
Taunton Municipal Lighting Plant Smartlight and Lightwaves Profile #42

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Executive Summary

The nation's first compact fluorescent lamp leasing program was pioneered in Taunton, Massachusetts in 1988 and named Smartlight. The Taunton Municipal Lighting Plant (TMLP) had an innovative idea: To lease energy-efficient compact fluorescent lamps to customers for 20 cents per month, thus overcoming high customer purchase costs, the number one obstacle to the purchase of energy-efficient equipment. For the utility, leasing lamps delays the need for any additional generating capacity and provides customers with a value-added service, or what now has become known as energy services.

Taunton launched the Smartlight program in 1988 for residential customers, and then in 1989, after proving the value of Smartlight, launched a parallel and far more aggressive component for its commercial and industrial sectors called Lightwaves. Lightwaves participants pay a fee of 10-40¢/month per lighting fixture for five years to cover approximately 25% of the gross program cost.

Since both programs were truly revolutionary and in some ways ahead of their time, Taunton had to shoulder the task of educating its customers about advances in energy-efficient lighting at the same time that it was recruiting participants for the program. A direct mailer was effectively used for Smartlight. The tri-fold mailer included an actual size cutout of a Philips SL*18 compact fluorescent lamp (CFL) which allowed customers to make sure that the rather large CFLs fit in desired sockets. It also presented the economics of replacing incandescents with CFLs in simple terms.

For its commercial and industrial customers, Taunton offers a turnkey service – from audits, to personalized consultation, to no up-front cost installations backed by the utility. Taunton also offers Lightwaves participants a public relations program which alerts local and regional media to the energy conservation efforts of program participants. Taunton portrays program participants as vital, contributing “corporate citizens,” helping to keep the community’s energy costs low.

To date, the Smartlight program has accounted for total annual energy savings of 322.36 MWh. In terms of total cumulative energy savings the program has accrued 1,310.93 MWh as of December 1992. The 121 completed jobs through the Lightwaves program have accounted for cumulative energy savings of 6,967.74 MWh and peak coincident demand savings of 2.2 MW.

Since its inception in 1988 the Smartlight program has cost a total of \$140,530 minus Smartlight income of \$43,890 for a net total program cost of \$96,640. Taunton has spent a gross of \$1,997,850 on the 121 Lightwaves projects that have been completed. The projected income from the measures installed through Lightwaves as of December 1992, is \$574,140, or 29% of the program’s costs including equipment.

Smartlight & Lightwaves

Utility:	Taunton Municipal Lighting Plant
Sector:	Smartlight: Residential; Lightwaves: Commercial/Industrial
Measures:	Compact fluorescent lamps, fluorescent & HID lamps, fixtures, ballasts, and reflectors.
Mechanism:	Taunton supplies and installs energy-efficient lighting measures in return for lease payments.
History:	Smartlight began in 1988; ramped down after first year success. Lightwaves began in 1989 as complement to Smartlight.

1992 Smartlight Data

Energy savings:	0.039 GWh
Lifecycle energy savings:	0.310 GWh
Winter peak capacity savings:	0.006 MW
Net program cost:	\$11,330

Cumulative Data (Smartlight & Lightwaves) (1988-1992)

Energy savings:	8.3 GWh
Lifecycle energy savings:	86.1 GWh
Winter peak capacity savings:	2.3 MW
Net program costs:	\$1,520,300

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 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

Taunton Municipal Lighting Plant (referred to throughout this profile as TMLP or Taunton) is a municipal utility located in Taunton, Massachusetts, in the southeast portion of Massachusetts about 35 miles south of Boston. The service area for TMLP has a population of 65,569, contains the City of Taunton and four surrounding towns, and covers 100 square miles. TMLP has 160 employees who serve its 28,608 customers which include 25,594 residential accounts and 3,014 commercial and industrial accounts. [R#7]

TMLP is overseen by the Municipal Light Board Commission which is an elected, three-person commission. TMLP is regulated in part by the Massachusetts DPU. The DPU, and its Siting Board (which used to be the independent Siting Council), oversees TMLP's forecasts and supply plans, makes sure that the rates charged by the utility are within state statutes, and may well have an increasing role in reviewing TMLP's DSM plans, perhaps eventually stipulating DSM program guidelines. (This situation in Massachusetts represents an unusual regulatory arrangement between a municipal utility and state regulatory commission in the United States.) [R#11]

In 1991, electricity sales of 420.4 GWh accounted for \$35 million in revenues for TMLP. The residential sector accounted for 170.6 GWh in sales, while the commercial sector purchased 123.2 GWh of power and the industrial sector purchased 119.9 GWh of power. Street lighting accounted for 6.7 GWh in sales. TMLP's power supply mix is 42% gas, 32% oil, 13% nuclear, 9% hydro, and 4% of TMLP's power is purchased outside of existing contracts. TMLP's peak demand was 91.4 MW and their generating capacity at peak demand was 115.6 MW, creating a reserve margin of 26%. TMLP has 93 MW of its own capacity and supplements this with power purchases from the New England Power Pool.

TMLP faced many challenges in 1991. Perhaps the biggest challenge was restoring power in the wake of Hurricane Bob. As a result of the storm, 23,000 out of

TMLP 1991 STATISTICS

Number of Customers	28,608
Energy Sales	420 GWh
Energy Sales Revenue	\$34.985 million
Peak Demand	91 MW
Generating Capacity	116 MW
Reserve Margin	26 %
Average Electric Rates	
Residential	7.20 ¢/kWh
Commercial	8.20 ¢/kWh
Industrial	6.30 ¢/kWh

[R#1]

28,608 TMLP customers lost power. Restoration crews worked around the clock and power was restored to almost all customers within four days.

Peak demand will be increasing for TMLP in 1993 with the opening of the Silver City Galleria. An additional 8 MW is projected to be used by the mall. The mall will be one of the largest in southern New England, measuring 1.2 million square feet.

Addressing future energy needs, TMLP received permission for and plans to buy power from the Taunton Energy Center, a 150 MW coal-fired generating station. TMLP plans to lease the land to an independent power producer for a coal-only power plant. Construction was slated to begin in late 1992, but the timeline on the project has slipped. In 1991 TMLP also performed a major overhaul of the 110 MW Cleary Flood Generating Station in order to improve its efficiency and reliability. [R#1,7]

Utility DSM Overview

Taunton's emphasis on conservation and demand-side management stemmed from the tremendous demand growth in its service territory. Starting in 1986 and continuing through 1988, Taunton experienced an 8% growth in peak energy demand as well as energy load. This rate was some four times the national average. From 1989 to the present the system's demand growth has been on the order of 2%/year, slightly higher than the national average and certainly not typical of northeastern utilities that have experienced flat and even negative load growth as a result of the national economic recession. These growth rates caused Taunton to evaluate new power supply and demand options.

Taunton also believed that energy conservation was necessary in order to avoid the possibility of brown outs or black outs. In 1988, power brown outs cost businesses in Massachusetts an estimated \$96 million in lost productivity. The national recession hit the Taunton service area especially hard and energy conservation programs were seen as a way to reduce electric bills and to thus bolster the economy.[R#9]

TMLP's first DSM program was Smartlight which began in March 1988. Smartlight focuses on getting compact fluorescent lamps into homes in the TMLP service territory and is strictly a residential program. Because of its success, and TMLP's commitment to DSM for all its customers, Lightwaves was created as a parallel program in order to reach commercial and industrial

customers. Both of these programs used a rather novel, yet simple, financing mechanism, providing audits and installation of equipment to customers at no charge up front, but through payments over time a portion of the marketing and administrative costs is recovered. These two programs, which jointly make up this profile and TMLP's Home Energy Audit Program, are essentially the only DSM programs run by TMLP.

As mandated by state law, TMLP promotes and implements the Home Energy Audit program. All homeowners in the State of Massachusetts, regardless of fuel type and income, are eligible for home energy audits. These fuel blind audits are advertised twice annually through bill inserts in both electric and gas company bills. The Massachusetts Division of Energy Resources controls the design and implementation of the Home Energy Audits, the Massachusetts DPU oversees and controls the program's budget, all utilities market and implement the program, often using a contracted agency to actually perform the audits.[R#11] (TMLP contracts DMC Services; several other utilities use the non-profit MASS-SAVE.) As discussed later in this profile, the audits are coupled with the giveaway of \$30 worth of energy-efficient materials.

Program Overview

Taunton launched the Smartlight program in 1988 for residential customers, and then in 1989 launched a parallel component for the commercial and industrial sectors called Lightwaves. The first installations for Lightwaves began in 1990. Lightwaves was a far more aggressive program and a huge challenge for the small utility. The market penetration of Smartlight suffered to a degree as the data in this profile shows, but Lightwaves began to rack up impressive savings using a similar financing mechanism.

THE LEASING MECHANISM RATIONALE

When Taunton reviewed other utilities' experiences with lighting programs it found the following institutional barriers to lighting retrofits: high first cost, consumer anxiety about lighting quality, perceived risk towards savings, low product availability, low product awareness, and physical limitations. TMLP had an innovative means of overcoming these barriers: to lease energy-efficient products to customers.

Through leasing, customers would not have to pay the high first costs of energy-efficient lamps but would reap the net present value benefits of the lamps' full lifecycle. By offering leasing of energy-efficient equipment, customers have no upfront costs. If a Smartlight is used for between one and a half and two hours per day, the customer has reached the breakeven point. Any additional use results in savings for the customer. More simply put, the lease mechanism provides a "positive cash flow" situation for the customer. The utility selects and guarantees the lamps and as long as the customer installs the lamp in a socket used more than a couple of hours per day, the lease payment is less than the monthly bill saving.

For the utility, leasing lamps and lights delays the need for additional generating capacity and provides customers with a value-added service, or what now has become known as energy services, while at the same time paying part of the cost of the DSM initiative. The customer contribution makes the program that much more cost effective from a utility standpoint and erases concerns about non-participants' cross subsidization of program costs.

The lease payment is an important part of the program. It serves to educate customers about the cost effectiveness of energy efficiency measures. Despite the fact that the lease fee is a small amount (20¢/month), the lease also creates a product value in the mind of the customer. With a giveaway program there is inherently less value created from the customer's perspective and thus no incentive for the customer to actually use the product and ultimately replace it with another, similar energy-saving device.

TMLP's leasing concept was met with a healthy mix of enthusiasm and skepticism and continues to be challenged by many DSM advocates. On the positive side, TMLP had figured out a way of getting customers to pay for efficiency, turning the corner and allowing the utility to act as an energy service company with a second revenue stream (selling both energy and saved energy). On the downside, many advocates of energy efficiency claim that if it is cost effective for the utility to pay 100% of the cost of efficiency measures, then any requirement of a customer contribution can be seen as a detriment. (See The Results Center's Profile #3, Burlington Electric Department's Smartlight program, for a full discussion of this issue.)

Program Overview (continued)

TMLP also believed that the utility had a strong financial incentive to lease the lamps to customers rather than give them away. The Massachusetts DPU authorized TMLP to use leasing and to ratebase the program costs, with the lamps treated as capital investments and their costs recovered over time. With a giveaway program, TMLP believed that it might have been denied cost recovery of the lamps because of the inability to document energy savings. [R#7]

The rationale behind Lightwaves was similar, a belief that the impact on cash flow for investments in conservation was the most often overlooked decision criteria. The attractiveness of immediate positive cash flow had not been researched. TMLP assumed if they could design a conservation program that would really remove all the elements of risk, hold constant all quality-related concerns and maintain a positive cash flow, it would be advantageous for business to participate in the program.

SMARTLIGHT

The Smartlight program markets compact fluorescent lights to Taunton's residential customers. These lamps promoted by the program use 76% less electricity to produce the equivalent light output of conventional incandescent lamps, and last ten to thirteen times longer than ordinary incandescent lightbulbs, saving replacement costs and frequent trips up the ladder! Taunton has marketed the program stating that each Smartlight will save customers approximately \$50 over its life since each bulb conserves 570 kWh over its life, using 18 watts to replace 75 watts.

Each Smartlight is leased for 20 cents per month on an ongoing basis. As long as the customer has the lamp,

the lease fee is active. (This is a key difference between the TMLP and Burlington Electric Department programs.) If the lamp burns out, either prematurely or at the end of its useful life, Taunton replaces it at no cost to the customer as long as the lease is active. The monthly charge for Smartlights appears as a line item on participants' electric bills. [R#3,7,9]

LIGHTWAVES

In 1989 Taunton introduced the Lightwaves Lighting Energy Management Program as a comprehensive initiative to capture the conservation potential available through energy-efficient lighting in existing commercial and industrial businesses. The program encompasses everything from formal presentations, to lighting assessments, through installations. [R#5]

Lightwaves is somewhat different than Smartlight and its financing mechanism is not technically leasing. Lightwaves participants pay a small monthly fee over a five-year period. Over this period, the customers repay about 25% of the gross program costs of the Lightwaves program to TMLP, covering the program's marketing and administrative costs. The equipment and installation costs are borne by the utility, similar to a direct installation program. Lightwave's "installation fee" that the customer pays is based on 10, 20, and 40 cent charges per fixture per month depending on the type of retrofit. This fee is paid for five years and typically represents approximately 20% of the customer's monthly bill savings. The Lightwaves fee, like the Smartlight fee, is also a line item on the customers' electricity bills. Technically, the Lightwaves program is not a leasing program in terms of the U.S. Internal Revenue Service (IRS) standard. Participants are not allowed leasing tax credits for program participation.

MARKETING AND DELIVERY

SMARTLIGHT

When Smartlight was introduced in 1988 it was the first leasing program in the country and was one of the first programs designed to place compact fluorescent lamps in customers' homes. Thus marketing became a multifaceted chore, educating customers about advances in energy-efficient lighting (from economics to less hassle), to making sure that the lamps would indeed fit in customers' lamp sockets.

A direct mailer proved to be the marketing technique that created the greatest response for Smartlights and was clearly the program's prime marketing strategy. The tri-fold mailer, made of a heavy cover-weight paper, included an actual size cutout of a Philips SL*18 compact fluorescent lamp (CFL). This cutout allowed customers to make sure that the rather large CFLs fit in their desired sockets. (Only recently have the sizes of CFLs been reduced through advanced technologies to more closely resemble the sizes and shapes of incandescents.) The mailer also presented in simple terms the economics of replacing incandescent lamps with CFLs.

Taunton also advertised the program in newspapers and discussed the program in customer newsletters and on radio talk shows.

Implementation for the Smartlight program is straightforward. Customers have two means of initiating participation. First, customers can fill out a card attached to the special direct mailer discussed above and send it back to the utility with the postage paid by TMLP. Smartlights are then shipped directly to the customer's home. Delivery takes from three to five weeks. Customers also have the option of picking up their Smartlights immediately at the main Taunton office. In both cases customers specify how many Smartlights they need; a maximum of ten Smartlights per account are available. [R#3]

The customer is encouraged to take the Smartlight home, make sure the lamp fits properly and make sure the light levels are adequate. If for any reason the customer is not satisfied he or she is able to return the bulb to TMLP. In the event of a bulb failure, the customer must bring the burned out Smartlight(s) to Taunton's main office for exchange. Bulbs are exchanged quickly and without concern about why the lamp no longer is operable.

If a customer chooses to close his or her Smartlight account, the customer must either return the Smartlights to TMLP or keep the Smartlights and pay the balance of the lease payments. The balance due is calculated as the number of lights leased multiplied by \$13 (\$12 plus an interest fee of \$1), less cumulative monthly Smartlight payments. [R#3]

TMLP is currently planning to "ramp up" the Smartlight program using more aggressive marketing and educational techniques and broadening the variety of types of compact fluorescent lamps available. In addition to resuming its quite successful marketing efforts used to date: direct mail, customer newsletter articles, etc, TMLP is planning a door-to-door approach and a pilot version has been approved which is planned to commence in April of 1993.

To support the door-to-door effort TMLP has purchased a program van (which will be stocked with energy-efficient lamps, harp extenders, etc.) that is currently being converted to electricity by students of the Bristol-Plymouth Regional Technical School. Not only will the students have the hands-on experience of an electric vehicle conversion, but the conversion will be relatively inexpensive for TMLP.

The door-to-door pilot program will encompass approximately 1,500 homes in targeted communities. TMLP staff will educate customers on the attractive economics of the leasing program and will suggest

Implementation(continued)

applications where leased lamps make sense. Other TMLP customers interested in the consultations and direct installations of efficient lamps in cost effective applications will be able to call TMLP to schedule Saturday visits.

TMLP is also considering piggybacking the program with the Home Energy Audit program mandated by the state and in operation throughout the state including the TMLP service territory. This program, which TMLP must provide to customers that call a state hotline and are then referred to TMLP, provides recipients with a comprehensive audit, information about energy-efficient technologies suitable for homes, and \$30 worth of energy-efficient equipment to customers including hot water heater wraps, faucet aerators, low-flow showerheads, and one compact fluorescent lamp per home (a different model than the Philips SL*18 offered by Smartlight). In addition, at the time of the Home Energy Audit, the customer's heating system is checked and the customer is provided with a computerized report to show cost effective efficiency measures, and estimates of their costs and savings benefits.

LIGHTWAVES

Initially, Taunton marketed the Lightwaves program by convening seminars and conferences with its large commercial and industrial customers to explain the structure and benefits of the program. Taunton also ran newspaper ads and included articles on Lightwaves in customer newsletters and trade journals. Lightwaves was also discussed on local radio and cable television talk shows. Trade allies, such as electricians in Taunton, also helped to inform customers about the program.

In 1992 TMLP did very little marketing of the program as there has been a steady demand for the program, resulting in a "tremendous backlog" of program partici-

pants. Customers have been put on hold for up to half a year as the utility and its contractors push to fulfill participants' requests and to complete their installations.

Lightwaves also has several attractive marketing features inherent in the program which have helped overcome the reluctance that businesses have to implement energy conservation programs. Many businesses are interested in energy conservation but become deterred when faced with the prospects of large initial dollar expenditures, doubts about product quality, and the impact of installation on working conditions. Lightwaves overcomes all of these concerns. The program has no up-front customer costs. Energy efficiency materials are free and fully warranted by TMLP. Installation is performed at the company's convenience.

In addition, TMLP removes the burden from individual businesses of selecting the best energy-efficient technologies as well as selecting qualified contractors. TMLP employs a select group of contractors for installation and works with the customer to make sure to use his or her electrician wherever possible.

Taunton also offers Lightwaves participants a public relations program which alerts local and regional media to the energy conservation efforts of program participants. Taunton promises to portray program participants as vital, contributing "corporate citizens," helping to keep the community's energy costs as low as possible.[R#4,9]

Another strong marketing tool for the Lightwaves program is a glossy, multicolored brochure with individual inserts that describe specific aspects of the program, which include: a Lightwaves program overview, a Lightwaves benefits overview, an introduction to efficient lighting technology, a Lightwaves agreement (which serves as a contract), and vendor warranties. Also included are seven product sheets which give more detail on energy

saving fluorescent lamps, compact fluorescent lamps, energy-efficient incandescent lamps, high intensity discharge lamps, electronic ballasts, and specular reflectors. [R#4]

At the request of an interested customer, TMLP evaluates lighting conservation measures at each customer's business at no cost. This energy audit is performed by an audit service company hired by TMLP. Then a formal presentation is made of the recommendations and their savings potential. There is no obligation to participate in the program. Upon approval, the utility's electrical contractors install the measures with all materials provided free to the customer. TMLP provides a quality control check and additional follow-ups to ensure customer satisfaction and savings. [R#5,9]

MEASURES INSTALLED

SMARTLIGHTS

The lights leased through the Smartlight program are Philips Lighting Company's SL*18 compact fluorescent lamps. This specific light was chosen based on price, lumens, rated life, color rendition, size, weight, materials, availability, manufacturer support, outdoor application, burning position, aesthetics, and interference.

These lights will last from one to eight years; ten to thirteen standard bulbs are needed to equal the life of a Smartlight. Smartlights, however, cannot be used with a dimming switch. Taunton purchases the lights in bulk from local distributors. The average number of Smartlights per active account is 3.61.

TMLP has received its commission's approval to expand the Smartlights program. The expansion programs will include an extended range of lighting products to reach a larger number of customers and facilitate a higher level of conservation product penetration. TMLP

has sent out requests for proposals from manufacturers to deliver a range of CFLs and has received bids on 30 different types and sizes of CFLs from different manufacturers.

Adding a range of lamps to the Smartlight program, while an attractive means of upgrading the program's effectiveness, will also complicate the program. TMLP is currently deliberating over whether to increase the monthly lease fee, and if so by how much, and is also considering a two-tiered lease fee schedule based on the type of lamps. These options are being weighed carefully because the lamps now being considered as additions to the program vary dramatically in price. TMLP plans on leasing modular compact fluorescents which cost about twice the price of integral units, but when the lamp burns out it can be replaced and the ballast, reflector, and housing all continue to be used. TMLP is also planning on offering quad lamps which provide for higher wattage replacements, and circular fluorescent lamps. Note that TMLP's goal in establishing a pricing structure will be to recover the total costs of the lamps through the lease payments although this has not been accomplished in the existing program (see Cost section). [R#7]

LIGHTWAVES

Energy efficiency measures installed with the Lightwaves program include fluorescent lamps, incandescent lamps, compact fluorescent lamps, high intensity discharge lamps, electronic ballasts, and specular reflectors. TMLP's bulk orders result in lower unit costs for the equipment.

TMLP purchases products from a wide variety of manufacturers through five local distributors and occasionally purchases hard-to-get items from two additional distributors. When a job order is issued to a specific vendor, the order specifies a certain type of equipment to

Implementation(continued)

be installed. However, if the distributor does not have the material in stock but does have an equivalent product that meets the technical specifications of the originally specified equipment, it can be used as a substitute as long as the vendor provides the equipment at the same price.

TMLP is also considering adding motors used in HVAC systems to the equipment offered in the Lightwaves program. Currently TMLP is participating in a joint effort with the state to analyze energy use in Massachusetts for all manufacturing customers. Recommendations from this study will likely have a bearing on how TMLP proceeds with serving motor loads and whether leasing, or perhaps rebates, will serve as the best mechanism to garner savings.

STAFFING REQUIREMENTS

Lightwaves is run by a full-time program manager who reports to a program administrator who divides her time between Smartlights and Lightwaves. Both of these staff report to TMLP's manager of energy services and resource planning department. In addition to the clerical staff that support the programs internally at TMLP, an audit service company performs the Lightwaves audits, and there are twelve contractors of varying sizes involved with Lightwaves installations on an as-needed basis.

TMLP's philosophy has been to use local electricians to perform the work whenever possible. This benefits the program in many ways as the customers are able to select the electricians they know. Also, many of the local

electricians have worked closely with their customers for a number of years and thus are familiar with not only the building but the expectations of the customer. It also benefits the electricians since they are able to mention this program to their customers to help them save money in this time of economic hardship. The customer is able to have someone he or she trusts and knows working in the facility and also someone who is familiar with the building and work environment. Currently, TMLP has a pool of 12 qualified contractors. If the customer does not have a preference, TMLP assigns the next available contractor to do the work.

Taunton's contractors are paid based on a schedule that TMLP has developed over the years for the price that it will incur for the installation of each unit, exclusive of the costs of the equipment. For example, TMLP pays the contractors \$10 for the installation of each ballast, \$1.00 for each 4-foot lamp installed, \$1.50 for an 8-foot lamp, and \$1.50 for the installation of each compact fluorescent lamp.

Reflector manufacturers bid a price for both labor and material. Any contractor wishing to perform reflector installations must be willing to work for the amount awarded in the bid.

Monitoring and Evaluation

MONITORING

Taunton is able to closely monitor the number of Smartlights in use because customers participating in the program are tracked by a Smartlights database program. Replacement lights must be picked up from TMLP and are thus internally tracked. The Lightwaves program is easy to monitor because TMLP pays for installing all new energy efficiency measures and thus tracks the program's impacts as a function of cost accounting. (However, the tracking system unfortunately has not allowed for annual snapshots of the program's impacts.)

DATA QUALITY

Fundamentally TMLP like other utilities of its size has committed far more time, energy, and resources into running its DSM programs than it has evaluating the programs. (This said, TMLP does collect quite "hard" data from its Home Energy Audit Program.) No impact or process evaluations have been done for either Smartlight or Lightwaves and the data presented in this profile is therefore quite "raw" and without verification. Like the profile prepared of Burlington Electric's Smartlights Program (See Profile #3), the strength of this profile is the program concept presented, rather than the program's impact data.

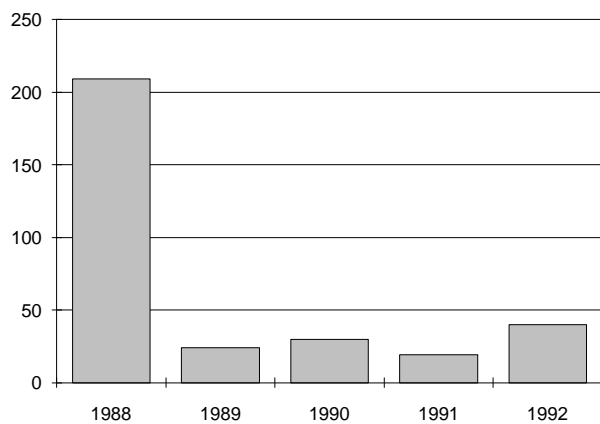
Perhaps the most interesting aspect presented in the Smartlight cost data is that given the lag time between the utility's up-front investments and the programs' accrual of revenues from customers, there is a disconnect which in fact leads to a "negative net cost" for the program in 1989. Since the Smartlight program had the bulk of its participation in the first year (1988) and TMLP paid for bulk purchases of lamps and their packaging materials, not to mention the program's promotional efforts in 1988, Smartlight income exceeded program costs in 1989.

The second issue surrounding the data quality in this profile is that costs and savings for Lightwaves are presented in terms of their cumulative effects. Thus we have been unable to show yearly trends for Lightwaves, though a breakdown between administrative and capital costs is presented in the Cost section. This is not a major issue given that the program is less than three years old. The savings and cost data presented for the Smartlight program cover the beginning of the program in 1988 through December 1992. For Lightwaves, the program has run from January 1990 to December 1992. Note that the cumulative energy savings for Lightwaves becomes discounted due to this aggregation of data.

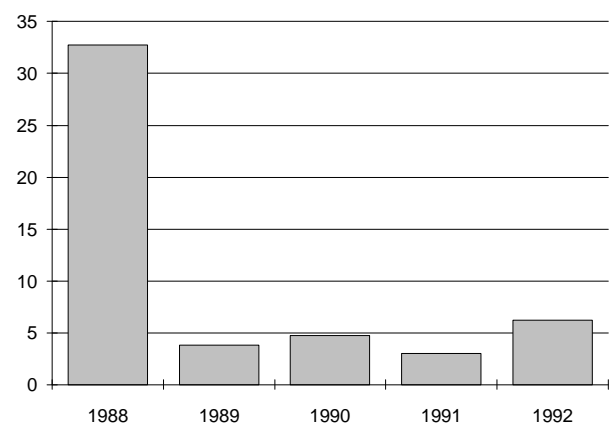
Program Savings

Savings Overview Table	Annual Energy Savings (MWh)	Cumulative Energy Savings (MWh)	Lifecycle Energy Savings (MWh)	Summer Peak Capacity Savings (kW)	Winter Peak Capacity Savings (kW)
1988	209.28	209.28	1,632.36	8.19	32.76
1989	24.10	233.38	188.00	0.94	3.77
1990	30.00	263.38	234.01	1.17	4.70
1991	19.15	282.53	149.38	0.75	3.00
1992	39.83	322.36	310.68	1.56	6.24
Smartlight Total	322.36	1,310.93	2,514.43	12.62	50.47
Lightwaves (1990 - 1992)	6,967.74	6,967.74	83,612.88	2,210.00	2,210.00
Total	7,290.10	8,278.67	86,127.31	2,222.62	2,260.47

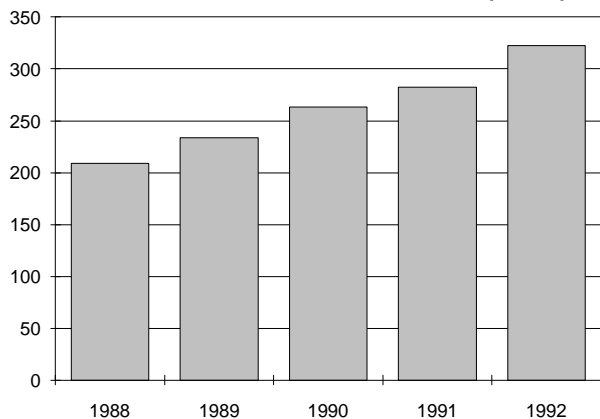
SMARTLIGHT ANNUAL ENERGY SAVINGS (MWH)



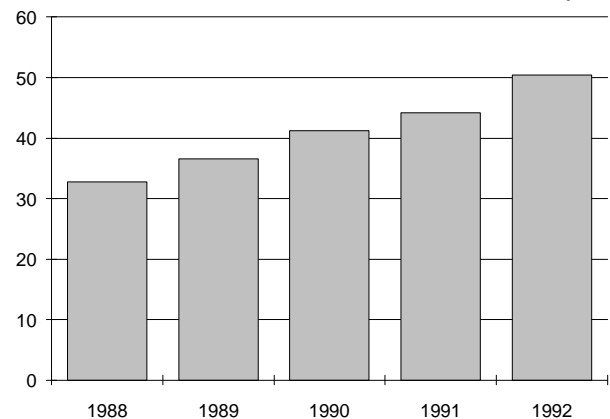
SMARTLIGHT ANNUAL WINTER PEAK CAPACITY SAVINGS (MW)



SMARTLIGHT CUMULATIVE ENERGY SAVINGS (MWH)



SMARTLIGHT CUM. WINTER PEAK CAPACITY SAVINGS (MW)



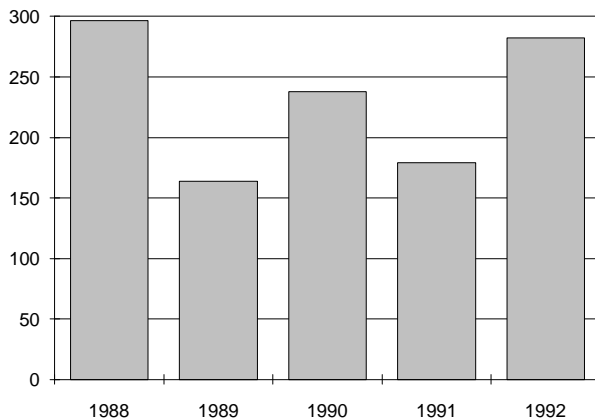
DATA ALERT: The savings numbers presented below are not derated for free ridership or other evaluation findings but are instead based on engineering estimates and customers' claims of building occupancy schedules and lighting usage. Note that all savings for Lightwaves are aggregated and thus negatively weight the program's cumulative energy savings.

To date, the Smartlight program has accounted for total annual energy savings of 322.36 MWh. Annual energy savings for the program were by far the greatest during the first year of the program when 209.28 MWh were saved. In terms of total cumulative energy savings the program has accrued 1,310.93 MWh as of December 1992. The implementation of Smartlights in TMLP's service territory to date will result in lifecycle savings of 2,514.43 MWh based on an average lifetime for Smartlights of 7.8 years.

In terms of Smartlight's peak coincident demand savings, TMLP assumes a 5% summer coincidence factor resulting in summer peak demand savings to date of 13 kW, and a 20% winter coincidence factor which has resulted in 50 kW of peak winter demand savings to date.

The 121 completed jobs through the Lightwaves program have accounted for energy savings of 6,967.74 MWh and peak demand savings of 2.21 MW. (Note that TMLP assumes a 95% peak coincidence factor for Lightwaves as the summer system peak occurs at 3:00 in the afternoon, and the winter system peak occurs at 6:00 in the evening.) Lifecycle savings for the measures in place, assuming a 12-year average lifetime for the measures installed, account for 83,612.88 MWh.

SMARTLIGHTS SAVINGS PER PARTICIPANT (KWH)

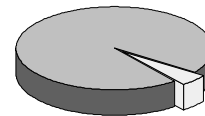


In addition to the savings from projects completed as of December 1992, several other Lightwaves projects are in various phases of construction. Taunton projects savings of 1,021.469 MWh and demand reduction of 0.5 MW from the 10 Lightwaves projects that are 98% completed. The other 24 Lightwaves jobs that are currently in progress are expected to account for savings of 1,125.8 MWh and demand reduction of 0.21 MW. The 158 buildings that have been audited but have not begun the retrofit process have projected savings of 5,450 MWh and demand reduction of 4.5 MW. [R#7]

PARTICIPATION RATES

Of Taunton's 25,594 residential accounts, 1,227 were actively participating in the Smartlight program as of December 1992. These numbers represent a 4.79% program participation rate. The largest number of participants were signed up to lease the lamps in 1988. The number of new participants dropped off greatly after the first year

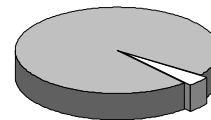
Non-Participants
95%



SMARTLIGHT
Participants
5%

of the program. This drop-off can be attributed to a shift in focus, especially monetarily, on the part of Taunton. With Smartlight, Taunton was primarily interested in discovering whether the concept (customer leasing of

Non-Participants
96%



LIGHTWAVES
Participants
4%

energy-efficient lighting) of the program was viable. Initial participation showed that such a program would work so Taunton elected to shift focus to the commercial and industrial sectors, where much greater energy savings could be achieved. [R#6]

Program Savings (continued)

Participation Table	Participants	Number of Lamps Installed	Number of Lamps per Participant	Annual Energy Savings per Participant (kWh)
1988	706	2,874	4.07	296
1989	147	331	2.25	164
1990	126	412	3.27	238
1991	107	263	2.46	179
1992	141	547	3.88	282
Smartlights Total/Average	1,227	4,427	3.61	263
Lightwaves (1990 - 1992)	121			57,585

A total of 6,179 Smartlights have been issued during the course of the leasing program. (TMLP purchased another 688 bulbs that were defective.) Of the total, 28% of the Smartlights have been returned by customers, usually because they ordered more lights than they could use and later found they wouldn't fit where they had planned to install them. In 1988, 1,410, or 33%, of the bulbs issued were returned. This return rate has decreased rapidly with only 5% of the bulbs issued in 1992 being returned. (When the program was introduced the customers were extremely excited about Smartlight. Many of the customers ordered the maximum of ten bulbs, then realized the lamps were not able to be used in all locations. They also realized that if they were not using the bulb an average of 1.5-2 hours per day, they were not getting any savings.)

As of December 1992, 121 Taunton customers had received completed Lightwaves installations. Since Taunton has approximately 3,014 commercial and industrial customers, Lightwaves has an overall participation rate of 4%. Participants in the Lightwaves program range from small businesses to large corporations. To date, Lightwaves has reached a representative sample of the TMLP customer base, including installations in all the schools in the service territory. [R#7,9]

MEASURE LIFETIME

The average lifetime of a Smartlight is 10,000 hours. Thus assuming a duty factor of 3.5 hours per day the

average Smartlight will last approximately 7.8 years. This lifetime has been used to calculate lifecycle savings for Smartlights and to calculate the cost of saved energy of the Smartlights program.

The Lightwaves program supplies seven types of energy-efficient lighting products which each have been assigned independent measure lifetimes based on manufacturer's data. Fluorescent lamps have lifetimes of 12,000 hours for 8-foot tubes and 20,000 hours for 4-foot tubes. Compact fluorescent lamps have an average lifetime of 10,000 hours. Electronic ballasts and specular reflectors have an average lifetime of 15 years. Incandescent lamps have an average lifetime of 1,000- 3,000 hours and high intensity discharge lamps have a lifetime of 24,000 hours. The Results Center calculates lifecycle savings based on an average measure lifetime of 12 years.

PROJECTED SAVINGS

TMLP plans to maintain the two programs for as long as they are cost effective and to ramp up the Smartlight program in April of 1993. Although no specific targets are set for Smartlight, TMLP has filed its projections for capacity savings associated with Lightwaves with the Massachusetts DPU. The following are cumulative capacity savings forecasted for Lightwaves: 1993 - 2.95 MW; 1994 - 4.48 MW; 1995 - 6.18 MW; and 1996 - 7.12 MW. [R#7]

Cost of the Program

Costs Overview Table	Bulb Orders (x1000)	Advertising (x1000)	Start Up Costs (x1000)	Administrative Costs (x1000)	Program Income (x1000)	Net Program Cost (x1000)	Gross Program Cost (x1000)	Net Cost per Participant
1988	\$49.33	\$5.04	\$18.67	\$11.72	(\$5.52)	\$79.24	\$84.76	\$112.24
1989	\$0.00	\$0.00	\$0.19	\$3.56	(\$10.11)	(\$6.36)	\$3.75	(\$43.28)
1990	\$9.02	\$0.00	\$0.00	\$3.95	(\$9.67)	\$3.31	\$12.98	\$26.26
1991	\$14.24	\$2.47	\$0.00	\$4.33	(\$11.92)	\$9.12	\$21.04	\$85.23
1992	\$10.94	\$2.32	\$0.00	\$4.73	(\$6.67)	\$11.33	\$17.99	\$80.35
Smartlight Total	\$83.53	\$9.84	\$18.86	\$28.30	(\$43.89)	\$96.64	\$140.53	
Lightwaves 1989-1992	n/a	n/a	n/a	253.408	(\$574.14)	\$1,423.7	\$1,997.8	\$11,766.18
Total						\$1,520.3	\$2,138.3	

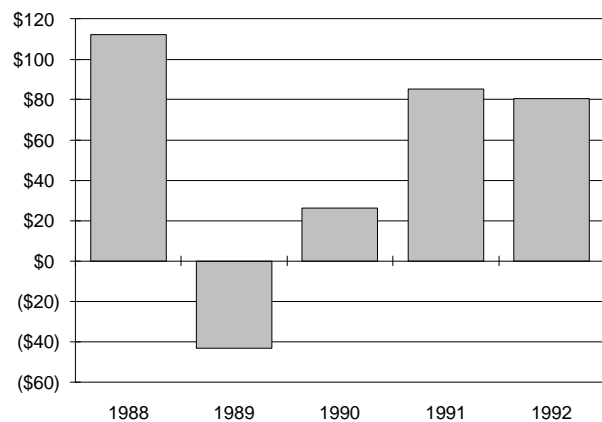
DATA ALERT: Lightwaves' costs are not available on an annual basis, nor can they be disaggregated. Similarly, Lightwaves revenues are not available on an annual basis and are presented in the accompanying tables as a lump sum. Thus Lightwaves' total costs, which drive the cost of saved energy calculation, are presented over the life of the program rather than in our usual annual format. Note that the cost of saved energy is calculated for Lightwaves based on the net program cost which in turn is based on the total projected revenues over the five years that complete installations will pay monthly fees.

Since a significant share of Lightwaves' costs represent projects in midstream (either in the audit stage or various stages of construction) as well as inventory that will be used in the future, TMLP and The Results Center have discounted the gross program costs discussed in the following text by 30% to more accurately portray only those expenditures that are actually coupled with the savings in the previous sections. This discounted, gross value is used to drive the cost of saved energy, the cost per saved kilowatt of capacity, and the average cost per participant, expressed as both gross utility cost and ultimate cost when the participants' payments are complete.

**SMARTLIGHT
NET PROGRAM COST (x1,000)**



**SMARTLIGHT
NET COST PER PARTICIPANT**



Cost of the Program (continued)

Since its inception in 1988 the Smartlight program has cost a total of \$140,530 minus Smartlight income of \$43,890 for a net total program cost of \$96,640. Fully \$83,530 has been spent on lamp purchases, nearly 60% of the gross program costs, with less than \$10,000 spent on advertising over the tenure of the program.

Taunton had spent a gross sum of \$2,997,070 on Lightwaves program as of December of 1992, but as stated above some of these costs are more accurately assigned to inventory and labor for projects in midstream. TMLP estimates that it has spent \$1,997,850 on the 121 Lightwaves projects that have been completed, with \$574,140 projected in revenues from these customers (29% of the gross program cost), for a projected net program cost of \$1,423,710. Note that the total revenues from the Lightwaves measures installed was \$87,190 as of December 1992, or 4.3% of the program's gross costs. Revenues received to date represent only a small portion of the "revenue balance" projected (approximately \$502,000) based on the

five-years worth of monthly payments of the equipment installed to date.

COST EFFECTIVENESS

The Results Center calculates the average cost of saved energy of the Smartlight program at 3.11¢/kWh based on a real discount rate of 5%. Using a range of discount rates, from 3% to 9%, Smartlight's average cost of saved energy ranges from 2.87-3.63¢/kWh.

The cost of saved energy for Lightwaves projects based on a 5% real discount rate is 2.31¢/kWh. Using the range of discount rates presented in the accompanying table, the cost of saved energy ranges between 2.05-2.85¢/kWh.

Early in the program Taunton subjected Smartlight to the Total Resource Cost Test and the more rigorous No-Losers Test for cost effectiveness. In order to pass with a

Cost of Saved Energy (¢/kWh)	Discount Rates						
	3%	4%	5%	6%	7%	8%	9%
Smartlights							
1988	5.52	5.75	5.98	6.22	6.46	6.71	6.96
1989	-3.85	-4.01	-4.17	-4.34	-4.51	-4.68	-4.85
1990	1.61	1.67	1.74	1.81	1.88	1.95	2.03
1991	6.94	7.23	7.52	7.82	8.13	8.44	8.76
1992	4.14	4.32	4.49	4.67	4.86	5.04	5.23
Five Year Smartlights Average							
1988-1992	2.87	2.99	3.11	3.24	3.37	3.49	3.63
Projected Three Year Lightwaves Average							
1990-1992	2.05	2.18	2.31	2.44	2.57	2.71	2.85

benefit/cost ratio greater than one for the No-Losers Test, program savings have to offset all program costs including any lost revenue as a result of conservation. Because the Smartlight program passed the No-Losers Test, the program ensures that non-participants do not subsidize the savings of others and the effect of the program's savings will not result in short-term rate increases. [R#10]

The Lightwaves program is also evaluated for cost effectiveness on a per-project basis. Taunton estimates that expenditures of \$1,500 or less per kW saved denote a cost effective project. [R#7] Note that The Results Center calculates the average net cost per saved kW to be \$644/kW. (The value based on the gross program cost is \$904/kW.)

COST PER PARTICIPANT

As of December 1992 a total of 1,227 customers had participated in the Smartlight program, using a total of 4,427 lamps for an average of 3.61 lamps per customer. The net cost per participant to date has ranged from a high of \$112 per customer to a low of negative \$43.28 in 1989.

The average yearly net cost per participant has been \$52.16.

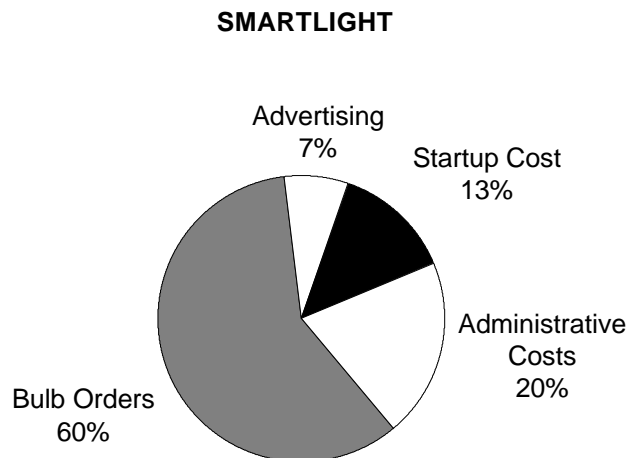
The Lightwaves program had completed 121 jobs by December 1992 at a net cost of \$1,423,710, or \$11,766 per customer.

FREE RIDERSHIP

According to TMLP free ridership is not an issue for either the Smartlight program or Lightwaves. For Smartlight, about half of the costs of the measures are recovered ultimately from the customers. For Lightwaves, TMLP has conducted no formal evaluation but assumes that potentially low levels of free ridership are negated by the approximate 25% cost recovery of the program.

COST COMPONENTS

From January 1988 to December 1992 the Smartlight program cost TMLP a total of \$83,530 on bulb orders, \$9,840 on advertising, \$1,030 on packing materials, \$17,830 on startup costs, and \$28,300 on administrative costs for a gross program cost of \$140,530. [R#6]



Environmental Benefit Statement

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%	17,849,000	423,000	86,000	9,000
B	10,000	1.20%	19,033,000	164,000	55,000	41,000

Controlled Emissions

A	9,400	2.50%	17,849,000	42,000	86,000	1,000
B	10,000	1.20%	19,033,000	16,000	55,000	3,000
C	10,000		19,033,000	109,000	55,000	3,000

Atmospheric Fluidized Bed Combustion

A	10,000	1.10%	19,033,000	50,000	27,000	14,000
B	9,400	2.50%	17,849,000	42,000	34,000	3,000

Integrated Gasification Combined Cycle

A	10,000	0.45%	19,033,000	34,000	5,000	14,000
B	9,010		17,120,000	12,000	4,000	1,000

Gas Steam

A	10,400		10,381,000	0	24,000	0
B	9,224		9,015,000	0	56,000	3,000

Combined Cycle

1. Existing	9,000		9,015,000	0	35,000	0
2. NSPS*	9,000		9,015,000	0	16,000	0
3. BACT*	9,000		9,015,000	0	2,000	0

Oil Steam--#6 Oil

A	9,840	2.00%	15,026,000	228,000	27,000	25,000
B	10,400	2.20%	15,936,000	226,000	34,000	16,000
C	10,400	1.00%	15,936,000	32,000	27,000	9,000
D	10,400	0.50%	15,936,000	95,000	34,000	5,000

Combustion Turbine

#2 Diesel	13,600	0.30%	19,943,000	40,000	62,000	3,000
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Refuse Derived Fuel

Conventional	15,000	0.20%	23,677,000	61,000	80,000	18,000
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Avoided Emissions Based on 8,278,670 kWh Saved (1988 - 1992)

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

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

HOW TO USE THE TABLE

1. The purpose of the previous page is to allow any user of this profile to apply Taunton Municipal Lighting Plant's level of avoided emissions saved through its Smartlight and Lightwaves programs 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

Joe Blain, Taunton's General Manager, stands firmly behind both Smartlight and Lightwaves. He believes in the principle that customers share in the costs of efficiency. If it's so cost effective, why can't the consumer foot the bill, or inversely, why does the utility need to pay its entire cost? Taunton feels that customer use of energy-efficient lighting products is facilitated when they have a vested interest in the product. Providing lighting technologies for free would likely lessen the value of these products in the eyes of the customers.

Historically, compact fluorescent lighting and other energy-efficient lighting technologies have had limited success in the residential, commercial, and industrial markets. Many utilities have attempted to penetrate the market using rebate programs. The Smartlights and Lightwaves programs avoid many of the barriers to customer participation associated with rebate programs. Because the Lightwaves program was modeled after the Smartlights program, both programs provide similar lessons.

One of the keys to the TMLP's success with both programs is that customer worries about lighting quality and savings are offset by an unconditional guarantee of satisfaction and free light replacement. Customers are assured risk-free investment. Selecting products, product availability, and contractor abilities are not potential problems for customers because Taunton supplies the lights and checks the installations. This program capability will be enhanced by the customer interface that the door-to-door Smartlight pilot will provide.

The Philips Lighting Company's SL*18 lights provided in the Smartlights program are suited for a wide

range of applications which has facilitated customer acceptance. Similarly, Lightwaves offers a tremendous variety of lighting technologies, which provides customers with access to very expensive products, which likely would not be purchased otherwise. [R#5,10]

Lightwaves has been very popular with customers for reasons beyond reduced electricity bills. The new installed lighting measures make people and merchandise look better. In fact, the actual fixtures are much sleeker than traditional lighting. Many employees of Lightwaves program participants find that the new lighting is much easier on their eyes. Taunton describes the high quality of the lighting to customers, but they often have to see it to believe it.

"The energy-efficient bulbs add a little color to your face. Most fluorescents drain people of color, but now, you almost look like you have a tan, even when you don't. With Lightwaves, we've received blanket approval from our employees. That's unusual but this program is a no-brainer. You can't lose." Gary Perkins, Executive Vice President for Perkins Paper. [R#9]

From an administrative point of view, Taunton has learned that it is worthwhile to pay higher prices for certain energy-efficient lighting measures instead of purchasing the least cost options. Similarly, the quality of contractors must be evaluated by means beyond the dollar amount of their bid. Contractors are paid on a per unit installed basis with some flexibility permitted for unique projects. Specific, structured training for auditors would also help to raise their level of expertise.

Taunton also discovered that a larger supply of certain lighting materials was required, as the installation

rate could not keep pace with the number of audits performed.

Taunton learned that it is important to keep an open mind towards new technologies and their potential for use. For example, Taunton had predicted the use of specular reflectors in only 25% of installations but the actual number has been closer to 75%. [R#8]

Time and experience have made it clear that the Smartlight program would benefit most by offering a wider range of energy-efficient lighting products versus the single type of Smartlight currently available. Presently Taunton is working on adding other lighting products to the program.

A final, key lesson to be learned from both of Taunton's leasing programs is the importance of DSM programs focusing on one end-use at a time instead of trying to tackle all possible energy efficiency measures at once. When utilities do a good job with early DSM programs, customer acceptance of additional programs is much easier to achieve. As such, TMLP's introduction of Smartlight, then Lightwaves, now has opened the door for customer acceptance of further energy efficiency initiatives.

TRANSFERABILITY

The Smartlight program is clearly transferable to other utilities as it has been emulated already by Burlington Electric Department (See The Results Center Profile #3).

Taunton believes that Lightwaves is a very good model for utilities interested in expanding their scope of energy service options while pursuing least-cost planning. A utility can sell the energy services that its custom-

ers want and then finance its demand-side investments. Customers are motivated to participate because of the low risk, minimal customer effort offered by the program. Taunton claims that programs with customer contribution in conjunction with positive cash flow have numerous benefits. In fact, TMLP thinks that programs having a similar design and delivery system to Lightwaves can be designed for many types of equipment, including thermal storage and electric vehicles, and for all customer classes. [R#5]

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4. Taunton Municipal Lighting Plant, Lightwaves brochure.
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9. Taunton Municipal Lighting Plant, early press kit that includes interview with Joe Desmond by Specular+, "Mapping the Road to Risk-Free Energy Conservation."
10. Taunton Municipal Lighting Plant, "The Smartlight", unpublished internal document.
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Special thanks to Jennifer Love for her assistance with the development of this profile.