Utility Sponsored Low-Income Weatherization as a DSM Option

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Almost one-fourth of U.S. households are at or below the 150 percent-of-poverty-level guideline used by the federal government to define eligibility for low-income weatherization assistance. These households tend to have less efficient homes and appliances compared to middle and high income groups. Furthermore, a higher portion of their income is required to pay their energy bills. This market segment is important for demand-side management (DSM) investment because it has an enormous potential for energy savings. Even though studies show that low-income weatherization programs can be cost-effective when the evaluation quantifies all of the costs and benefits, most utilities continue to regard such programs more as a social responsibility than as a genuine DSM option. At least 27 states have utility-sponsored low-income weatherization programs at present. Even the six states where such programs failed economic evaluation tests are still planning to continue investing in them for social equity. However, as long as low-income weatherization programs are conceived by utilities as social programs, significant and cost-effective energy savings will be foregone. This paper explores an innovative mechanism which enhances the cost-effectiveness of low-income DSM programs under the framework of a state-utility partnership.

Introduction

Since the rnid-1980s, stability in energy prices has made the energy crisis fade in the minds of the public. However, low-income families continue to suffer from the burden of high energy costs in relation to their budgets (Byrne et al. 1985).[1] According to a report published by the National Consumer Law Center, the poor devoted in excess of 20 percent of their income to pay their heating bills in 1988 (1989: 17). There are about 21 million households within 150 percent of the poverty level in the U.S. (Fenichel 1992). These low-income households usually have difficulty in paying their energy bills and especially so during months when heating or cooling systems have to be operated.

Low-income households have a higher energy intensity (defined as energy consumption controlling for housing size, number of appliances and degree days) compared to middle- and high-income groups. This is because such households have to cope with older, less energy-efficient homes, appliances, furnaces, and they also have limited financial resources to invest in energy-efficiency improvements. The 1992 residential energy consumption survey conducted by the Energy Information Administration (EIA) shows that low-income households have fewer energy conservation measures: only about 64 percent of households in the lowest income category (below $5,000) have ceiling insulation while the same is true for more than 91 percent of the households in the highest (above $50,000) income bracket. The same trend holds true for other residential energy conservation measures (see Table 1). The equipment in low-income households is more energy-intensive than the average market model. For example, 14 percent of households in the lowest income bracket have refrigerators that are more than 20 years old but only 5 percent-of the households in the highest income bracket have refrigerators that are more than 20 years old (EIA 1992).

These energy consumption characteristics of low-income households indicate the existence of an enormous potential for energy conservation and justify the need to concentrate our efforts to conserve energy in low-income households. If weatherization of homes is seriously considered and evaluated as a DSM resource, utilities may find that low-income households represent a largely unrealized DSM opportunity.

Meanwhile, an important issue with respect to utility DSM programs is that of fairness. Typically, utility DSM programs limit involvement to those who can afford capital investments required for participation in DSM, leaving low-income consumers at a serious disadvantage (Kahn 1992). To date, utilities generally continue to investigate and expand residential DSM programs

Table 1. Energy Conservation Measures Installed in Households (%)

	Annual Income in US $ (1,000)						
Measure Taken	< 5	5 ~ 10	10 ~ 15	15 ~ 25	25 ~ 35	35 ~ 49	50 <
Ceiling	63.9	71.2	69.7	74.3	81.7	86.0	90.7
Weather Stripping	35.7	49.8	49.2	52.0	62.0	64.8	74.4
Wall Insulation	47.8	56.8	60.8	60.3	68.4	72.8	75.3
Storm Window	39.4	50.9	48.8	45.9	51.3	54.8	56.9
Storm Doors	27.5	38.2	39.0	39.1	43.1	45.0	39.1

Source: Adapted from EIA (1992).

that benefit middle- and upper-income classes, despite enormous potentiality for the low-income group (President's Commission on Environmental Quality 1992). Low-income households do not have the economic power to affect the effective demand in the market for new homes, and their disposable income is insufficient to enable them to take advantage of capital improvement subsidies. Along with the benefits of stabilized energy rates and environmental benefits, middle and upper income consumers have been enjoying the benefits of reduced energy consumption and utility bills resulting from their participation in DSM. On the other hand, low-income consumers whose budget precludes their involvement in DSM see little direct benefit from these DSM sources. Instead, they bear the costs of DSM programs, as reflected in rate increases. Low income consumers are typically left holding the bag.

This paper attempts to explore potential mechanisms which encourage utility participation in low-income weatherization programs as a DSM option. Given utilities' high interest in DSM, the proved viability of such a program will encourage their utilities' active involvement in the "programs, and consequently increase the effectiveness of utility DSM efforts. This paper is organized into five sections. Following the introduction, the second section reviews the Weatherization Assistance Program (WAP) initiated by the Department of Energy (DOE). The third section presents an overview of the current utility participation in low-income weatherization programs. The fourth section assesses the viability of WAP as a DSM option by examining the evaluation processes presently used to determine cost-effectiveness. The final section presents a cost-effective partnership mechanism to implement the program as a DSM policy tool, followed by our conclusion and suggestions.

Low-Income Weatherization Programs

DOE's WAP is one of the major programs to attempt to mitigate the hardships of the vulnerable class of the American society. In the eleven year period from 1978 to 1989, 3.9 million low-income homes have received approximately $4.4 billion in weatherization improvements. However, this still leaves an estimated 24 million homes eligible for weatherization improvements but untreated (Power and Brown 1993). Indeed, during the six year period between 1987 and 1992, total National WAP funding has constantly decreased, especially in inflation-adjusted terms (Byrne et al. 1993).

WAP was established in 1975 under Community Services Administration (CSA) on an emergency basis after the 1973 energy crisis. One year later, it was authorized by the Energy Conservation in Existing Building Act of 1976. DOE began involvement in 1976 and was given full responsibility of operating a low-income weatherization program in 1979. Program funding continued expanding as Low-Income Home Energy Assistance Program (LIHEAP) and Petroleum Violation Escrow (PVE) funds became available since 1982 and 1986 respectively. However, federal funding has not kept pace with the increasing number of eligible households. Since 1987, total national WAP funding has constantly declined from $511 million in 1987 to $380.2 million in 1992, primarily due to the exhaustion of PVE funds and fluctuating LIHEAP contributions (Byrne et al. 1993: 10).

Exclusively targeting low-income households, the goals of WAP include reduction in energy consumption and lowering energy bills of these groups by increasing the energy

efficiency of their dwellings. WAP also aims to provide benefits of improved health and safety. In the early years, low cost/no cost and temporary measures were emphasized, including caulking, weather-stripping, and plastic window sheets. By the time of EIA's evaluation of the 1981 weatherization program, the emphasis had changed to more permanent building envelope measures, such as storm windows and insulation. Since 1984, WAP has kept expanding the range of flexibility with respect to state's decision on weatherization measures, from thermostat control systems to cooling efficiency improvements (Brown et al. 1993: 4.1). From 1978 to 1989, 3.9 million weatherized homes are estimated to have saved the energy equivalent of "up to 5 million barrels of oil each year'' (DOE 1992: 5).

Utility Participation

Low-income weatherization programs reach the consumer via three types of mechanisms: a state funded program; a utility program mandated by the Public Utility Commission (PUC); and an independent utility program. Although low-income weatherization has significant potential as a DSM resource, utilities are still reluctant to combine it with their DSM programs (Fenichel 1992).

A survey of the low-income weatherization programs in the country shows that 27 states have utility-sponsored low-income weatherization programs. Analysis of these programs revealed that most utilities and state commissions do not review the programs systematically with a view to make them more effective in future. Of these 27 states, as many as 11 had not systematically evaluated their programs. Even the six states, where such programs failed the economic evaluation tests, are planning to continue investing in them for reasons of social equity (Alliance to Save Energy 1992). The survey shows that these programs are pursued more as social programs than as genuine DSM resources.

Some utilities participate in such programs in order to meet mandatory state requirements. Wisconsin has had regulations in place since 1983 requiring all major gas and electric utilities to provide weatherization to low-income consumers at no charge. In Connecticut, PUC ruled in 1987 that utilities develop comprehensive low-income weatherization programs for the purpose of reducing the energy bills of low-income households (Schlegel 1992). In Vermont, the regulatory board has required that utilities file comprehensive DSM plans that include a portfolio of cost-effective measures to serve low-income consumers to reduce their energy bills. As of March 9, 1993 plans of seven utilities covering 90 percent of state's residential consumers were approved.

The Low Income Usage Reduction Program (LIURP) is a major utility-sponsored DSM activity targeted toward low-income customers in Pennsylvania. It is a mandated program that concentrates its resources on weatherization. All utilities are required to spend 0.05 percent of their gross revenues on this program. While the amount of overall utility fund available for energy conservation activities has decreased by 2.6 percent during 1991-1992, the total budget for LIURP in 1993 remains at a decent $13.8 million (Pennsylvania PUC 1993). The LIURP, due to be expired in 1992, has been extended for a period of five years. Additional electric base-load measures like efficient lighting and efficient appliances would be considered in the new version of LIURP.

The DSM plan of the Philadelphia Electric Company (PECO) has a pilot program targeted towards low-income consumers who are enrolled in PECO's Customer Assistance Program (CAP). The program includes in-home energy education, compact fluorescent screw-in lamps and a refrigerator swap. An energy specialist conducts home visits to stress the benefits of conservation. High wattage incandescent lamps are replaced with energy efficient compact fluorescent lamps, and PECO removes and disposes of inefficient refrigerators and replaces them with new, efficient ones. There are no customer costs to this program (PECO 1991). The PECO program met with great success. The program reduced consumption in refrigerator group households by 1,471 kWhs per year. This produced consumer savings worth $210 a year at current PECO rates. The average direct cost per household was $683, creating a simple payback of 3.3 years. In addition, with an average of three bulbs installed, lighting group participants saved an average of 606 kWhs per year. This is worth $87 at current PECO rates. At an average cost of $205 per household, the simple payback period was a mere 2.4 years. Even after such costs as operation, staff training, oversight and evaluation costs were added to the PECO program, simple paybacks of 4.1 and 4.4 years for the refrigerator and lighting groups were achieved, respectively (Krehling 1993). These impressive numbers are well within the Pennsylvania PUC's LIURP guideline of seven years.

At present, U.S. utilities' commitment to low-income households remains quite limited. Relative to DOE, utilities invested less and installed fewer energy conservation measures in the dwelling units occupied by lower-income households (Power et al. 1992). This seems to result from their failure to look at the potential of DSM in lower-income households and the evaluation structure for weatherization programs. However, some utility commissions do feel that low-income DSM programs make economic sense. The New York Public Service Commission argues that if targeted toward customers with

high energy usage and payment trouble, these programs could significantly benefit both utility and customers. It envisions benefits from reduced costs of bill collection, service termination, and complaint handling. In the following section, low-income weatherization will be discussed as a viable and cost-effective DSM option.

Economics of Low-Income Weatherization

The low-income weatherization programs could be a cost-effective and viable demand-side management (DSM) option. However, these programs fail to qualify as cost-effective options under the conventional economic evaluation criteria (Alliance To Save Energy 1992). One of the reasons for utilities' limited commitment to low-income households originates in the evaluation structure of DSM programs. The Total Resource Cost Test (TRC) is one of the primary tests used by utilities in evaluating DSM programs. In the manner this test is operationalized by utilities, the benefits of DSM programs, especially low-income programs, are not reflected adequately. Commonly, the approach ignores savings from reductions in uncollectible, disconnections and reconnection.[2] The test also fails to consider environmental benefits, improved housing stock and participant health and comfort levels (Fenichel 1992). If such programs are to be considered as a DSM source, these benefits have to be included while evaluating the program for cost effectiveness.

Recent DOE research (Power et al. 1993) has shown that inclusion of these benefits provides a more realistic picture of net gains by the society. According to this study, low-income conservation programs can be cost effective when evaluation tools quantify all of the costs and benefits. This study has evaluated the cost effectiveness of DOE's WAP from three different perspectives: Installation Perspective, Program Perspective, and Societal Perspective. As shown in Table 2, under the social perspective, all the costs and benefits including non-energy benefits are considered in evaluation. This method includes benefits accrued from enhanced property value and extended lifetimes of dwellings, reduced fires, reduced arrearages, federal, state and local taxes generated from direct employment, income generated from indirect employment, avoided costs of unemployment benefits, and environmental externalities. According this study, DOE's WAP is cost effective, under any of the evaluation perspectives.[3] However, with societal perspective, benefit/cost ratio is the highest. This means that when nonenergy benefits are also included, the program returns $1.72 for every $1.00 invested.

The National Consumer Law Center (NCLC 1993) also reports that utilities could generate substantial savings and improved revenues by implementing this type of DSM program. For instance, the reduced energy consumption and cost through improved energy efficiency will enhance credit and collection savings such as those associated with disconnections and reconnection, negotiating deferred payment plans and the like. Diverted revenue, otherwise lost through reconnection fees and costs associated with forced mobility, will be recaptured as affordable bills allow consumers to pay bills and sustain their utility service. More affordable energy bills will lead to the decrease of bad debt. In addition, as consumer bills are paid more regularly, the lag time for achieved revenues will be shortened. Thus, the amount of working capital required by utilities will be reduced. Though estimates of these cost savings are not available in detail, the magnitude of these savings could be presumed to be significant judging from the current cost measures spent by utilities in these areas. For example, according to a Pennsylvania utility estimate, it costs between $67 and $84 to try and collect a single delinquent bill.

Table 2. Cost Effectiveness of DOE's WAP Program

Perspective	Benefits	Costs	B/C
Program	Energy Savings Only	All Costs	1.09
Installation	Energy Savings Only	On-Site Installation Costs	1.61
Societal	Energy and Non-Energy Savings	All Costs	1.72

Source: Brown et al. 1993. *National Impacts of the Weatherization Assistance Program in Single-Family and Small Multifamily Dwellings*. Oak Ridge National Laboratory, p. 10.13.

It is important that utilities consider all the benefits that are internal to the system, and not solely the avoided power production costs. Such an outlook would improve the economics of low-income programs and deliver all its true benefits. It is also possible to devise regulations which make low-income DSM investments attractive. The manner in which cost-effectiveness of programs is evaluated can be modified by the PUC to take into account benefits accrued to society as a whole. For example, under a PUC order, nine utility companies in New York have launched a three-year pilot program, Utility Low-Income Energy Efficiency Program (ULIEEP). The PUC order stipulates a provision of program evaluation that the program be evaluated for cost-effectiveness with TRC Test. However, the Commission has explicitly emphasized that utilities should include in evaluation nonenergy benefits such as the improved safety of dwellings, environmental benefits, and better health. Though these benefits are not easy to quantify, they can be estimated indirectly. For example, an Emissions Reductions Index (ERI), expressive of the amount of CO_2 emissions avoided by reduced energy consumption, can be one way to quantify environmental benefits (Kinney 1993).

Indeed, low-income DSM programs could have significant non-energy benefits. During the past five years, weatherization programs in Pennsylvania have produced more than 7,000 jobs, increasing earnings $126 million and increasing overall economic output by $225 million. In addition, weatherization programs have added $8 million in tax revenue to the state treasury (ECA 1993). But most utilities continue to regard such programs more as a social responsibility as a genuine DSM option. Some DSM planners in utilities and some regulators are not yet ready to accept full TRC tests in the evaluation of low-income weatherization program as a DSM option. In the next section, we explore an innovative mechanism which enhances the cost-effectiveness of low-income weatherization programs under the conventional cost-effective test and the current regulatory environment.

Partnership Strategies

A partnership between the state and the utilities may bean effective way to establish a link between cost-effective state weatherization programs and utility DSM programs. Through the partnership, both parties could realize their goals cost-effectively.

Utility DSM programs have emerged as the most preferred option of utilities and regulators for future energy generation (Byrne, Wang and Hoffman 1992). In less than six years, the DSM market in the U.S. has grown to over $1.2 billion in annual utility investments in demand-side efficiency (Hirst 1992). Given the increasing attention to DSM by utilities, low-income weatherization programs appear to emerge as a viable DSM option. On the other side, in October 1991, DOE proposed changes in its current regulations of WAP. Among the proposed changes to be effective in 1993, the provision of the Incentive Fund[4] is one of the most important. This rule permits DOE to give incentive monies to those states which "obtained a significant amount of [their] income from non-Federal sources for their weatherization programs or increased significantly the portion of low-income weatherization assistance obtained from non-Federal sources" (DOE 1991: Section 440.26). Thus, each state needs to leverage and use effectively other resources in addition to DOE appropriations. In fact, utilities could emerge as an important source of funding for weatherization programs.

If low-income weatherization were considered as a DSM source by utilities, both demand and energy savings would increase. Recent changes in DOE' weatherization program regulations include peak shaving measures as part of weatherizing homes, making it possible to save both demand and energy through weatherization. In earlier programs, only energy savings were considered. While the situational factors are ripe for implementing low-income weatherization programs in a mutually beneficial way to both states and utilities, the mechanisms to connect their interests effectively have not yet been developed. The section below explores some possible strategies to improve the cost-effectiveness of low-income weatherization programs.

One type of a state-utility partnership is shown in Figure 1. Under this model, the state provides the major part of the weatherization funding. Utilities pitch in extra funds to harness more energy benefits and also enhance overall program effectiveness. Cost-effectiveness of program delivery is further improved by involving both gas and electric utilities. The utility part of funding could be jointly pooled in by gas and electric utilities, in proportion to the benefits they would accrue.

Alternatively, low-income programs could be added to the utility DSM portfolio through state support for such programs. In this model, the utility would treat weatherization as any other residential DSM program which requires customer contribution. The state would provide the utility with funds that would take the place of an actual customer contribution. Again, program effectiveness would be much more prominent when electric and gas utilities jointly deliver such programs.

The Case of Delaware

The cost-effectiveness of the weatherization program depends on the selection of the most appropriate measures for each of the participating homes and following it with

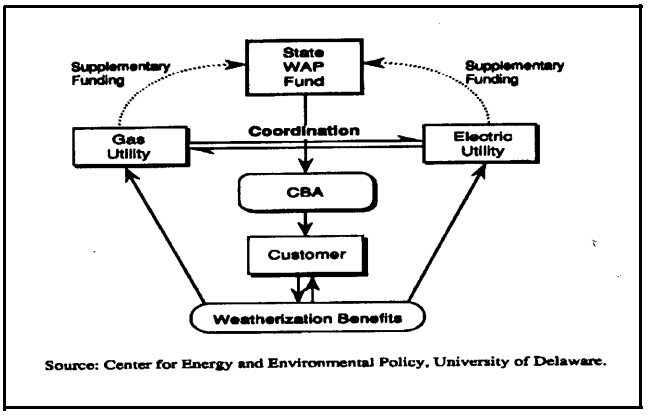

Figure 1. State-Utility Partnership Model

proper installation. Measures are selected for each individual house based on its energy audit. Thus, the audit procedure is critical to the success of weatherization programs. Recently, DOE has proposed that energy audits should include advanced diagnostic and assessment techniques that meet sound engineering principles (DOE 1993: 12528). As Table 3 shows, these advanced diagnostic and assessment techniques include blower door analysis, infra-red thermography, furnace combustion efficiency testing, and computerized audit calculation (Davis 1993: 3). Employment of these techniques may increase the cost-effectiveness of weatherization programs and enable them to compete as effective utility DSM resources.

A partnership between the State of Delaware and Delmarva Power, a regional utility serving Delaware and a portion of Maryland and Virginia, in the delivery of low-income weatherization assistance is designed to enable for low-income households to participate in the DSM goals of Delmarva Power and also to strengthen the State's capacity to improve the efficiency of household energy use. The partnership could be instituted between Delmarva Power and the State Office of Community Services (OCS) in cooperation with community organizations already participating in the State's WAP.

A key feature of DOE's proposed rule is to encourage states to utilize instrumented energy audit procedures. This includes use of blower door technology to identify cost-effective reductions in air infiltration and to set priorities for mechanical work on heating and cooling systems. According to a preliminary analysis of 80 households by OCS, energy savings from weatherized households in which a blower door audit was performed are much greater than those in which conventional audit technology was used. Compared to non-weatherized households, households which received blower door audits reduced energy requirements by 22%, while households that received conventional audits saved only 14% (Byrne and Wang, 1992).

An in-depth analysis of the demand and energy savings attributable to the WAP is not available at this time. A preliminary analysis by OCS suggests, however, that Delmarva Power customers who are also eligible for state WAP services will use 1,200 fewer kWhs annually under a weatherization procedure including an instrumented audit compared to weatherization using conventional audit methods. At an incremental cost of $250 for the instrumented audit procedure, and assuming a 10-year lifetime for weatherization savings and a 11.5% discount rate, the levelized cost per kWh saved equals $0.032. This is just below Delmarva Power's first-year avoided energy cost of $0.033 per kWh, making it a cost-effective utility

Table 3. Advanced Diagnostic Technologies, Description and Purpose

Diagnostic Technology	Purpose
Blower Door	Measures house tightness; also used with smokestick or infra-red to detect leaks
Infra-red	Detects location of air leaks
Furnace Combustion Test	Increases furnace efficacy; reduce toxic gases
Computer Audit (NEAT)	Quantifies and selects cost-effective measures

Source: Brown et al. 1993. *National Impacts of the Weatherization Assistance Program in Single-Family and Small Multifamily Dwellings*. Oak Ridge National Laboratory, p. 10.13.

investment. In the past, the State WAP has annually weatherized approximately 130 housing units belonging to Delmarva Power customers. For 130 homes, Delmarva Power would invest $32,500 in weatherization services carried out by the State WAP. This partnership would appear to be beneficial to the utility, the State, and Delaware's low-income households.

Community-Based Agencies

The effectiveness of the state-utility partnership can be further improved by encouraging inter-utility coordination (IUC) and involvement of community-based agencies (CBAS) in delivering low-income weatherization programs. The goal of IUC is a coordinated provision of energy conservation among the gas and electric utilities. Such a coordination has been encouraged in Pennsylvania and Connecticut. The Public Utilities Commission of Pennsylvania has required all the gas and electric utilities to participate in low-income programs since 1988. In its second phase, beginning 1993, LIURP would involve more coordination between electric and gas utilities. The Connecticut Low-income weatherization program, known as the Weatherization Residential Assistance Program (WRAP), was a collaborative effort of Northeast Utilities and Yankee Gas. The funding for the project came from both companies and later also from Connecticut Natural Gas Corporation.[5]

CBAs have several advantages that make them effective vehicles for delivering utility low-income weatherization programs. They have established a sound network in the community, are sensitive to the needs of low-income consumers, and reduce the program costs due to reduced overheads. Also, CBAs have strong commitment to serve the community and use their income to strengthen local economies (Hayes and Thomas 1992). In fact, CBAs are appropriate agents to deliver DSM programs to low-income consumers. CBAs are historically involved in various community issues and have developed a sound information network in the area. A sound information network combined with door to door solicitation generated a keen" interest in energy conservation.[a]

A link between community based non-governmental organizations and utilities is an important step in getting the low-income community involved in energy conservation programs. In addition to reducing the utility bills of those served by conservation programs, CBAs can help to establish an "energy ethic" in their communities. Such behavioral changes will produce more persistent energy savings and also lower the cost of conserved energy in the long run (ASDMP 1993). In addition, the environmental benefits inherent in conservation programs would be greatly enhanced.

Conclusion

While recent evaluation of low-income weatherization programs has proved their cost-effectiveness, utilities are still reluctant to show strong commitment to such programs. It is argued that utilities stand to benefit significantly by utilizing this unrealized DSM resource. Utility evaluations of low-income programs commonly exclude some of the important program benefits. The role of low-income weatherization as a DSM option can be enhanced if utilities are allowed, or encouraged, by PUCs to include direct and indirect benefits in their economic calculation. State-utility partnerships provide a favorable environment for influencing utilities to participate in low-income weatherization. The case study of Delaware shows how such a partnership could be highly beneficial to both state and the utility.

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Endnotes

1. Low-income households are spending a much higher portion of their income on energy bills relative to middle- and high-income households (27.1% vs. 8.7%).

2. Communicated in correspondence to the Public Utilities Commission by Elizabeth Robinson, the Energy Coordinating Agency of Philadelphia, February 10, 1922.

3. It is assumed that the discount rate is 4.7 and the lifetime of measures is 20 years. This evaluation is still conservative as it does not include some benefits like thermal comfort improvements, indoor air quality, benefits of increased nonenergy expenditures, and savings associated with fewer residential moves.

4. The fund is divided into the State Incentive Fund (supplementary financial assistance to the states that achieved the best performance of leveraging non-Federal sources in the previous year) and the Local Agency Incentive Fund (for local agencies that performed best in the previous fiscal year).

5. In a sample based evaluation, over 65 percent of the participants reported that they were more comfortable in their homes since weatherization. Over 95 percent thought that the service provided was either "good" or "very good" and almost half of the surveyed people

said that their opinion of the local utility was better than it had been prior to the program.

6. In the Southern California Edison's (SCE) low-income relamping program, compact fluorescent lamps were distributed free of charge through community based agencies to eligible customers. Since 1985 when the program was initiated, SCE's program continues to be successful from the utility perspective as well as in alleviating the burdens of low income consumers. In 1991, the program saved capacity of 3 MW and energy of 27 GWh. Over 56,000 SCE customers saved almost $3 million on their energy bills.

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