “Audit” is a very unstructured term in Energy Opportunities. Whether a customer wants a “comprehensive audit,” a “walk-through,” or a “single measure review,” UI considers each of these to be “audits.” Thus, what the utility delivers in an audit varies greatly. In general, audits suggest measures which the Sales Engineer determines are acceptable to both the customers’ financial and application needs as well as meeting UI’s desire to have long lasting DSM installations. There is not a cost effective measure list dictated by UI as nearly any legitimate measure is acceptable to the program. Thus UI acknowledges that different customers in different circumstances will require different consideration for measures recommended. [R#10]

TURN-KEY INSTALLATION SERVICE

Customers may be eligible for the direct installation component of Energy Opportunities, the “Turn-Key Installation Service.” This service is available to small commercial customers whose demand is less than 50 kW, state customers, and to select customers (select customers are industrial customers who are interested in implementing a project but are financially strapped). Starting in 1993, the Turn-Key Installation Service is offered through the Energy Opportunities Small Business program. The turn-key component for small business customers is 

Implementation (continued)

entirely implemented by a contractor to UI. After determining customer eligibility, the contractor conducts an audit and design analysis for the customer's facility. A proposal is submitted to the customer detailing the recommendations for energy-efficiency improvements.

Small Business program measures are pre-engineered and developed for inclusion into the program and must pass a cost effectiveness screening for UI. Many of the measures recapture the efficiencies originally built into the energy systems (gaskets on refrigeration systems), while others strive for more state-of-the-art improvements such as T8 lamps and electronic ballasts. Whatever the measure, UI claims some amount of the energy improvement over existing conditions for a prorated life of the technical life of the measure, typically 7 years. [R#10]

If the customer decides to proceed with the project, measure installation is completed by the contractor or subcontractors. The customer is responsible for 50% of the total project costs, with UI contributing the remaining 50% of the costs. (This service is somewhat analogous to other small commercial retrofit programs, though the other programs profiled by The Results Center have paid the full costs of the retrofits. See Profiles #1, #31, and #48.)

INCENTIVES

Large customers or small commercial customers who are not eligible for the Small Business component may receive incentives under Energy Opportunities without first having an audit or design analysis. The customer must complete an application and incentive calculation worksheet which are submitted to UI for approval. Upon receipt of the application, UI determines if the project is eligible under Energy Opportunities. In order to verify the existing equipment, a pre-installation survey must be conducted if the customer has not had an energy audit. In some cases UI will require a detailed analysis of the project's demand and energy reduction potentials and the life expectancy of the measures. Upon approval of the project the customer may proceed with installation of the measures.

POST INSTALLATION AND PAYMENTS

After the measures have been installed the customer must submit copies of all paid invoices to UI. UI staff then conduct post-installation inspections for each project to

ensure that the measures have been properly installed and that anticipated energy savings are likely to be achieved. If the post-installation inspection is satisfactory, then UI will issue the incentive check in accord with the application agreement. Payment is generally made within 60 days of the post-installation inspection.

MEASURES INSTALLED

Through Energy Opportunities, UI's commercial and industrial customers receive audits and incentives to install energy efficiency measures recommended during the audits. The evaluation of 240 customers who had energy audits conducted in 1991 revealed that indoor lighting equipment was the most frequently recommended and installed conservation measure. Other measures include outdoor lighting equipment, heating and cooling equipment, water heating improvements, cooking and refrigeration equipment, motors, and process improvements. Additionally, energy recovery measures and cogeneration systems may be eligible for design funding and incentives under Energy Opportunities. Incentive levels and structures vary depending on the type of customer, as shown in the Rebate Table. Customers are not required to obtain any predetermined efficiency levels. A minor efficiency improvement is rewarded with a minor incentive. [R#10]

STAFFING REQUIREMENTS

Energy Opportunities is administered and implemented by 10.5 full-time equivalents (FTEs). The program is one of the programs managed by Robert Mills, who is assisted by marketing and sales representatives who perform audits and customer site inspections, assist customers with rebate applications, and provide other customer services. In addition, the Supervisor of Energy Services, Sean West, oversees the program implementation and administration. One member of the Energy Services group devotes half of his time to evaluating the program.

The Energy Opportunities Small Business program is implemented entirely by a contractor to UI. The contractor was selected through a competitive bid process to implement the program. UI estimates that the contractor has 2 FTEs working on the program. ■

CASE STUDY: FIRST NATIONAL STORES

First National Stores took full advantage of the services offered under Energy Opportunities. The chain has four retail groceries in UI's service territory and through Energy Opportunities they were able to identify areas for energy-efficiency improvements, receive incentives for installing energy-efficient equipment, and switch to an optimal electric rate. The changes implemented in the four stores are expected to save \$115,000, 1,373 MWh, and 158 kW yearly.

The biggest savings will come from the lighting improvements implemented. Nearly 2,000 lighting fixtures were converted to energy-efficient fixtures, for expected savings of 827 MWh and 122 kW. This part of the project qualified for an incentive payment of \$19,000, while First National Stores invested \$130,000. Lighting improvements are expected to save \$69,000 each year in energy costs.

Installation of energy management systems in the four stores qualified for an incentive payment of \$43,000, with First National Stores investing \$162,000. The energy management systems provide efficient monitoring and temperature control, replacing less efficient individual thermostats and pressure controls on the stores' refrigeration units. The energy management systems are expected to achieve annual energy savings of 286 MWh and cost savings of \$16,000 per year.

A retrofit of the motors and drives on the stores' HVAC systems qualified for an incentive of \$7,000 and is expected to achieve annual savings of 260 MWh and 36 kW. The annual energy-cost savings attributable to this part of the project is \$15,000. First National Stores invested \$35,000 in the retrofit.

Finally, through Energy Opportunities optimal pricing review component, it was determined that the stores would benefit from a different rate structure. The stores use energy primarily during off-peak hours, and switching to a new rate is expected to save \$15,000 yearly.

CASE STUDY: LENDER'S BAGEL BAKERY WAREHOUSE

The Energy Opportunities program performed an audit at the Lender's Bagel Bakery warehouse and found that installation of air curtains would cut energy use dramatically. Air curtains are used to prevent inflow of warm air and outflow of chilled air when refrigerator and freezer doors are opened. Instead of plastic strips, which provide a physical barrier, an air curtain is a thermal barrier to heat transfer.

Installation of air curtains not only reduces energy use, but cuts down on dust, humidity, and airborne contaminants, as air is circulated through a fan and filter. Additionally, use of the air curtain ensures more stable freezer temperatures. The air curtains are expected to save 110 MWh per year, and \$5,500 in annual energy-cost savings. Lender's invested \$11,500 in the project, and UI paid an incentive of \$3,000.

Monitoring and Evaluation

MONITORING

The Energy Opportunities program is tracked through a sophisticated database that has evolved over the course of several years. This provides monthly and annual tracking reports and can be sorted in a number of ways to highlight different variables and impacts.

Load shapes developed over the course of several years are used in determining peak demand savings as well as determining the distribution between on- and off-peak energy savings. Load shapes are constantly being revised as the results of new evaluation efforts become available. The Energy Opportunities impact evaluation will include analysis and revision of the load shapes used in determining program savings.

Energy Opportunities staff perform a post-installation inspection (lasting anywhere from 20 minutes to 3 hours) of all projects prior to issuing an incentive check. In this way staff can ensure that installations conform with current practices and that expected savings are likely to be realized. The customer must agree to ensure that energy and demand savings are not diminished if maintenance or replacement is necessary within ten years of equipment installation. UI checks up on customers with phone calls and site visits anytime from a few months up to two years after installations have taken place. If indicated, UI may require customers to enter into a service contract with an approved vendor that ensures that savings will remain in place for ten years. Program participants have entered into these service contracts in only a very few instances. UI has not actively pushed for such contracts.[R#7]

UI also reserves the right to monitor customers' equipment to determine actual energy and demand savings from measure installation. However, incentive payments would not change if monitoring showed different savings from those used in determination of the incentive payments. UI monitors a significant number of projects, both pre- and post-installation. This monitoring aids in devel-

oping an understanding of the actual energy performance of special and common measures implemented through the program.[R#7]

EVALUATION

In 1993, UI completed a process evaluation of the Energy Opportunities program. The evaluation was based primarily on a survey of 287 customers who received energy audits in 1991, and 199 non-participants randomly selected from UI's 30,000 commercial and industrial customers. In addition, the process evaluation included interviews with Energy Opportunities program and field staff, and three vendors.

Overall, the process evaluation found that most customers, vendors, and program staff were very satisfied with the program, its implementation, and the results it has achieved. The process evaluation found that only one-third of non-participants were aware of the program, and recommended increasing marketing efforts to broaden the base of customers who are aware of the program.

Most customers felt that the rebate application process was simple and that the paperwork was easy to fill out. Of the participants analyzed, 52% said they had filled out the rebate applications themselves, 38% were filled out by UI staff, and 14% were filled out by the dealer. Interestingly, though customers were satisfied with the application process and worksheet designs, vendors expressed some dissatisfaction. The vendors found the worksheets cumbersome and thought that when an energy analysis was required the process was slowed down. One way that the Energy Opportunities program has expedited the incentive application process from the vendor's point of view has been the installation of a fax number. In this way, vendors may fax project proposals and applications to the Energy Opportunities staff who can approve the incentive calculations for submittal to a customer within 48 hours.[R#8]

The process evaluation also found that schools, industrial facilities, nonprofits, and government facilities represented the majority of the participants in the program. Smaller commercial and industrial customers were not participating in the program in proportionate numbers. The implementation of the Energy Opportunities Small Business program in 1993 was done to encourage participation by this under-represented segment. UI believes that the 50% incentive combined with the turn-key services and free nine-month financing addresses the majority of customer resistance to implementation.[R#10]

The process evaluation also looked at barriers to participation through a comparison of participants' and non-participants' answers to a series of questions. Of the one-third of non-participants who were aware of the program, many did not participate in the program because they thought participation would be difficult or time-consuming. Additionally, many non-participants (41%) believed they would not benefit from the program, while another 41% did not feel they had enough information to pursue participation. Twenty-two percent did not think they were eligible to participate.[R#8] Interestingly, participants were more likely than non-participants to think their equipment could be more efficient, indicating the influence of the program on customers' attitudes toward efficiency.

Ongoing impact evaluation efforts utilize a combination of strategies and techniques. UI recognizes both the importance and the uncertainty of the baseline, or pre-existing, condition in calculating and measuring savings. The company periodically updates the baseline assumptions for standard building practices, equipment availability and market preferences in its area through surveys, interviews and field contacts. In addition, UI is validating engineering estimates of hourly load savings through short-term metering of installed measures using various data loggers, including experimental devices developed under an Electric Power Research Institute tailored collaboration.[R#6]

UI is also planning to focus on persistence of measures and savings in its impact evaluation efforts. An on-site inspection will document whether specific measures have been maintained and are still contributing the same energy and capacity savings as were anticipated when the measures were first installed. Hours and days of equipment operation will also be investigated as part of the persistence studies.[R#6] These studies are currently underway with 0.5 FTE working on them.

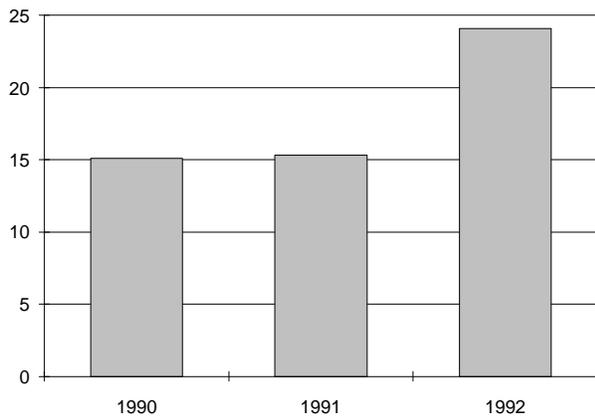
As a final impact evaluation strategy, UI is collaborating with several other New England utilities to determine savings attributable to specific energy conservation measures. As part of this undertaking UI will be experimenting with different types of measuring devices including the "Basic Measuring Instrument" and other types of data loggers. In the second phase of its impact evaluation UI will conduct a survey of baseline building practices and use the Basic Measuring Instrument to confirm engineering estimates of energy savings.[R#4,5,6] ■

Program Savings

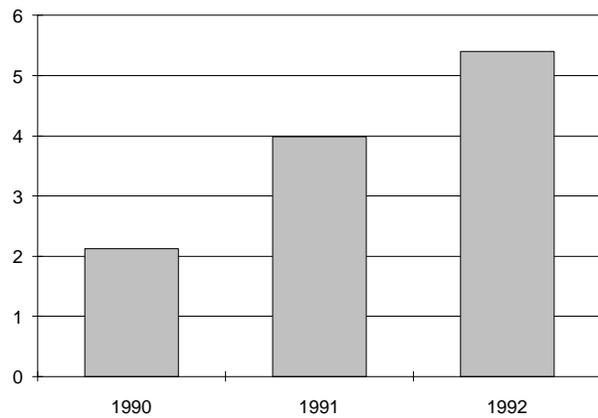
Savings Overview	Annual Energy Savings (MWh)	Cumulative Energy Savings (MWh)	Lifecycle Energy Savings (MWh)	Annual Peak Capacity Savings (MW)	Cumulative Peak Capacity Savings (MW)
1990	15,084	15,084	150,838	2.125	2.125
1991	15,341	30,425	153,410	3.987	6.112
1992	24,109	54,534	241,090	5.400	11.512
Total	54,534	100,042	545,338	11.512	

Data Alert: While UI does not derate program savings for a specific level of free ridership, the utility does factor the free ridership issue into its savings by offering conservative incentive amounts and assigning a conservative measure lifetime to the program. The utility also realizes that there are several additional factors which likely effect savings estimates including confidence of operating schedules and replacement with comparable components upon failure. [R#10]

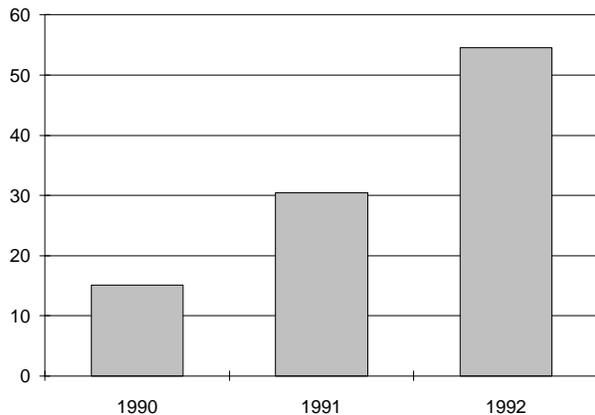
ANNUAL ENERGY SAVINGS (GWH)



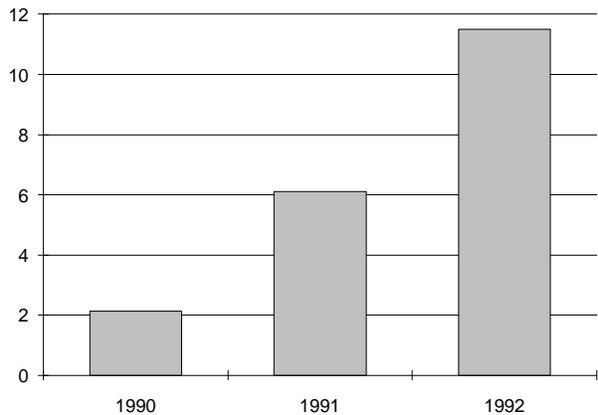
ANNUAL PEAK CAPACITY SAVINGS (MW)



CUMULATIVE ENERGY SAVINGS (GWH)



CUMULATIVE PEAK CAPACITY SAVINGS (MW)



In its three years Energy Opportunities has achieved annual energy savings of 54.5 GWh and annual peak capacity savings of 11.5 MW. Annual energy savings in the first two years of the program were similar, at 15 GWh, and in 1992 annual energy savings increased with 24 GWh achieved. Peak capacity savings have increased each year from 2.1 MW to 4.0 MW, and 5.4 MW in 1992.

PARTICIPATION RATES

While all 30,000 of UI's commercial and industrial customers are eligible to participate in Energy Opportunities, UI has focused its marketing effort on a subset of the eligible market, the 1,000 largest customers within the service territory. Additionally, the program targets state facilities and small commercial customers.

In three years, 1,212 customers have received audits through Energy Opportunities for an overall audit participation rate of 4%. The number of customers receiving incentives through the rebate portion of the program totals 528, or almost 2% of the total eligible population. On average for the three years, 43% of those customers receiving audits have received incentives through the program. Note, however, that not all incentive participants receive audits, nor do all audit participants apply for incentives.

FREE RIDERSHIP

The evaluation of the Energy Opportunities program completed in February 1993 included an estimation of free-ridership. Eighty-one rebate participants were asked what impact the rebate had on the timing, quantity and efficiency of their equipment purchases. A high free-ridership scenario found that 27% of the participants were free-riders, while the low free-ridership scenario revealed free-ridership of 16%. [R#8]

The Energy Opportunities program never sought to discourage free ridership. UI has attempted to make conservation a part of customers' everyday business decisions by including the value of the energy performance in their decision making process. This does not allow UI to assume energy operating costs are the only or even predominant factor in the decision making effort, but rather places energy on the list of issues which a customer must consider. The incentive structure attempts to derate the incentive as energy becomes less of a concern to the customer. [R#10]

Participation	<i>Audit Participants</i>	<i>Incentive Participants</i>	<i>Annual Energy Savings per Incentive Participant (kWh)</i>
1990	314	169	89,253
1991	475	173	88,676
1992	423	186	129,618
Total	1,212	528	

MEASURE LIFETIME

UI uses an average lifetime of 10 years for measures installed through the Energy Opportunities program. Many of the measures installed are lighting efficiency improvements, with shorter lifetimes than heating, cooling and refrigeration equipment, motors, and other durable equipment installations. The Results Center used the 10-year average lifetime in calculating lifecycle savings and the cost of saved energy.

PROJECTED SAVINGS

Program goals for 1993 are to reach 455 customers and achieve 15 GWh in energy savings and 3 MW in peak capacity savings. These goals include savings and customers in the small business pilot (150 customers, 0.7 GWh and 0.275 MW) and the state component (5 customers, 2.2 GWh and 0.3 MW) of Energy Opportunities. [R#5]

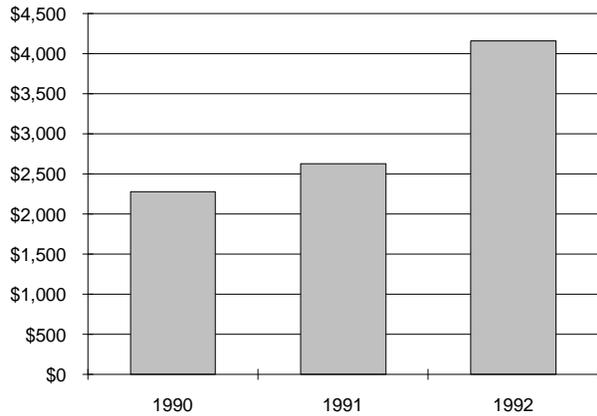
The program has significantly exceeded its energy and capacity savings goals in each year. In 1992 EOP reached 151% of the energy goal and 178% of the capacity goal. In 1991, EOP reached 210% of the savings goal and 181% of the capacity goal. In 1990, EOP reached 277% of the energy goal and 206% of the capacity goal. [R#2,3,4]

Energy Opportunities is expected to continue in its present form and is projected to provide 22% of UI's conservation and load management peak reductions in the years 2000 and 2010. The program is also expected to contribute 49% of all conservation and load management energy reductions in 2000, and 54% in 2010. [R#4] ■

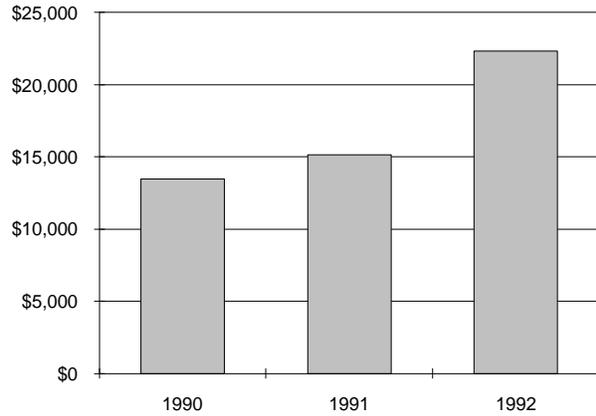
Cost of the Program

Costs Overview	<i>Administration (x1000)</i>	<i>Advertising (x1000)</i>	<i>Contract Labor (x1000)</i>	<i>Incentives (x1000)</i>	<i>Monitoring & Evaluation (x1000)</i>	<i>Total Program Cost (x1000)</i>	<i>Cost per Participant</i>
1990	\$291.4	\$17.8	\$913.8	\$1,004.9	\$47.2	\$2,275.1	\$13,462.36
1991	\$294.0	\$21.7	\$1,326.3	\$976.7	\$5.7	\$2,624.3	\$15,169.45
1992	\$553.7	\$54.9	\$1,264.3	\$2,275.2	\$5.1	\$4,153.3	\$22,329.56
Total	\$1,139.1	\$94.5	\$3,504.4	\$4,256.8	\$57.9	\$9,052.8	

TOTAL PROGRAM COST (x1,000)



COST PER PARTICIPANT



Cost of Saved Energy (¢/kWh)	<i>Discount Rates</i>						
	3%	4%	5%	6%	7%	8%	9%
1990	1.77	1.86	1.95	2.05	2.15	2.25	2.35
1991	2.01	2.11	2.22	2.32	2.44	2.55	2.67
1992	2.02	2.12	2.23	2.34	2.45	2.57	2.68

Between 1990 and 1992 UI spent a total of \$9.05 million on the Energy Opportunities program. Costs have risen each year from \$2.3 million in 1990, to \$2.6 million in 1991, and \$4.2 million in 1992. [R#10] In 1993, a total of \$3.4 million (unlevelized) was budgeted, with \$0.37 million budgeted for the Small Business component, \$0.34 million budgeted for the State component, and \$2.7 million budgeted for the remainder of the Energy Opportunities program. [R#5]

COST EFFECTIVENESS

The Results Center calculated the annual cost of saved energy for the Energy Opportunities program as shown in the accompanying table for a range of discount rates. The cost of saved energy was lowest in 1990 when the costs ranged from 1.77 ¢/kWh to 2.35 ¢/kWh depending upon the discount rate used. At a 5% discount rate, the 1990 cost of saved energy was 1.95 ¢/kWh. In 1991 the cost of saved energy at 5% increased to 2.22 ¢/kWh and in 1992 the cost at 5% increased slightly to 2.23 ¢/kWh. This upward trend is likely due to more expensive and elaborate retrofits as the program has developed.

COST PER PARTICIPANT

The Results Center calculated the overall cost per participant for the Energy Opportunities program by dividing

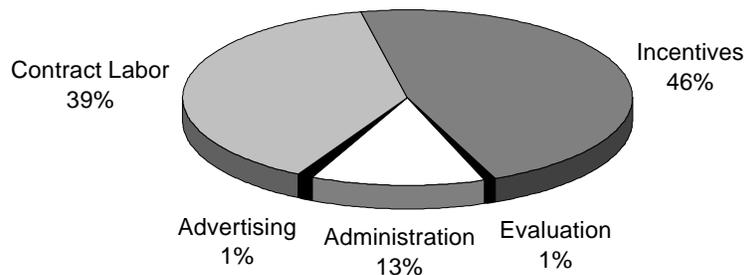
each year's total utility cost by the total number of participants (participants receiving incentives) each year. Using this methodology, the cost per participant has increased from \$13,462 in 1990 to \$15,169 in 1991 to \$22,330 in 1992.

The average cost per audit, including those completed by consulting engineers and sources internal to UI, is approximately \$2,000. This cost is likely higher than other programs due to the desire to maximize impact and deliver design specifications along with audit findings for the special needs customers (state, municipal, distressed, small business, etc.). The average customer incurred cost per installation for the program has been \$33,057. [R#10]

COST COMPONENTS

In 1992, UI spent \$2.3 million on incentives, or 55% of the total program costs for that year. The remaining 45% of the costs were distributed among the following categories: contract labor \$1,264,300, administration \$553,700, advertising \$54,900, and monitoring and evaluation \$5,100. [R#10]

From 1990 through 1992 UI spent a total of \$4,256,800 on incentives, \$3,504,400 on contract labor, \$1,139,100 on administration, \$94,500 on advertising, and \$57,900 on monitoring and evaluation. [R#10] ■



Environmental Benefit Statement

AVOIDED EMISSIONS: Based on 100,042,347 kWh saved 1990 - 1992

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

A	9,400	2.50%	215,691,000	5,117,000	1,034,000	103,000
B	10,000	1.20%	229,997,000	1,981,000	668,000	495,000

Controlled Emissions

A	9,400	2.50%	215,691,000	512,000	1,034,000	8,000
B	10,000	1.20%	229,997,000	198,000	668,000	33,000
C	10,000		229,997,000	1,321,000	660,000	33,000

Atmospheric Fluidized Bed Combustion

A	10,000	1.10%	229,997,000	605,000	330,000	165,000
B	9,400	2.50%	215,691,000	512,000	414,000	31,000

Integrated Gasification Combined Cycle

A	10,000	0.45%	229,997,000	407,000	66,000	165,000
B	9,010		206,888,000	147,000	50,000	10,000

Gas Steam

A	10,400		125,453,000	0	286,000	0
B	9,224		108,946,000	0	682,000	32,000

Combined Cycle

1. Existing	9,000		108,946,000	0	418,000	0
2. NSPS*	9,000		108,946,000	0	198,000	0
3. BACT*	9,000		108,946,000	0	28,000	0

Oil Steam--#6 Oil

A	9,840	2.00%	181,577,000	2,751,000	325,000	308,000
B	10,400	2.20%	192,582,000	2,729,000	408,000	198,000
C	10,400	1.00%	192,582,000	390,000	328,000	103,000
D	10,400	0.50%	192,582,000	1,144,000	408,000	63,000

Combustion Turbine

#2 Diesel	13,600	0.30%	241,002,000	480,000	745,000	41,000
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Refuse Derived Fuel

Conventional	15,000	0.20%	286,121,000	737,000	971,000	216,000
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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 accompanying page is to allow any user of this profile to apply United Illuminating's level of avoided emissions saved through its Energy Opportunities 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 include a 10% credit for DSM savings to reflect the avoided transmission and distribution losses associated with supply-side resources.

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

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

* Acronyms used in the table

TSP = Total Suspended Particulates

NSPS = New Source Performance Standards

BACT = Best Available Control Technology

Lessons Learned / Transferability

LESSONS LEARNED

The savings and level of satisfaction of customers with the Energy Opportunities program are indicative of the success that the program has enjoyed. The program has achieved 55 GWh in annual energy savings and a total of 11.5 MW in peak demand savings in just three years of operation, after having reached just 4% of the eligible population with audits and just under 2% with incentives. In addition, a clear majority of 253 participants surveyed indicated that they were very satisfied with the program and with the UI representative's competence and helpfulness. [R#8]

The influence of the energy audit on customers' energy efficiency attitudes and behaviors was also confirmed through the process evaluation. When comparing participants to non-participants, it became clear that participants had more optimistic views of their ability to improve energy efficiency in their facilities. There is, of course, no way of knowing whether non-participants truly did have super-efficient equipment. However, it is likely that the non-participants were simply not aware of the opportunities for improving the efficiency of their equipment, and thus viewed their existing equipment as being the most efficient available.

One of Energy Opportunities greatest successes according to supervisor Sean West is that the program helps to retain customers who may be thinking of moving out of the service area or who may be considering reducing production levels or even going out of business entirely. Program staff make a concerted effort to help customers identify areas where they can save money. Customers may be helped to stay on their feet through the savings and incentives provided by UI. With this focus on flexibility and customer service, the program has been instrumental in helping UI to retain its customer base even in the face of a sluggish economy. [R#9] For example, a locally based metalworking company was in financial trouble and was considering moving out of state, but decided to stay after they found that the energy-efficiency incentives and cost-cutting measures through Energy Opportunities and other UI programs would cut their costs significantly. [R#1]

Sean West also noted that many customers are initially motivated to ask for an energy audit when they recognize a need to cut operating costs. When the energy audit is conducted and recommendations for saving en-

ergy and reducing costs are made, the customer realizes that some expenditures must first be made before any savings can be realized. Customers may not have the available resources to immediately implement the recommendations, or they may be reluctant to make any investments when they are trying to cut costs. For this reason, there is often a 12 to 18-month lag time between the time a customer receives an energy audit and the decision to implement the recommended measures.

In fact, the Energy Opportunities evaluation found that the number of customers who indicate that they are definitely not planning to implement any recommended measures drops as time passes after the audit. [R#8] These customer attitudes point to the importance of flexibility in timing and continued customer contact after the audit in order to improve the frequency of installation of recommended measures.

The Energy Opportunities program has implemented several changes since the program was initiated in 1990. The incentive levels have been modified and terms and conditions refined in order to best encourage implementation of measures while at the same time ensuring that anticipated savings are realized. Perhaps the largest change in the program has been the introduction of the Small Business component in 1993. UI recognized that this market was not being adequately served by the Energy Opportunities program, and made the modifications in marketing and implementation strategies in order to better serve that segment of the population.

TRANSFERABILITY

Most utilities include a commercial and industrial audit and retrofit program in their DSM portfolios. UI's program is highly transferable in that it provides versatility in implementation strategies to meet the varied needs of its target customers. The incentive structure for the program may be particularly attractive to other utilities that wish to encourage implementation of measures that are likely to achieve persistent savings. By combining a program aimed at both small and large commercial/industrial customers with the special component for small commercial customers, UI has achieved economy in implementation while at the same time reaching the varied segments of the program's target population. ■

Regulatory Incentives and Shareholder Returns

Traditional utility ratemaking, where each and every kilowatt-hour sold provides profit, is a major barrier to utilities' implementation of energy efficiency programs. Several state regulatory commissions and their investor-owned utilities have been pioneers in reforming ratemaking to: a) remove the disincentives in utility investment in DSM programs, and b) to provide direct and pronounced incentives so that every marginal dollar spent on DSM provides a more attractive return than the same dollar spent on supply-side resources.

The purpose of this section is to briefly present exciting and innovative incentive ratemaking mechanisms where they're applied. This we trust, will not only provide some understanding to the reader of the context within which the DSM program profiled herein is implemented, but the series of these sections we hope will provide useful snapshots of incentive mechanisms being used and tested across the United States. (Note that dollar values presented in this section have not been levelized.)

CONNECTICUT OVERVIEW

Integrated Resource Planning (IRP) is in practice in Connecticut through requirements that utilities submit conservation and load management plans to the Connecticut Department of Public Utility Control (DPUC) annually. A comprehensive IRP filing is currently required biannually. By law, Connecticut's utilities may recover the costs of DSM programs, both in terms of actual DSM costs and resulting lost revenues, by capitalizing and amortizing most expenditures and including them in the ratebase.[R#12]

The DPUC has taken several steps to remove the disincentives for utilities' investments in demand-side management. Both of the state's utilities, UI and Connecticut Light & Power (a subsidiary of Northeast Utilities), are engaged in separate collaborative processes. These collaboratives have helped to get the disincentives to investments in DSM removed and replaced with attractive incentive mechanisms.[R#12]

DSM PROGRAM EXPENDITURES & LOST REVENUES

Utilities in Connecticut can ratebase their conservation and load management expenditures using an average life to amortize the investments included in the rate base. Both UI and CL&P are also allowed to recover lost revenues resulting from DSM programs. Lost revenues are included in the test year forecast and are thus recovered in base rates in the first year following a rate case. Lost revenues realized in subsequent years are recovered through Connecticut's year-old Conservation Adjustment Mechanism.[R#12]

In the fall of 1992 the Connecticut DPU approved an energy Conservation Adjustment Mechanism (CAM) for both United Illuminating and CL&P that will be adjusted annually and which is folded into the monthly fuel adjustment clause. (It therefore does not appear separately on customers' bills.) The CAM provides a systematic means of rectifying DSM program costs and savings after verification. While decoupling had been in place in Connecticut prior to the CAM, the CAM is a "clean shot" that allows for accurate balancing of DSM program costs. As evaluation practices become more refined (for example engineering estimates of savings are replaced with metered data), the CAM will allow for more refined and systematized feedback for cost recovery and incentive purposes.[R#6,12]

Note that the CAM, like fuel adjustment clauses, allows for the two-directional flow of money. If UI doesn't spend its authorized amount on DSM, as was the case in 1992 when the utility spent a million dollars less than authorized, then the money is returned to ratepayers (or put in an escrow account for future year DSM costs.) Similarly, if UI's evaluations of specific programs reveal less savings than had been initially reported, then ratepayers are compensated as UI has to return a portion of the money that had been set aside for lost revenue adjustments. Inversely, if UI's program participation levels exceed plans, and more savings are accrued and more money is spent than planned, UI can recover its costs using the CAM mechanism. (UI's first use of CAM will be in October of 1993.)[R#6]

SHAREHOLDER INCENTIVES

A 1988 state statute allows the DPUC to grant utilities an additional 1-5% rate of return on ratebased DSM investments. (Note that by law the state's utilities can earn

Regulatory Incentives (continued)

up to 5 basis points above the company's overall rate of return for ratebased DSM investments, but that in practice, the DPUC has made it clear that it will only reward utilities with up to 3 basis points as a bonus.) The incentive, which was designed by the collaborative, rewards the United Illuminating Company for minimizing costs and maximizing electricity savings in the implementation of its demand-side management programs. The incentive allows UI to recoup its DSM program expenditures over a ten-year period at its normal rate of return plus a bonus rate which is based upon the aggregate success of its DSM programs. There are no penalties for poor performance.

The bonus rate of return is determined by a unique DSM program scoring system. Each of the applicable DSM programs, including Energy Opportunities, contributes to the overall DSM Performance Score. Each program's contribution is based on the following factors:

1. Planned Cost Rate (PCR) – the expected annual program cost divided by the expected lifetime energy or capacity savings of measures to be installed that year.
2. Actual Cost Rate (ACR) – the actual annual program cost divided by the committed lifetime energy or capacity savings of actual measures installed that year.
3. Program Performance Ratio (PPR) – PCR/ACR.
4. Program Weight – the fourth root of the product of the program budget and the square of the ratio of costs to benefits. The sum of all program weights is 100.
5. Program Score – PPR multiplied by the Program Weight.
6. Performance Score – the sum of all Program Scores. This value defines the aggregate success of UI's DSM programs and is used to calculate its bonus rate of return.

The effect of the weighting factor is to cause programs with large budgets and/or large cost to savings ratios to

have the greatest influence on the Performance Score. Therefore, it is in UI's interest to improve its delivery of these programs and to operate them as efficiently as possible. The effect of taking the fourth root of the product is to prevent any programs from having a disproportionate influence on the overall Performance Score.

In 1991, Performance Scores greater than 115 resulted in a 3% bonus rate of return. Scores between 85 and 115 resulted in 2% bonuses. Scores less than 85 yield a 1% bonus. In 1991, UI calculated its overall Performance Score to be 116. This Performance Score qualified UI to recoup its \$10.6 million investment in DSM at its normal rate of return (about 11%) plus a 3% bonus.[R#6]

For 1992, UI proposed modifications making the Performance Score ranges narrower and the DPUC accepted the changes with minor revisions. (UI suggested that narrowing the range was appropriate because UI's ability to project program costs and to forecast results had become more accurate with experience making it more difficult for UI to improve upon projections.) The revised incentive mechanism provides a 3% bonus rate of return for any score greater than 107.5, a 1% bonus for any score equal to or below 92.5, and a bonus prorated between 1% and 3% for scores between 92.5 and 107.5. In 1992, the Energy Opportunities program had a net present lifetime value, savings to cost ratio of 1.7 and UI had an overall DSM Performance Score of 112.2 for which the utility will be awarded a 3% bonus on its return on investment in DSM.[R#5,6,12]

While the incentive mechanism and its bonus for good performance is nice and a meaningful gesture, Brian Lonergan, Lead Planning Analyst at UI, notes that the incentives help but certainly won't alter the company's investment strategies! For instance, you won't see the utility deferring a substation because of a 3% point enticement on approximately \$10 million per year. What gets the attention of management and the company's shareholders, is the lost revenue adjustment. This, more than the incentive mechanisms which have captured the attention of DSM advocates across the country, is what levels the playing field between profits and selling a kWh and saving a kWh.[R#6] ■

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