United Illuminating Homeworks

Profile # 15, 1992

Executive Summary

In 1989, United Illuminating (UI) created the Homeworks program in response to an agreement that came out of New England's collaborative process. The program began in 1990 and was modeled after the Energy Fitness program administered by New England Power Service.

Homeworks is a direct installation program for low income households in some of Connecticut's most economically-depressed communities. The basic approach is to make an intensive pass through a targeted area and to install as many measures to as many customers as possible. To do this UI utilizes a primary contractor and three non-profit agencies to deliver the energy-efficiency measures. Homeworks also hires and trains youths to work on the program from the low-income neighborhoods that are serviced. This not only provides employment for the community but provides a means for the utility to get into areas that are hard to reach. Customer education is also emphasized by the program in regard to the measures received and also other energy-efficiency opportunities within the community.

The program provides a number of energy-efficient measures at no cost to the customer. While compact fluorescent light bulb installation is the primary focus of the program, the utility also provided homeowners with a coil cleaning brush and cleans the refrigerator coils at the time of the visit. (Coil cleaning brushes are no longer part of the program -- see Implementation section.) Whether the customer has an electric hot water heater or gas hot water heater, the contractor wraps the heater, insulates both hot and cold water lines that supply the unit, sets back the water temperature, and installs water-efficient measures including high performance showerheads and kitchen faucet aerators. A key feature of the program is that it effectively integrates the local gas utility into the door to door approach. Kemper Management Services, the program's contractor, performs the services and then bills both United Illuminating and Southern Connecticut Gas Company for the measures installed.

Homeworks provides average annual energy savings of 606 kWh and just under a half a kilowatt of capacity savings per installation, at a cost of approximately $157 per participant. The gas portion of the program costs $32 per participant and saves each customer 3.19 MCF or 2.2% of the annual gas bill. Through the end of 1991 the program had accomplished 16,846 installations, or 16.8% of the eligible participants, and has saved 8.09 GWh and 972 kW at a cost of $2.39 million to United Illuminating. Through the first half of 1992 the program has resulted in cumulative total energy savings of 4.1 GWh and total capacity savings of 604 KW. The program cost for the gas portion of the program to Southern Connecticut Gas Company was $34,957 in 1991. Oil, gas, and water resources are also saved.

Homeworks

Utility:	United Illuminating
Sector:	Residential
Measures:	Compact fluorescent lighting, refrigerator coil cleaning and hot water efficiency measures.
Mechanism:	Utility hires a contractor and pays 100% of the cost of the measures' implementation.
History:	Program was introduced in June of 1990 and is still in operation.

1991 Program Data

Energy savings:	6,075,000 kWh
Lifecycle energy savings:	49 GWh
Peak capacity savings:	0.74 MW
Cost:	$1,680,956

6/90 - 6/92 Data

Cumulative energy savings:	23,061,675 kWh
LIfecycle energy savings:	97 GWh
Capacity savings:	1.58 MW
Cost:	$2,388,956
Participation rate:	23%

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

United Illuminating (UI) provides electricity to seventeen communities in southwestern Connecticut serving a total of 305,000 customers. There are 276,000 residential customers, as well as 29,656 commercial, and 230 industrial accounts.[R#4]

The major cities in the UI service territory are Bridgeport and New Haven. UI serves eight universities including Yale as well as a number of major shopping malls and hospitals. Commercial customers include a number of defense industry contractors, manufacturers, brass foundries, architectural hardware fabricators, and printing companies.

The United Illuminating Company is a diversified investor-owned utility whose four wholly-owned subsidiaries are:

- 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's capacity situation has changed significantly in the past two years because the Seabrook nuclear power plant came on line. UI has an 17.5% ownership of Seabrook Unit 1 which generates 29% of its capacity or 427 MW. When this capacity came on line UI went from a position of being in a capacity crunch to a position of surplus capacity.

UI 1991 STATISTICS

Number of Customers	305,000	
Residential	276,000	
Commercial	29,656	
Industrial	230	
Energy Sales	5.20	GWh
Summer Peak Demand	1.15	MW
Generating Capacity	1.47	MW
Reserve Margin	28.60	%
Average Electric Rates	**11.18**	**¢/kWh**
Residential	12.45	¢/kWh
Commercial	11.49	¢/kWh
Industrial	8.00	¢/kWh

[R#4,12]

Currently UI has 1,474 MW of generating capacity which is made up of coal (34%), nuclear (29%), oil (21%), refuse-derived fuel (9%), gas (4%), and hydro electricity purchased from Quebec (3%). UI currently has a generating capacity surplus, and a reserve margin of 28.6%, and is not expected to need additional capacity for at least ten years.[R#4]

In terms of energy, UI sold 5,234 GWh in 1991, with 35% sold to residential, 45% to commercial, and 20% to industrial. 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 it's DSM effort in 1981 by participating with other utilities in Conn Save, a program in which energy audits were performed by an outside contractor. At the time the Connecticut Department of Public Utilities required that the State's utilities fund energy audit programs. Due to the low penetration of electric heating in the UI service area these programs resulted primarily in oil and gas energy savings. In 1984, UI began implementing DSM programs with an in-house staff.

The focus of UI's DSM programs changed in the past five years due to high utility rates. Programs were implemented to help UI remain competitive and to maintain commercial and industrial customers within its service territory. Commercial programs are more cost effective and have a higher savings potential than residential programs. The prime focus of commercial programs was reducing lighting loads by providing incentives for energy-efficient lighting technologies. Residential programs are not generally cost-effective in the UI service territory because there is very little electric space heating or water heating. Energy-efficient lighting offers the greatest potential in residential programs and that is the focus of Homeworks.

Utility DSM Overview Table	Annual DSM Expenditure (x1000)	Annual Energy Savings (GWh)	Annual Summer Capacity Savings (MW)
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	$13,399	47.1	13.30

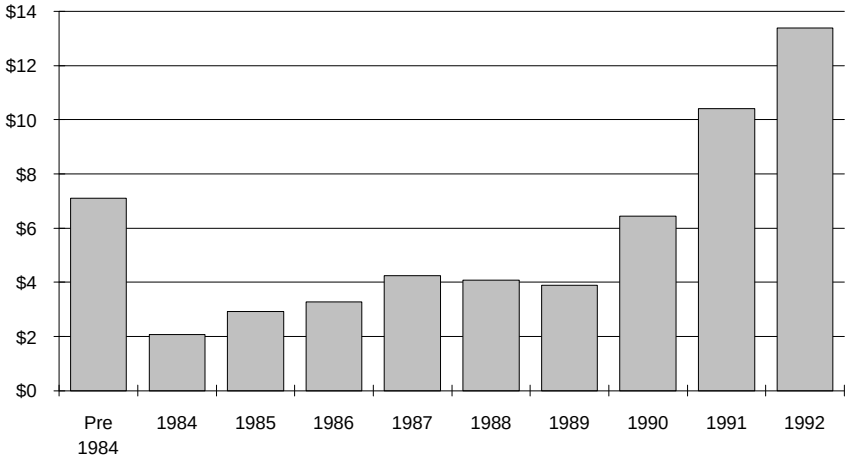
UI'S CURRENT DSM PROGRAMS.

Residential
- Central Air Conditioning Tune Ups
- Good Cents New Homes
- Great Cover Up (water heater wraps)
- Efficient Water Heaters
- Few Proud and Cool (appliance program)
- Appliance Pick-Up (refrigerator disposal)
- Smart Energy (high use customized services)
- Homeworks
- Better Bulbs (rebate program)
- Energy Conservation Loans (State Department of Housing loans)
- Residential Conservation Service Audits

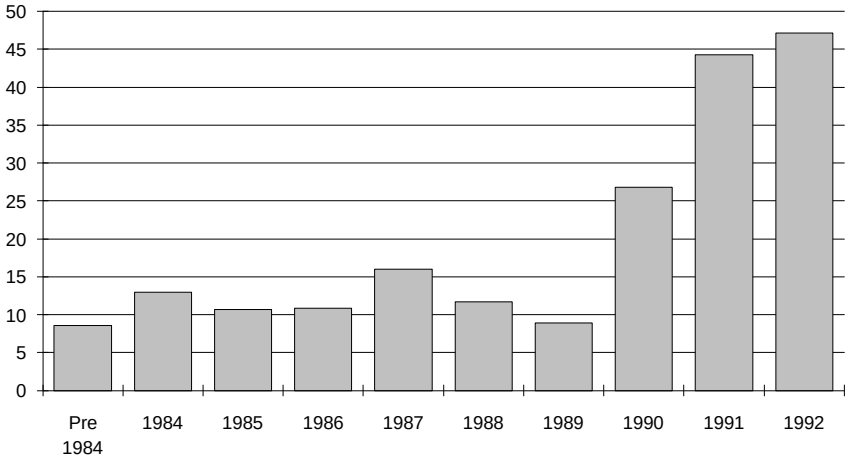
Commercial & Industrial
- Cool Storage
- Energy Blueprint (new construction standards, incentives)
- Energy Blueprint-RRR (retrofit assistance)
- Energy Opportunities (generic rebate program)
- Small Business Energy Opportunities
- Standby Generation (customer-owned generation)
- Street Light Conversions

In 1989 there was a DSM plan developed by UI in conjunction with the Conservation Law Foundation and state agencies including the Department of Public Utility Control, the Office of Consumer Counsel, and the Office of Policy and Management. This collaborative resulted in an agreement for greater resource commitment to DSM programs. New programs were added and older programs were cancelled. The current three-year collaborative effort ends December 31, 1992, although there are plans to continue the collaborative beyond that date. UI's 1991 budget for Conservation and Load Management was $10,404,915, or 1.6% of the utility's $645,034,807 gross revenue.[R#3,4]

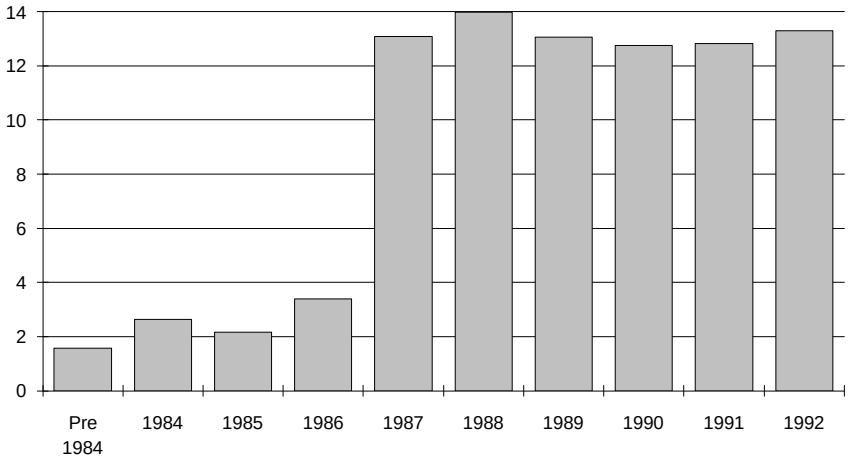
ANNUAL DSM EXPENDITURE ($1,000,000)



ANNUAL ENERGY SAVINGS (GWH)



ANNUAL CAPACITY SAVINGS (MW)



Program Overview

Homework's primary objective is to provide cost-effective electrical energy savings to residential customers in low-income neighborhoods. Related objectives of the program are:

- Increase the level of energy-efficiency awareness and understanding, particularly regarding the benefits of compact fluorescent lighting.
- Promote better public relations with utility customers.
- Avoid customer bill arrearage potential for the utility.
- Enlist the cooperation of water and gas utilities.
- Satisfy the DPU (regulatory commission) requirements regarding low income DSM programs.[R#1]

Through United Illuminating's Homeworks a number of energy-saving measures are delivered at no cost to the customer. The measures include installing fluorescent light bulbs, cleaning refrigerator coils, and implementing a number of hot water energy-efficiency measures. When hot water energy-efficiency measures are installed for customers with a gas water heater the cost is charged to the local gas utility.

The target market for this program is the estimated 100,000 households that are in low-income neighborhoods primarily in Bridgeport and New Haven. Once an area is targeted to receive Homeworks, any customer within that neighborhood, regardless of his or her income, is eligible to receive program measures. The potential number of customers eligible to participate in Homeworks is 36% of UI's residential customer base. The program had served 16,846 customers by the end of 1991, or 16.8% of the potential market, with energy-efficiency measures. Homeworks 1992 objective is to provide measures to 12,500 additional customers. Nearly a third (29.3%) of eligible customers will have been treated with program measures when the goal for 1992 is met. UI is currently working on extending the program for five years, beginning in 1993, providing 9,000-10,000 customer installations annually for a potential market penetration of almost 75% when completed.[R#6]

By using a contractor for turnkey service, Homeworks has been a relatively easy and inexpensive program for UI to implement. Homeworks is implemented by one primary contractor and three community-based agencies. The primary contractor, chosen through a competitive bidding process, is Kemper Management Services (KMS) of Glastonbury, Connecticut. KMS markets the program, installs the measures, and tracks the data and billing information for UI.

One of the unique elements of the program are the job placement and training programs that it has fostered. These training programs are implemented by the community-based agencies delivering Homeworks measures. The training programs hire and train inner city youths to deliver program measures creating jobs within low-income neighborhoods. Although the job training element of the program was designed into the program from the start, training did not get under way until the second year. Part of the intent of the training element, in addition to providing employment, was to work with members of the communities who in turn could effectively penetrate very difficult neighborhoods with energy efficiency measures.

MARKETING

Marketing of the Homeworks program is quite simple and is based on a direct mail piece that explains the program and notifies residents in specific neighborhoods that Homeworks is coming their way. The timing of these mailings is such that residents get the notification just a few days before Homeworks representatives come to their particular community. At that time a door-to-door canvasser schedules visits for installers. These installers provide the second "marketing" element: written materials that educate the homeowners of the benefits of energy efficiency and inform them of other opportunities. The customer is also referred to six local and state agencies on appliance use, domestic hot water heating costs, energy use labels on appliances and other related information. All promotional and educational materials are printed in both English and Spanish.[R#1,2]

Note: UI clearly does not want to publicize the program outside of the targeted neighborhoods, and only wants to market the program within the targeted neighborhoods using a specific delivery method. As such, marketing the program is not at all broad based, but is very directed within specific neighborhoods and within specific time frames.

DELIVERY

The first step in implementing the Homeworks program is targeting eligible neighborhoods, areas whose residents' income levels are up to 200% of the national poverty level. Initially areas were chosen exclusively from the 1979 Census reports but the program administrator now has a feel for targeting appropriate areas.[R#5] For the targeted neighborhood, UI provides the contractor and the non-profit agencies with complete customer information, including customers' account numbers, their names, and addresses. The contractor then prints out two sets of labels with the customer information on it. One label is attached to the direct mail piece that is sent to the customer. The other label is attached to the work order that Kemper Management Services (KMS) uses for their field staff. The field staff then updates information on work orders and adds any changes to the data base.

After the targeted areas receive the direct mail piece, canvassers knock on customers' doors and set up appointments for the installation of the efficiency measures. At present the two canvassers are bilingual, speaking both English and Spanish. The canvasser sets up appointments for either the same or the next day. (When the customer is not home the canvasser leaves a door hanger with a phone number on it to schedule a Homeworks installation.) The installation crew uses a van equipped with a cellular phone so the supervisor can directly schedule a Homeworks visit when a customer calls. The second time a customer is not home a second door hanger is left. In the event that the customer does not respond after the second door hanger, the customer is considered not interested and is no longer pursued to participate. On the same or next day an installer arrives to install the light bulbs, clean the refrigerator coils, and install water-efficiency measures. An installation typically takes the installer about forty-five minutes to complete. The installer also leaves the homeowners with educational materials and discusses other efficiency options that are available. To save time as well as for security reasons the installation team remains in constant radio contact with one another.

As discussed previously, the program is actually implemented by the contractor (KMS) who is assisted by community agencies. (By the end of June 1992, KMS had performed 18,730 installations or 82% of the total (22,776), Community Action Agency of New Haven had performed 1,738, or over 7%, the two other community agencies had completed 1,260 or 6% of the total, and the Summer Youth Corps during the summer of 1991 completed 1,048 or 5%.[R#5]) These agencies are provided with an inventory of products to install for Homeworks installations by the contractor. The agencies can return any excess or damaged inventory to KMS which in turn bills UI for the cost of the products. By doing this the contractor allows the community agencies to support Homeworks without having to invest in an inventory to do so.

The community agencies are, however, responsible for the quality of the installations that they perform. A customer satisfaction survey form is left with each installation and the customer is encouraged to return it to Homeworks. Additionally, the installer must complete a registration form for each customer served that describes all the measures installed.

There have been two recent changes made to the Homeworks program. A coil cleaning brush is no longer left with the customer because it was not cost effective for the energy savings achieved. The giveaway of night-lights was discontinued because the collaborative thought it was unnecessary.[R#5]

INSTALLED MEASURES

Homeworks provides a package of electric energy-efficiency measures and information which include:

- Compact fluorescent light bulbs are installed wherever the two hour per day duty cycle minimum is met, which is an average of close to six bulbs per household.
- A refrigerator coil cleaning and a coil cleaning brush for customers to do future maintenance. (Note the brush giveaway has been discontinued.)
- A .5 watt fluorescent night light.
- Outlet and switch gaskets.
- A packet of information on how to save energy and a list of services that are available to customers.

In addition customers also benefit from a number of efficiency measures for reducing hot water use which include:

- Wrapping electric water heaters in R-11 tank jackets.
- Turning down/setting back thermostats to 125°F.
- Installing fifteen feet of R-3.2 sleeve-type pipe insulation on both the hot and cold water lines.
- Equipping the kitchen faucet with a maximum 2.5 gallon per minute aerator with a shut-off that allows the user to maintain the proper water mix temperature while an swering the phone, etc.
- Equipping all showers with water-efficient, maximum 2.5 gallon per minute showerheads.

When KMS is providing Homeworks services they install water-efficient measures even if the customer has a gas water heater. KMS then charges the gas utility for the measures installed and for half of the trip expense. Sharing the program delivery costs between electric and gas utilities keeps the costs lower for each utility.

STAFFING REQUIREMENTS

From a utility perspective, Homeworks is administered by a program administrator who's time is divided between Homeworks and another program (thus ½ full time equivalent [FTE] staff). UI's marketing and monitoring departments also assist with the implementation of this program by providing a total of about ¼ FTE. The total in-house staff requirement for UI is less than one FTE.[R#6] In addition, UI has hired independent inspectors to verify the installations and the persistence of savings. There is one full time inspector and a part time manager for a FTE of 1.5 staff.

Kemper Management Services staff includes a program administrator, a computer and data entry person, two supervisors, two canvassers, and six installers, for a total of 12 FTE.[R#3]

Three community agencies, with a total of approximately one full time equivalent each, are involved in installing Homeworks measures. It is difficult to determine the Homeworks staffing requirements because the community agencies often piggy-back the implementation of Homeworks to their existing audit and weatherization programs. When the measures are not incorporated as part of their existing programs, they are delivered door-to-door exclusively for Homeworks.

Roughly speaking the total staffing requirement for Homeworks is 17-18 FTE though we caution the use of this number.

Community agencies involved with the program are:

- The Community Action Agency of New Haven (CAANH)
- Family Services of Woodfield
- TEAM (Training, Education, Action, Manpower) a group that services an area in both the service territories of UI and Northeast Utilities.

CAANH works primarily in public housing projects in New Haven. They have worked together with KMS for various low-income projects over the past eight years. CAANH is the most active of the community agencies with a FTE of one staff member delivering the Homeworks measures. In 1990 they delivered Homeworks measures to 412 customers and increased their effort to 1,020 installations in 1991. By the end of June 1992 CAANH had done 306 installations.[R#5] The other community agencies are involved in a more sporadic manner. All of the other community agencies together have done less than a thousand installations of Homeworks measures since 1990.

JOB PLACEMENT AND TRAINING : THE BRIDGEPORT URBAN CORPS & SUMMER YOUTH CORPS

In 1991 UI added two groups involved with job training and placement services that had not been previously involved with Homeworks. The groups are the Bridgeport Urban Corps and the Summer Youth Corps. The Bridgeport Urban Corps (BUC) focuses on youths in inner-city neighborhoods, and provides them with remedial training in basic skills as well as with the opportunity to learn a trade. BUC participants go through a nine-month training program which includes physical fitness as well as work on a specific project. BUC provides areas of Bridgeport with Homeworks into which KMS is wary of sending crews. Many of the group members are from the area and are therefore more readily accepted by area residents. At the end of the program, participants are assisted with locating permanent jobs.

Summer Youth Corps is sponsored by CAANH. Five high school and five college students from the area are taught the basics of energy efficiency and the specifics of installing the Homeworks measures. With a supervisor provided by CAANH the students do Homeworks installations during the summer. A high school and a college student are paired up to become an installation team. Besides the training they are also given information on filling out job applications, scholarship forms, and college applications. In the summer of 1991 five, two-student installation crews did a thousand installations for the Homeworks program. UI plans to continue incorporating Youth Involvement and Job Training into the Homeworks program.

MONITORING

The monitoring of Homeworks is based on separate tracking systems, developed by Kemper Management Services, that collect and organize essential program data and information for each expenditure and measure. This computer program allows for very accurate tracking of location and number of measures installed. The tracking results are put into a database and are retrieved and used for analysis and evaluation. Access to this level of information has been pivotal to allowing gas utilities to have measures installed at their expense. The gas utility feels that the billing and information systems are reliable and is therefore confident that the measures were installed as stated and that the charges are correct.

Tracking results can be merged with UI's customer information systems and other databases for:

- Searching and sorting information,
- examining customer service records,
- providing reliable, consistent and up-to-date data,
- measuring goal achievement,
- performing billing analysis,
- meeting regulatory reporting requirements, and
- performing other administrative and management con trol functions.

Homeworks expenditures are tracked by a number of accounting procedures. All DSM expenditures are directed to the company's financial accounting system. Expenditures for goods and services must comply with accounts-payable procedures. Work orders are assigned by the Plant Accounting Department when a project manager requests a work order number for a specific project. Some programs require a number of work orders for tracking the costs of each project within the DSM program.

Item numbers are used to classify each cost component associated with a particular work order. The item number tracks cost by classification or type. The cost data includes all transactions for a particular work order, item numbers, vendor information, detailed payroll expenses and the overhead or administrative cost of the program.

The work order form is also used to provide additional information. The customer verifies the installation of all measures on the work order form, including the educational materials on energy-efficiency. The input from the work order form is combined with other relevant data, such as cost and impact assumptions, to calculate kWh savings. For example the tracking data for lighting measures includes the wattage of the old lamp, wattage of the new lamp, location in the home and hours of use. Tracking data for water measures includes the number and type of measures installed, the size, location, and the type of fuel the hot water tank uses, as well as previous and new tank temperature settings. If a measure is not installed, the reasons why are also documented. A separate inspection form and tracking system duplicates the features of the measures tracking system. The inspection tracking system also tracks if and why a measure was later modified by a customer.

Maintaining a high quality of workmanship for the measures installed is a priority in the Homeworks program. UI has an independent inspection contractor to verify measure installations. The inspection contractor confirms tracking inputs, assesses customer satisfaction, and provides explanations for dissatisfaction where possible. Five to ten percent of the installations are randomly checked for quality of workmanship by KMS supervisors the day of the installation. New installers are checked more frequently until the supervisor is confident of the quality of their work. In early 1991 UI hired A&C Enercom to perform independent inspections of Homeworks installations. The company created a random sample of 400 customers from the installations done in 1990. Of these 170 received inspections by licensed auditors.[R#2] The result of this independent audit was that there was an 11% percent removal rate for light bulbs after a single year of operation. Currently there is another study underway to find out the number of light bulbs that were removed after two years.[R#6]

EVALUATION

Both impact evaluation and process evaluations have been performed for the Homeworks program.[R#1,2] One of the key findings of the preliminary 1990 monitoring results was that Homeworks was marginally cost-effective (see further discussion in Cost section). A thorough impact evaluation was recommended before proceeding with program expansion as planned. Thus UI recommended and began a two-phase impact evaluation for Homeworks. Phase I has been completed and provided a rationale for derating estimated savings based on actual program tracking and inspection records. Proposed program changes and their impacts as well as cost effectiveness issues were addressed. Phase II was in process at the time of publishing this profile.

The primary issues to be addressed in Phase II are the hours of use for lighting measures and the attrition rate of the bulbs installed. Phase II will also contain persistence estimates. Preliminary findings from Phase II indicate: 1) There is an 11% removal rate of lighting measures after the first year; 2) Design projections of 4 hours a day of light usage is very close to actual usage; 3) Six bulbs on average are installed per household; 4) Customers recognized the value of the products and took them when they moved; and 5) Information about the products passed along at the installation was effectively retained by customers.[R#6]

The June 1992 process evaluation focused on six basic areas:[R#2]

1) Tracking installation and durability of measures,
2) Participation of gas and water utilities,
3) Delivery mechanisms,
4) Customer education,
5) Program administration, and
6) Marketing.

The results of the 1992 process evaluation were very positive. From the perspective of those involved with providing and receiving the services the program is well run. The evaluation showed that the program has a strong monitoring component which is improving over time. Key findings of this report are:1) It is a well managed program that is responsive to its customers needs; 2) Homeworks collaborates well with local water and gas utilities; 3) Quality control in the program is high; 4) The data tracking system has provided the necessary information; 5) The canvassers are a key program strength; 6) There are two difficult to contact groups, younger poor families because they are so transient, and elderly people because they are not willing to allow someone into their home; 7) 98% of customers rated the installation service as good or very good; 8) 74% of the customers were satisfied with their savings on their utility bills. However, 20% were unsure of the savings benefits; and 9) Customers viewed the educational aspect of the program as being positive.[R#2]

DATA QUALITY

The tracking mechanism used for this program is very thorough and concise. The number of measures installed at each residence is accurately monitored. The energy savings projections are less reliable due to a transient customer base. The current Phase II impact evaluation is focused on persistence of savings, which tracks light bulb usage a year or two after initial installation.

The weighted lifetime of the measures of the water-efficient products seemed to be unusually low. Energy-efficient showerheads and faucet aerators were assessed weighted lifetimes of 7 years when conventional wisdom is 15+ years. This was done for a confidence factor in designing the program. There was also concern that a number of customers receiving the measures would not like them and would put the old measures back into use. The conservative lifetime estimates were an attempt to account for this factor.[R#6]

The peak capacity savings are determined differently than is often the case for an individual utility. Being a member of the New England Power Pool (NEPOOL), the coincident power pool peak kW savings value is determined by calculating 70% of kW peak usage and 30% of kW monthly average usage. This type of calculation and reporting format is necessary to reflect conservation and load management's contribution to reducing UI's capacity responsibility in NEPOOL.[R#8]

UI also calculates the total dollar savings of the program by multiplying the on-peak kWh reduction by the on-peak avoided cost, plus the off-peak kWh reduction times the off-peak avoided cost. Capacity savings are derived by multiplying the kW reductions by the average dollar/kW cost. The sum of the capacity savings (kW) in dollars and the energy savings (kWh) in dollars minus an environmental adjustment of 25% equals gross savings. The net savings is the total savings minus the cost of the program.[R#1]

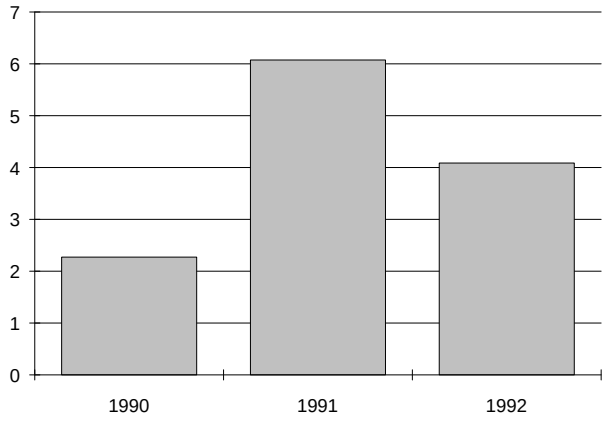
Compact fluorescent lamps can have deceptive savings due to the dependence of duty cycle on energy savings. A third of Homeworks customers had moved within a year of having measures installed and many had taken the lamps with them. Half of the customers surveyed didn't understand the relationship of lamp location to energy savings so perhaps some of the lights were reinstalled in low duty cycle light sockets. This makes it difficult to make an accurate savings estimate for CFLs.

Market penetration figures are also very difficult to quantify. The customer base for the program is very low income and transient. Penetration figures are estimates based on the target market and installation numbers.

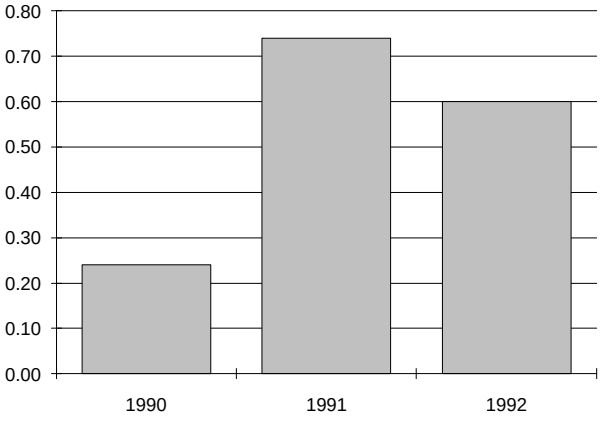
Program Savings

Savings Overview Table	Annual Energy Savings (kWh)	Cumulative Energy Savings (kWh)	Lifecycle Energy Savings (kWh)	Annual Capacity Savings (MW)	Cumulative Capacity Savings (MW)
1990	2,275,000	2,275,000	16,200,000	0.24	0.24
1991	6,075,000	8,350,000	48,600,000	0.74	0.98
1992	4,086,675	12,436,675	32,693,400	0.60	1.58
Total	12,436,675	23,061,675	97,493,400	1.58	

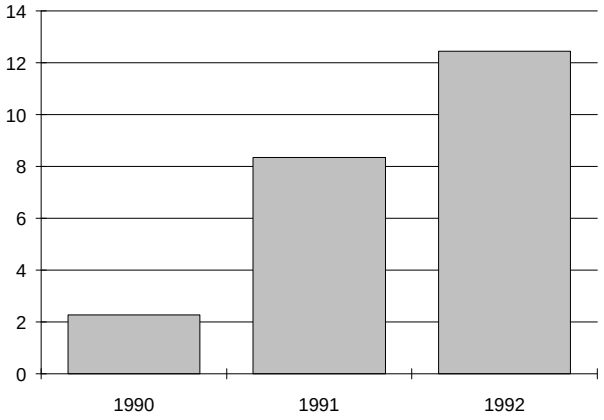
ANNUAL ENERGY SAVINGS (GWH)



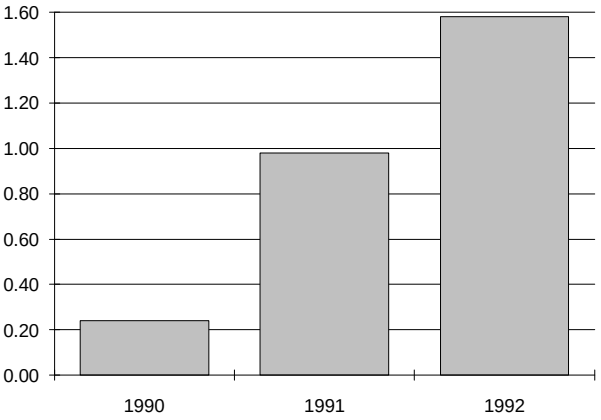
ANNUAL PEAK CAPACITY SAVINGS (MW)



CUMULATIVE ENERGY SAVINGS (GWH)



CUMULATIVE PEAK CAPACITY SAVINGS (MW)



All 1992 figures for the charts and tables in this section are for January 1 - June 30 1992

To date Homeworks has resulted in annual energy savings that have risen from 2.275 GWh in the latter half 1990, to 6.075 GWh in 1991, and 4.087 GWh in the first half of 1992. This equates to cumulative total energy savings over the life of the program of 12.437 GWh. In terms of capacity, the program saved 236.75 kW in 1990, 735.25 kW in 1991, and 603.97 kW in the first half of 1992 for total program savings of approximately 1.6 MW to date. Lifecycle savings from Homeworks measures installed through 1991 are 64.6 GWh, 16.2 GWh for measures installed in 1990, and 48.6 GWh for measures installed in 1991. Projected lifecycle savings of 1992 measures are 57.4 GWh.[R#6]

SAVINGS PER PARTICIPANT

The annual average savings of all Homeworks participants is 606 kWh. In 1991, the average capacity savings was just under a half a kilowatt (.468 kW). Customers experienced typical savings of 10-15% on utility bills after the Homeworks measures were installed. The savings from the program were achieved primarily from efficient lighting where annual savings is estimated at 365 kWh. The hot water savings are substantial; where electric water heating exists average annual savings are 1,453 kWh. However, since only 5% of the eligible homes have electric water heaters the weighted annual savings are only 241 kWh.[R#1]

Savings per Participant Table	Participants	Annual Energy Savings per Participant (kWh)
1990	4,228	606
1991	12,618	606
1992	5,658	606
Total	22,504	

MEASURE LIFETIME

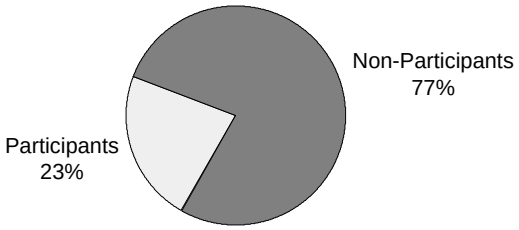
The 8 year weighted average lifetime of Homeworks measures is a composite estimate based on the following:[R#1]

Compact fluorescents	8.5 yrs
Tank wraps	5 yrs
Pipe wraps	10 yrs
Energy-efficient showerheads	7 yrs
Faucet aerators	7 yrs

One of the difficulties in determining the persistence of savings for Homeworks is the transient nature of the targeted population. Fully a third of the eligible customers move within the utility district annually. Second, impact evaluations reveal that most of the customers take the measures with them, most are reinstalled (though not necessarily in the most appropriate location), so some of the savings continue. However, only half of the customers questioned realized that the location of the bulb may impact its energy savings. Savings presented in this section reflect this attrition.[R#2]

PARTICIPATION

The target market of the Homeworks program is 100,000 low-income residential households. Of these, 85,000 are in Bridgeport and New Haven. The remaining 15,000 are from other smaller communities.[R#5,6] UI's three-year goal, beginning in 1990, was to install energy-efficient measures in 24,500 customers' homes. UI planned to perform 3,000 installations in 1990, 9,000 in 1991, and to complete 12,500 homes in 1992.[R#2]



In 1990 UI performed installations in 4,228 homes, or for 4.2% of the eligible customers. In 1991, UI treated another 12,618 homes, or 12.6% of eligible participants. In the first half of 1992, the program covered another 5,658 homes for a total of 22,504, or 22.5% of the eligible participants. Thus by the middle of 1992, UI was only 2,000 homes short of its three-year goal, easily attainable by year's end.[R#5]

PROJECTED SAVINGS

The Homeworks program is in the process of being extended for another five years with a goal of 9,000 to 10,000 installations annually. Assuming 9,000 installations for each of five years, and 606 kWh/year/installation, a technical life of the measures of eight years, the annual savings will be on the order of 5.5 GWh and the projected lifecycle savings for the extended program will be on the order of 218 GWh.[R#6]

Cost of the Program

In 1990, Homeworks cost $708,000 and in 1991 its budget was increased to $1.7 million. In 1992, Homeworks projected budget was $1.8 million (approximately 27% of UI's entire 1992 residential DSM budget of $6.5 million), for a total program expenditure through 1992 of $4.2 million.

COST EFFECTIVENESS

UI has reported to the Department of Public Utility Control that the Homeworks program is marginally cost-effective largely because of United Illuminating's surplus capacity situation.[R#1] Nevertheless, the program has been continued for several reasons. To begin with, the screening model evaluates program cost-effectiveness solely from a ratepayer impact perspective (RIM test). When participant savings for incandescent bulb purchases are considered (TRC), the program passes the breakeven point. In addition, the model only considers electric savings, and does not assign a value to the significant water and gas saving benefits of the program. Another important reason for continued program delivery are the customer equity benefits of the program in relation to other UI DSM initiatives. Homeworks is UI's principal offering for low-income and elderly customers. Finally, use of the results from monitoring and evaluation studies as inputs into the cost-effectiveness analysis has helped reduce the margin for error. The studies include Homeworks telephone surveys and on-site visits that verified actual installed measures, hours of use, and removal rates.

COST COMPONENTS

Payments to outside contractors headed by Kemper Management Services (KMS) have clearly been the largest component of the program costs, $1.5 million in 1991 or fully 90% of the total program cost of $1.7 million.

The 1991 budget was broken down in the following allocation:[R#5]

Outside Contractors	$1,540,142
Admin. and General Overhead	$83,339
UI Labor	$45,980
Miscellaneous	$11,495
Total	$1,680,956

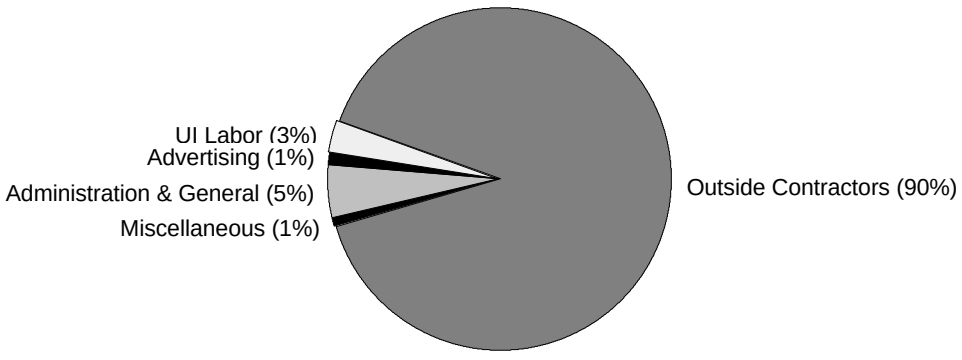
In addition to the 1991 expenditure of $1,680,956, in 1991 United Illuminating spent $72,802 for Phase I Impact Evaluation and $71,844 for a Process Evaluation. UI plans to spend $121,655 in 1992 for the a second process evaluation ($25,864) and for Phase 2 of the Impact Evaluation ($95,792). Note: These evaluation costs are not included in the program costs used to determine the cost of saved energy.[R#1]

COST PER PARTICIPANT

During the last six months of 1990 crews installed 4,228 program measures at $157 per household. This is almost exactly the same cost as their estimate of $158 per participant but included an additional 1,000 customers. In 1991 the cost per participant dropped slightly and is approximately $155 per participant through the end of June 1992.[R#5]

FREE RIDERSHIP

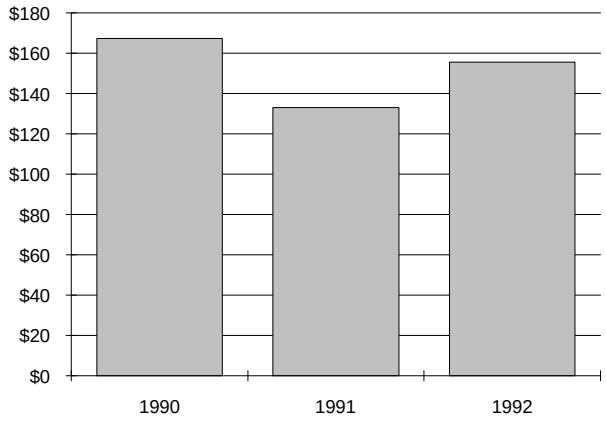
Free ridership does not appear to be a significant issue with this program because the participants in the program are all low-income families who are highly unlikely to purchase and install energy-efficiency measures in the absence of assistance such as Homeworks.



Costs Overview Table	Outside Contractors (x1000)	Advertising (x1000)	Other Costs (x1000)	Total Program Cost (x1000)	Cost per Participant
1990	$496.0	$2.0	$210.0	$708.0	$167
1991	$1,540.1	$1.9	$138.9	$1,681.0	$133
1992	$760.6	$7.5	$57.4	$825.5	$146
Total	$2,796.7	$11.4	$406.3	$2,389.0	

TOTAL PROGRAM COST (x1,000)

COST PER PARTICIPANT



Cost of Saved Energy Table (¢/kWh)	Discount Rates						
	3%	4%	5%	6%	7%	8%	9%
1990	4.43	3.24	3.37	3.51	3.65	3.79	3.94
1991	3.61	3.77	3.92	4.08	4.25	4.41	4.58
1992	2.83	2.95	3.07	3.20	3.32	3.45	3.59

All 1990 figures for the charts and tables in this section are for June 30 - December 31, 1992 figures are for January 1 - June 30 1992

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%	49,721,000	1,180,000	238,000	24,000
B	10,000	1.20%	53,019,000	457,000	154,000	114,000
	Controlled Emissions					
A	9,400	2.50%	49,721,000	118,000	238,000	2,000
B	10,000	1.20%	53,019,000	46,000	154,000	8,000
C	10,000		53,019,000	304,000	152,000	8,000
	Atmospheric Fluidized Bed Combustion					
A	10,000	1.10%	53,019,000	140,000	76,000	38,000
B	9,400	2.50%	49,721,000	118,000	95,000	7,000
	Integrated Gasification Combined Cycle					
A	10,000	0.45%	53,019,000	94,000	15,000	38,000
B	9,010		47,692,000	34,000	11,000	2,000
Gas	**Steam**					
A	10,400		28,919,000	0	66,000	0
B	9,224		25,114,000	0	157,000	7,000
	Combined Cycle					
1. Existing	9,000		25,114,000	0	96,000	0
2. NSPS*	9,000		25,114,000	0	46,000	0
3. BACT*	9,000		25,114,000	0	6,000	0
Oil	**Steam--#6 Oil**					
A	9,840	2.00%	41,857,000	634,000	75,000	71,000
B	10,400	2.20%	44,394,000	629,000	94,000	46,000
C	10,400	1.00%	44,394,000	90,000	76,000	24,000
D	10,400	0.50%	44,394,000	264,000	94,000	15,000
	Combustion Turbine					
#2 Diesel	13,600	0.30%	55,556,000	111,000	172,000	9,000
Refuse Derived Fuel						
Conventional	15,000	0.20%	65,956,000	170,000	224,000	50,000

Avoided Emissions Based on 23,061,675 kWh Saved (6/90 - 6/92)

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 marginal power plant analysis table is to allow any user of this profile to apply UI's level of cumulative total avoided emissions saved through its Homeworks 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 the table 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.

UNITED ILLUMINATING AVOIDED EMISSIONS

Currently UI is in a surplus capacity situation; it has a reserve margin of 28.6%, or 328 MW. The utility expects to be in a surplus generating situation for the next ten years. At that time UI is considering building a gas turbine, peaking power plant to address shortfalls in summer peak demand. For these reasons we do not present utility-specific avoided emissions from the Homeworks program.

*** Acronyms used in the table**

TSP = Total Suspended Particulates

NSPS = New Source Performance Standards

BACT = Best Available Control Technology

Lessons Learned / Transferability

In the design phase of the program it was assumed that 16% of the residences would have electric water heaters. Since water-efficiency measures save 1,453 kWh annually per participant there would have been substantial savings provided for the program had this original estimate been accurate. The actual percentage of electric water heaters in the service area, however, is closer to 5%, which makes annual weighted water-efficiency savings only 241 kWh per participant. Program savings as well as cost/benefit ratios have been impacted as a result of the difference from proposed to actual electric water heating percentages. In response to this situation Homeworks has targeted master-metered apartment buildings with electric water heating for program measures.[R#5]

Since 1991 five master-metered complexes have had Homeworks measures installed. Landlords are highly motivated to reduce their electric bills and in the five buildings complete to date, 91% of the apartments have been delivered services. The letter sent out by the landlord to introduce the program to tenants was composed by Kemper Management Services (KMS) but printed on the building management letterhead. This strategy has been the key element to success in these complexes. Depending on the type of lease in the apartment complex, the landlord letter is left as a 24-hour notification of installation. If the landlord cannot attain such access then the letter is accompanied with a form through which written permission is given to allow maintenance staff to escort installers into apartments. To limit the man-hour commitment by the landlord KMS usually works through a building in two passes. In the first pass, installers knock on doors and install services for residents that are home. The second pass targets only missed apartments and requires an escort to open the doors of these units. The second pass can be the same day or postponed until later in the week. Enlisting the assistance of the landlord to guarantee access to apartments has been very successful. The initial planning process takes as much time as canvassing but the results are consistently better. Not only does the process allow access to a high percentage of apartments, it also produces high levels of customer satisfaction, high numbers of measures installed per unit, and a comfortable work pace for the installation crew. The process is flexible and can be applied to small apartment buildings, boarding houses, or major high-rise complexes.

There have been two current minor changes to the Homeworks program. The giveaway of night-lights was stopped because the collaborative thought that it was not necessary. The refrigerator coil cleaning has been discontinued as well. Upon assessing energy savings it was determined to not be cost effective to leave a brush with the customer.[R#5]

The database established by Kemper Management Services to implement Homeworks is essential to delivering the program. Thorough information allows UI to accurately track the measures installed for program evaluation reports. Reliable information also helps to facilitate prompt bill payment to the primary contractor and all community agencies delivering measures. The quality of program reporting helped KMS to convince the local gas utility to participate in and share the costs of delivering Homeworks measures. This participation was a direct result of the gas company's confidence in the tracking and billing information KMS provided.

Clearly one of the most important lessons learned has been the effectiveness of the training programs which have recruited local residents to work for Homeworks. Not only has the training provided jobs in much-needed areas, but the use of local residents to implement the program in hard to reach neighborhoods has been invaluable.

The program managers for Homeworks have been completely satisfied with the program's success. When asked point blank what they would change if they could do it all over again, both Program Manager Donna Dudeck and Lead Planning Analyst Brian Lonergan say they wouldn't change a thing!

An incentive, designed by the Collaborative Development Effort, 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 simple DSM program scoring system. Each of the applicable DSM programs, including Homeworks, 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, the Homeworks Program earned a Program Performance Ratio of 1.02 and UI calculated its overall Performance Score to be 116. As of August 1992, these scores had not been approved by the Department of Public Utilities Control (DPUC). If approved by the DPUC, this Performance Score qualifies UI to recoup its $10.6 million investment in DSM at its normal rate of return (a little less than 11%) plus a 3% bonus.[R#3]

For 1992, UI has proposed modifications making the Performance Score ranges more narrow. UI suggests that this is appropriate because UI's ability to project program costs and to forecast results has become more accurate with experience (and the PCRs have been lowered), making it more difficult for UI to improve upon projections. The revision would provide the 3% bonus rate of return for any score greater than 107.5, the 1% bonus for any score less than 92.5, and a bonus rate prorated between 1% and 3% for any score falling between 92.5 and 107.5.[R#3]

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