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KEYS TO SUCCESS: TEN CASE STUDIES OF EFFECTIVE WEATHERIZATION PROGRAMS

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WEATHERIZATION ASSISTANCE PROGRAM

MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

ORNL/CON-328

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EXECUTIVE SUMMARY

BACKGROUND

Since 1976, the U.S. Department of Energy (DOE) has operated the nation's largest energy conservation program — the Weatherization Assistance Program. The Program's aim is to increase energy efficiency and conservation in low-income households in order to reduce their energy consumption, lower their fuel bills, increase the comfort of their homes, and safeguard their health. The Program targets vulnerable groups including the elderly, people with disabilities, and families with young children.

In 1990, DOE initiated a nationwide evaluation of its Weatherization Program, with assistance from Oak Ridge National Laboratory and an advisory group of 40 weatherization professionals, program managers, and researchers. The evaluation is comprised of three impact studies covering the Program's major market segments:

- Single-family homes, mobile homes, and dwellings in small (2 to 4-unit) multifamily buildings (the Single-Family Study — Brown et al., 1993);
- Single-family homes heated primarily with fuel oil (the Fuel-Oil Study — Ternes and Levins, 1993); and
- Dwellings in buildings with five or more units (the Multifamily Study — MacDonald, 1993).

Two supporting studies address additional aspects of the Program. They include:

- Characterization of the DOE Weatherization network's capabilities, technologies, procedures, staff, and innovations (Mihlmester et al., 1992); and
- Profile of low-income weatherization resources, the weatherized population, and the Program-eligible population that remains to be served (Power et al., 1993).

The Single-Family Study, the subject of this report, is a critical part of this coordinated evaluation effort. Its focus on single-family dwellings, mobile homes, and dwellings in small multifamily buildings covers 83% of the income-eligible population and 96% of the dwellings weatherized during Program Year 1989. The first phase of the Single-Family Study involved the analysis of a massive data base of information collected from 368 local weatherization agencies and 543 electric and gas utilities. This analysis resulted in energy-saving and cost-effectiveness estimates for the Weatherization Program and the identification of a set of ten high-performing agencies located throughout the country. The second phase, which is the subject of this report, involves a "process" evaluation of these ten high performers, aimed at identifying those weatherization practices that explain their documented success.

RESEARCH DESIGN

The ten high-performing agencies were selected to include large, medium, and small weatherization operations, and programs located in cold, moderate, and hot climates. The main criterion for high performance was higher-than-average savings of natural gas in gas-heated dwellings weatherized in PY 1989. Agencies were considered as possible high performers only if gas savings estimates were available for at least ten weatherized dwellings. On average, savings estimates were available for 47 gas-heated dwellings for each high-performing agency.

Agency performance was measured strictly in terms of gas savings because 90% of the weatherized dwellings with utility consumption data in the Single-Family Study heated primarily with natural gas. Since gas savings are highest in the cold region, somewhat lower in the moderate region, and much lower in the hot region, "high performance" was determined in relation to the average savings within each region. The final sample of agencies is shown in Fig. A.1, and the agency names and locations are listed below.

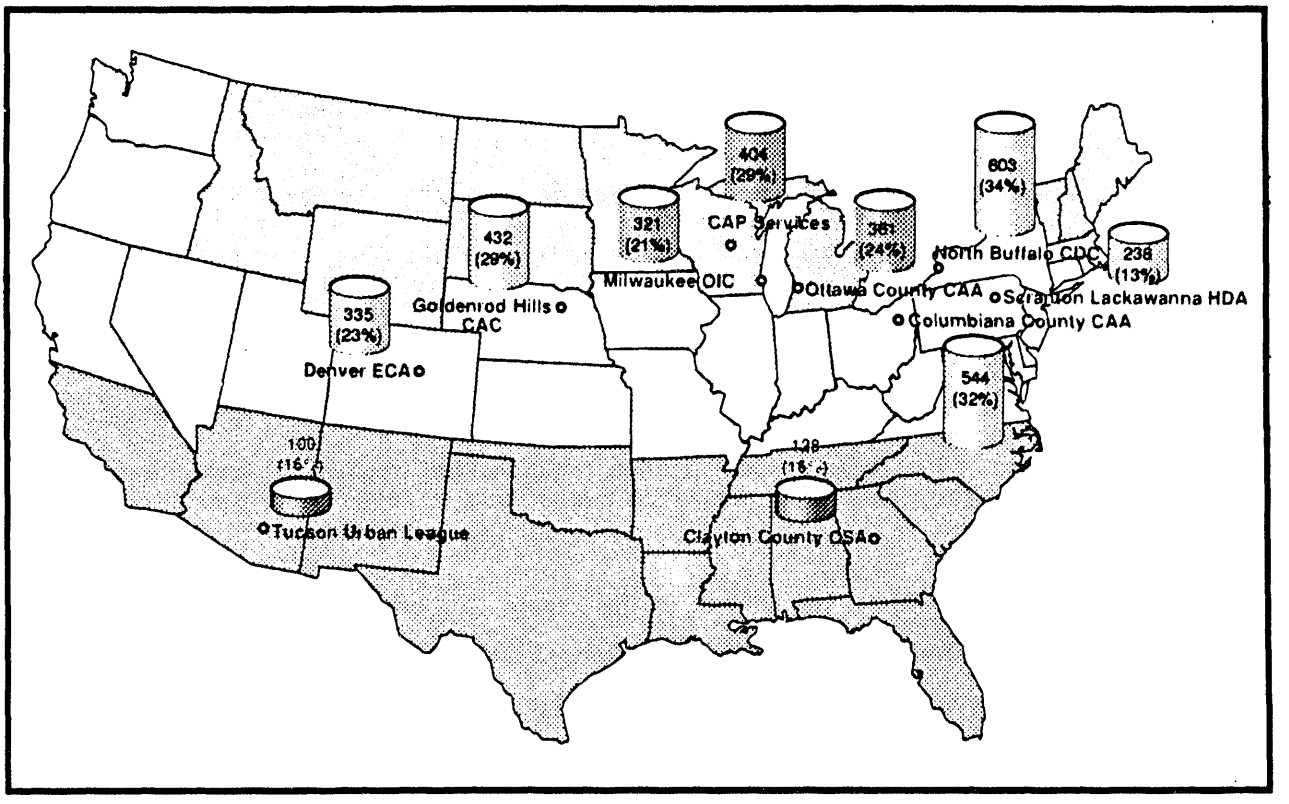

Fig. A.1 Location of the Ten High Performers and their Annual Gross Gas Savings (in ccf/dwelling and as a percent of pre-weatherization gas consumption)

- Tucson Urban League, Tucson, Arizona
- Energy Conservation Association, Denver, Colorado

- Clayton County Community Service Authority, Clayton County, Georgia
- Ottawa County Community Action Agency, Ottawa County, Michigan
- Goldenrod Hills Community Action Council, Goldenrod Hills, Nebraska
- North Buffalo Community Development Corporation, Buffalo, New York
- Community Action Agency of Columbiana County, Columbiana County, Ohio
- Scranton/Lackawanna Human Development Agency, Scranton, Pennsylvania
- CAP Services, Incorporated, Stevens Point, Wisconsin
- Opportunities Industrialization Center of Greater Milwaukee, Milwaukee, Wisconsin

A great deal of information on the weatherization practices and accomplishments of each of these ten agencies was compiled, covering the period from 1989 through 1992. Sources of information included records provided by the agencies, one to two-day interviews with agency personnel, on-site visits to weatherized dwellings, and gas consumption data from utility companies.

More limited baseline information for 1989 is available on the practices of a national sample of weatherization agencies. In particular, these national data come from the first phase of the Single-Family Study (Brown et al., 1993). Three types of baseline variables are used in this report: dwelling and occupant characteristics; measures installed; and performance indicators (costs, energy savings, and cost-effectiveness). Two national samples are described: (1) those 166 agencies for which dwelling, occupant, and weatherization measures data are available on at least 15 weatherized gas-heated dwellings; and (2) a subset of 97 of these 166 agencies for which performance indicators also are available on at least 10 gas-heated weatherized dwellings. The ten high-performing agencies are a subset of the 97 agencies with complete data.

For the ten high performers and both comparison groups, mean values were calculated at the agency level. Altogether, the data on dwelling characteristics, occupants, and measures installed by the 166 agencies represent information on 8,193 dwellings. A total of 823 of these dwellings were weatherized by the ten high performers. The subset of 97 agencies includes data on 2,921 dwellings, and 470 of these dwellings were weatherized by the ten high performers. Fig. A.2 describes the various samples of agencies and dwellings studied in this report.

Table A.1 presents the performance indicators for these 97 agencies and the ten high performers. It documents the superior energy savings and cost-effectiveness of the high performers: they saved almost twice as much natural gas per weatherized dwelling (344 vs 169 ccf/year), while spending only $20 more per dwelling ($1,523 vs $1,503). These savings represent a 34% reduction in gas use for space heat (and a 24% reduction in total gas use) over pre-weatherization consumption

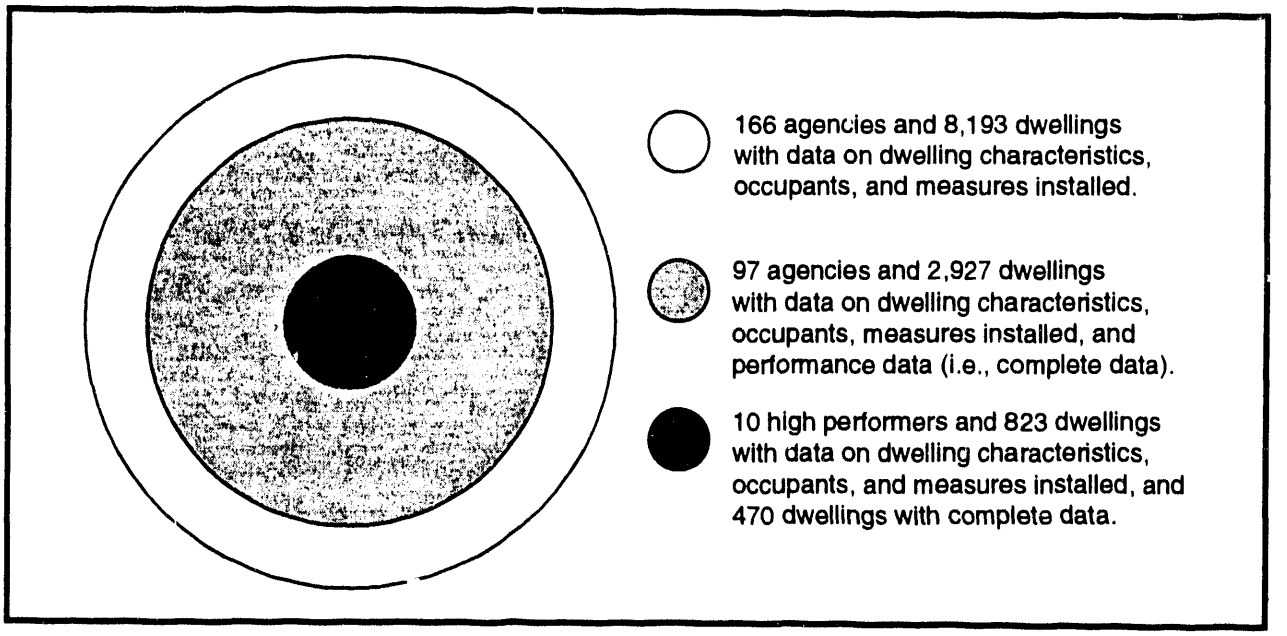

Fig. A.2 Samples of Agencies and Dwellings

Table A.1 Performance Indicators for the Agencies Nationwide

Indicator	High-Performing Agencies (n=10)	Other Agencies (n=87)	National Sample (n=97)
Pre-weatherization Normalized Annual Consumption (in ccf/year)	1,411*	1,212	1,233
Gross Gas Savings (in ccf/year)	303***	125	141
Net Gas Savings (in ccf/year)	344**	169	185
Net Gas Savings as a Percent of Gas Use for Space Heat	34.3%***	18.7%	21.1%
Net Gas Savings as a Percent of Total Gas Use	24.4%***	13.3%	15.0%
Installation Costs (in 1989 $s)	$1,023	$1,003	$1,005
Total Costs (in 1989 $s)	$1,523	$1,503	$1,493
Program Benefit/Cost Ratio)[a]	1.99***	0.97	1.08
Societal Benefit/Cost Ratio[b]	2.65***	1.65	1.76

*,**, and *** indicate that the high-performing agencies are different from the other agencies on a particular indicator, based on a 0.05, 0.01, and 0.001 level of significance. The Wilcoxon rank-sum test, a nonparametric test, was used to compare each indicator across the two populations.

[a] Based on energy-savings benefits and total weatherization costs.

[b] Based on energy-savings, employment, environmental, and other non-energy benefits and total weatherization costs.

levels for the high performers, as compared to a 19% (and 13%) reduction for the other 87 agencies.[1] The result is a "program" benefit/cost ratio averaging 1.99 for the high performers, compared with 0.97 for the other agencies.[2] By including the value of nonenergy benefits (estimated to be $976 by Brown et al., 1993), the "societal" benefit/cost ratios rise to 2.65 for the high performers and 1.65 for the other 87 agencies.

Nonparametric statistics are used to test the differences between the ten high-performing agencies and other agencies, based on dwelling characteristics, occupants, measures installed, and performance data. Equally important, however, is the qualitative analysis of differences gleaned from the ten in-depth case studies and the authors' knowledge of weatherization practices nationwide. Recognizing that housing and weatherization needs, the potential for energy savings, the ability to leverage resources, and weatherization practices differ across climate regions, the body of this report is organized into three sections corresponding to the three climate regions used throughout the National Weatherization Evaluation. Due to small sample sizes, however, it is not possible to conduct a statistical analysis of differences between high performers and other agencies within each region. Nor is it possible to draw any conclusions that are specific to a particular climate region. Instead, we focus on lessons learned from the national comparison of high performers and other agencies. These results are summarized below.

FINDINGS

The most striking finding of the ten case studies is that there are many different formulas for success. Indeed, each of the ten successful agencies employs a unique combination of useful and innovative approaches. Nevertheless, common features and trends do emerge when the ten high performers are compared to the national network of weatherization agencies. Some of the unique features of the ten high performers are highlighted in Table A.2. Additional features common to the ten high performers are identified by the case studies.

Agency Characteristics

Nine of the ten high-performing weatherization programs operate within the infrastructure of a large, multi-program community action agency.[3] These broad-based agencies combat many forms of poverty and hardship with programs such as fuel assistance; housing rehabilitation and

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[1] Energy savings were calculated using the Princeton Scorekeeping Method (PRISM), a widely used procedure that normalized energy use over time by adjusting for outside temperature differences. PRISM is described in the Special Scorekeeping Issue of *Energy and Buildings*, ed. M. Fels, Vol. 9, nos. 1 and 2, 1986.

[2] The "program" benefit/cost ratio is the ratio of the net present value of the natural gas saved to the total cost of weatherization.

[3] The exception is the Denver ECA, which is a single-purpose agency that provides only weatherization services. However, the Denver weatherization program is large and has leveraged substantial resources from utilities, resulting in many of the advantages of being in a multi-program agency.

Table A.2 Characteristics of Weatherized Dwellings, Occupants, and Measures Installed by Agencies Nationwide

Dwelling and Occupant Characteristics of Clients Served in Program Year 1989	High-Performing Agencies (n=10)	Other Agencies (n=156)	National[a] Sample (n=166)
Dwelling Type (percent):			
Single-Family Dwellings	69	70	70
Mobile Homes	8	14	14
Small Multifamily Dwellings	23	15	16
Age of Dwellings (years)	52	43	44
Area of Heated Space (square feet)	1,216	1,174	1,177
Central Heating Systems (percent)	88	75	79
Supplemental Heating Fuel (percent)	13	25	24
Occupants per Dwelling	2.8	2.9	2.9
Elderly Occupants (percent)	44*	30	31
Household Income (in 1989 $)	8,041	7,716	7,722
Owner-occupied Dwellings (percent)	65	60	61
Measures Installed (percent of dwellings that received measure)			
Attic Insulation (first-time)	38*	26	26
Attic Insulation (added to existing)	24	25	25
Wall Insulation (normal density)	37	23	23
Wall Insulation (high density)	2	4	3
Floor Insulation	6	12	12
Air Sealing with Blower Door	23	24	24
Furnace Cleaned and/or Tuned-up	29	25	26
Furnace Replacement	11*	3	4
Hot Water Tank Insulation	54	46	46
Hot Water Pipe Insulation	64*	34	36
Low-Flow Showerheads	14	11	11
Water Temperature Setback	27	13	14
Storm Windows	28	32	32
Window Repair	52	52	52

[a] National sample of agencies for which data on dwelling characteristics, occupants, and measures installed are available on at least 15 gas-heated dwellings weatherized in 1989.

* indicates that the high-performing agencies are different from the other agencies on a particular characteristic, based on a 0.05 level of significance. The Wilcoxin rank-sum test, a nonparametric test, was used to compare each characteristic across the two populations.

repair; health, nutrition, and food; employment and job training; and drug abuse prevention. As a result, several of the high-performing weatherization programs have larger agendas than just saving Btu's: their programs are "one-stop shops" for a broad array of community services.

At the same time, the high performers exert a strong effort to invest as much of the available DOE funding as possible in energy conservation measures instead of in repairs. Through referrals and leveraging with local, state, and federal housing rehabilitation programs, these agencies are able to dedicate DOE's funding primarily to energy conservation. Clayton County CSA illustrates this commitment to energy conservation — it rehabilitates or repairs a structure with DOE funds only when no weatherization can take place without it. Similarly, Goldenrod Hills CAC refers housing in need of repair to other federal or state programs, and then completes weatherization after the housing has been repaired.

Housing Stock Characteristics

As shown in Table A.1, dwellings weatherized by the ten high-performing agencies consumed more natural gas during the year preceding weatherization than the dwellings weatherized by the other agencies. Table A.2 indicates that the dwellings weatherized by high performers are less likely to be mobile homes, are older, and have more elderly occupants than the homes weatherized by the national sample of agencies. The dwellings weatherized by high performers also are more likely to have central heating systems and are less likely to have supplemental heating fuels. Thus, high-performing agencies weatherize dwellings with a somewhat higher potential for saving energy, which may be due, in part, to more targeted client selection procedures.

Weatherization Staff and Training

Strong leadership qualities are exhibited by each of the managers of the high-performing programs. These leaders combine outstanding management and weatherization-related experience with an ability to organize and motivate their staff and to coordinate and leverage resources. Their weatherization crews and contractors tend to have low employee turnover and their staffs have substantial experience in weatherization, construction, heating system installations and maintenance, and related building trades. Often, the weatherization supervisors and crew chiefs have risen up through the weatherization ranks, perhaps beginning as a crew member, progressing to estimator, auditor, or inspector, and then crew chief or supervisor.

Several of the high-performing agencies are supported by computer-assisted administrative and management tools. Computerized client tracking systems, for instance, are used at CAP Services, Milwaukee OIC, and Scranton/Lackawanna HDA. Other agencies maintain effective manual client tracking systems.

Among the high-performing programs, there is a trend away from operating programs entirely with contracted labor to either all in-house staff or a combination of in-house staff and contractors. These three different approaches are described below.

In-house Programs. Three programs operate entirely with in-house crews. Clayton County CSA operates a small program with only one in-house crew that specializes in envelope measures and does no furnace work. In contrast, both Scranton/Lackawanna HDA and CAP Services operate large programs using in-house crews that combine envelope specialists and furnace/boiler technicians. CAP Services deals with its large (5-county) area by operating out of two offices located 45 miles apart. Each office has warehouse facilities, field coordinators, secretarial and outreach staff, and crews.

Based on these program managers' opinions, the advantages of an in-house approach include the following:

- Direct management of services enhances the ability to conduct quality assurance: employee-based crews can be more accountable and good quality control results.
- In-house crews help meet agency goals of creating jobs for the local area.
- In-house crews are more readily trained than subcontractors, leading to better quality work.
- Weatherization can be performed more economically with in-house employees than with subcontractors, because there is no financial profit. One utility weatherization program in Pennsylvania found that Scranton/Lackawanna HDA crews could install weatherization measures at a lower cost than private-sector contractors.

Combination In-House and Contractor Programs. This is the most common approach to operating the high-performing programs.[4] In four of these programs, in-house staff members are used for most program functions, and contractors are used for boiler, furnace, and air conditioning repairs and replacements, which often requires licensed personnel. The Milwaukee OIC uses a different approach to a combined program: it uses in-house staff for insulation work, air sealing, furnace work, and all other field work but boiler replacements and chimneys, and it subcontracts out materials purchase, warehousing, and inventory. This arrangement allows the profit from materials to be counted on the materials side of the 60/40 ratio. This results in somewhat higher-than-average material costs, but more effective use of agency dollars.

[4] The following five programs operate with a combination of in-house staff and contractors: Tucson Urban League, Denver ECA, North Buffalo CDC, Columbiana County CAA, and Milwaukee OIC.

All Contractor Programs. Two of the high performers operate their weatherization programs entirely through subcontractors (Ottawa County CAA and Goldenrod Hills CAC). Ottawa County has different audit/inspection and installation contractors, as a means of separating the weatherization work from the quality control function. The following advantages were noted by these programs:

- Consistency with their host agency's goal of privatizing government services.
- Lower total expense with contractor labor, particularly in large metropolitan areas where union labor may otherwise be required.
- Ability to use private warehousing of materials when space at the community action agency is limited.
- Access to certified furnace/boiler technicians, which when hiring a full-time employee would be prohibitively expensive.
- Ability to cover vast service territory by subcontracting to multiple firms in different locations.

In short, the choice between contractors versus in-house staff depends upon the goals of the agency, the resources available to the program, the program's key weatherization measures, and the characteristics of its customers and service territory.

Client Recruitment and Selection

The high performers have increasingly focused on clients with high levels of pre-weatherization energy consumption. These households typically offer greater potential for cost-effective savings, because high levels of use are associated with waste and inefficiency. This focus on high energy users may result from agency recruitment activities, client selection and screening, or the methods used to determine weatherization investment levels. Some examples of this targeting are provided below. Clayton County is the only weatherization program that operates on a "first-come, first-served" basis, with no recruitment, screening, or investment strategies to target high energy consumers.

Recruitment Activities. Six of the high performers recruit their clients primarily or entirely from participants in the Department of Health and Human Service's Low-Income Home Energy Assistance Program (LIHEAP).[5] For instance, all clients in the Ottawa County CAA's service area who receive assistance with utility bills from LIHEAP are required to apply for weatherization. Similarly, all of CAP Services' clients come from LIHEAP rosters. In most of these cases, the host agency also operates the LIHEAP, so coordination is facilitated and recruitment of clients costs less. These

[5] These include the Denver ECA, Columbiana County CAA, Ottawa County CAA, Scranton/Lackawanna HDA, CAP Services, and Milwaukee OIC.

recruitment practices tend to produce a high proportion of the highest energy users among the weatherization applicants and great potential for conservation since "savings follows waste."

Several of the high performers also receive referrals from their local utilities. Columbiana County CAA, for instance, receives referrals of high arrearage customers from Columbia Gas, and the Scranton/Lackawanna HDA receives referrals from Pennsylvania gas and electric utilities. These referrals also tend to increase the intake of applicants with high levels of energy consumption.

Client Selection and Screening. In selecting and prioritizing clients, there is a movement away from "first-come, first-served" to an emphasis on potential for savings. The Tucson Urban League, for instance, assigns a 75% weight to the energy consumption of an applicant and a 25% weight to their status as handicapped, elderly, or with children. The Denver ECA requires that their clients' electricity and gas bills exceed $300 for a three-month period in winter.

Determination of Investment Level. Three high performers use audits that calculate investment levels based on past levels of energy consumption. In particular, the North Buffalo CDC uses the Targeted Investment Protocol System (TIPS), which determines an investment level for each house based on energy use. Similarly, both CAP Services and Milwaukee OIC employ the Wisconsin Energy Conservation Corporation audit, which directs investment toward households with high savings potential based on calculated estimates of savings.

Since more energy is saved by weatherizing homes that have historically consumed high levels of energy, these strategies to target high energy consumers generally enhance a program's ability to conserve energy. However, the Milwaukee OIC expressed some frustration with their inability to weatherize deserving clients because of their present low energy use. Penalizing a client for extreme frugality is clearly not desirable. It was suggested that instead, each client should be left with a home that meets some minimum efficiency standard.

Diagnostics and Audit Procedures

Most of the high performers employ advanced diagnostics and understand how to use them effectively. Because the high performers tend to conduct more furnace and boiler work than is typical of the program at large, they also tend to use a wide array of furnace diagnostic testing, including combustion gas detectors, heat exchanger leak detectors, furnace efficiency testers, and carbon monoxide analyzers. They also use more blower doors, and are increasing their reliance on blower doors by expanding their use throughout the various weatherization steps.

In 1989, the high performers that used blower doors tended to use them to a limited extent. Typically, blower door tests were performed by an auditor to quantify the amount of leakage and to identify the most prominent leakage locations. These leaks were then sealed by crew members who

did not do another blower door test to monitor the effectiveness of their efforts.[6] By 1992, weatherization crews had begun using blower doors to monitor the progress of their air sealing. This expanded use of blower doors characterizes the weatherization operations of Denver ECA, Tucson Urban League, North Buffalo CDC, CAP Services, Milwaukee OIC, and Columbiana County CAA.

CAP Services implements a variant of this approach. Crews deal with large infiltration holes and do insulation work before performing a blower door test. Then they accomplish whatever air sealing work the blower door indicates is needed to bring the structure down to 1200 CFM_{50}, or to reach the point where time on site is no longer cost effective.

Four of the ten high performers use advanced audit procedures: North Buffalo CDC uses TIPS, Tucson Urban League uses an integrated envelope/HVAC audit (which replaced their priority list in 1992) and Milwaukee OIC and CAP Services employ the WECC audit. The remaining high performers use priority lists to guide their work, but several of the program managers emphasize that house diagnostics and analyses by auditors and crews are key inputs into the selection of weatherization measures for a particular house.

Installation of Measures and Client Education

Installation of Measures. There is great diversity in the types of measures installed by the ten high performers. The measures that most distinguish high performers from other agencies are first-time attic insulation and wall insulation; furnace retrofits and replacements; and water-heater measures.

A majority of the high performers install first-time attic insulation and wall insulation at rates that exceed their climate region averages. On average, 38% of the dwellings weatherized by high performers in 1989 received attic insulation for the first time (compared to 25% for the national sample of 273 agencies) (Table A.1). Similarly, on average, 39% of the dwellings weatherized by high performers received wall insulation, compared with 20% for the national sample.

Six of the high performers install furnace measures at rates that greatly exceed their climate region averages.[7] North Buffalo CDC, for instance, cleans and tunes all heating systems that test below 75% efficiency, and work is sometimes conducted on systems that test 75% or better. CAP Services specializes in furnace replacements. It replaces more than one-third of the gas furnaces with high efficiency condensing gas furnaces in the homes they weatherize.

In contrast, no furnace work is performed by Clayton County CSA and Ottawa County CAA. In both cases, furnace repair and replacement require licensed personnel, and the agency's workers

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[6] Columbiana County CAA is an exception to this pattern. It began using blower doors in 1986 to determine the need for air leakage control, to monitor work as it was performed, and to assess the quality of work.

[7] Denver ECA, Goldenrod Hills CAC, Scranton/Lackawanna HDA, CAP Services, Milwaukee OIC, and North Buffalo CDC.

specialize in envelope work. Hiring an additional mechanical contractor is seen as prohibitively expensive.

A majority of the high performers installed more water-heater measures in 1989 than was typical of their climate regions. The average installation rates for four water-heater measures (for the ten high performers vs. the national sample of 166 agencies) were as follows:

- 54% vs. 46% for tank insulation;
- 64% vs. 36% for pipe insulation;
- 14% vs. 11% for low-flow showerheads; and
- 27% vs. 14% for water temperature setback.

Only two of the high performers install storm windows at rates that greatly exceed their regional averages. These are Clayton County CSA and Scranton/Lackawanna HDA. The latter is able to implement a cost-effective program with a strong emphasis on storm windows by bulk purchase agreements that provide storm windows at 20% less than the local wholesale price.

Two new measures have been added to many of the high performers' weatherization activities since 1989. High-density wall insulation is a new feature of the Denver ECA, Ottawa County CAA, CAP Services, and the Milwaukee OIC. Duct sealing is also a growing focus of the high performers.

Client Education. Most of the high-performing programs provide materials to help clients become more familiar with and committed to energy conservation. Four of the high performers have designed in-person client education activities that exceed weatherization norms nationwide.

- Ottawa County CAA conducts a strong client education effort, involving two personal counseling sessions, one at the intake interview and one at the post-weatherization inspection.
- Goldenrod CAC provides client education and reinforces conservation behavior during on-site visits by its estimators, contractors, and state monitors
- Columbiana County CAA has a formal client education component that involves on-site education by the estimator. Applicants for weatherization are asked to fill out a questionnaire regarding their energy behavior habits. From this, the estimator suggests low-cost and no-cost ways to increase energy savings. Applicants are then asked to sign a partnership plan to carry out the suggestions. Follow-up contacts are made approximately six months after weatherization to see if clients have followed their plans.
- Milwaukee OIC is in the process now of initiating a pilot program to test the effectiveness of client education. Using a quasi-experimental design, the agency will be estimating the impact of in-the-home energy education in combination with weatherization vs weatherization without any educational component.

Quality Control and Evaluation

One feature that clearly distinguishes the high performers is a management style that strives for improvement in energy savings and cost effectiveness. The Tucson Urban League distributes client feedback forms and visits each client one month after weatherization to assess client satisfaction. Goldenrod Hills surveys a sample of its clients periodically, and uses the resulting feedback to brief its crews and contractors.

Only one of the high-performing agencies has analyzed fuel bills to estimate the energy saved by weatherization. In particular, the Denver ECA set a 20% savings goal and conducted an evaluation to test the program's progress toward that goal. With this exception, the general lack of energy savings analysis is a program weakness that needs to be addressed.

Seven of the high performers inspect 100% of their weatherization jobs.[8] This quality control activity may be a key to the success of these agencies.

Resource Leveraging

The high performers are in nearly unanimous agreement that DOE funding is insufficient and declining for their programs. For instance, there are 40,000 eligible clients in Milwaukee, yet the Milwaukee OIC was able to serve only 1,450 families last year. Most of the high performers leverage funds from federal, State, and local programs, and from utilities so that more clients can be served and more complete weatherization can be conducted.

LIHEAP Funds. Two of the high performers use LIHEAP weatherization funds to supplement their DOE weatherization jobs. All of the homes weatherized by the Tucson Urban League are leveraged with LIHEAP and/or utility funds. These additional resources make it possible to install evaporative coolers in many of their clients' homes. Similarly, Denver ECA uses LIHEAP weatherization funding to pay for furnace measures.

Utilities. The high performers work with utilities in a variety of partnership arrangements. Three of the high performers directly receive utility funding:

- Utility funds from Pennsylvania Gas and Water and Pennsylvania Power and Light have enabled Scranton/Lackawanna HDA to weatherize homes that the agency could not serve within its DOE budget.
- Three Wisconsin utilities have provided CAP Services with funds to support more complete weatherization; in particular, furnace replacements have been purchased with utility funds, since they would be too expensive to install with DOE funds alone.

[8] Tucson Urban League, Ottawa County CAA, Goldenrod Hills CAC, North Buffalo CDC, Columbiana County CAA, Scranton/Lackawanna HDA, and Milwaukee OIC.

- Columbia Gas has provided funds for Columbiana County CAA to deliver its "Warm Choice" program to low-income households.

In addition, in-kind utility leveraging enhances several of the high-performing programs:

- Arizona utilities have donated electric portable heaters and domestic hot water heaters to be installed by the Tucson Urban League in tandem with DOE weatherization.
- referrals from National Fuel Gas and Columbia Gas have helped Scranton/Lackawanna HDA and Columbiana CAA recruit clients.
- Scranton/Lackawanna HDA refers clients to PG&W's furnace program when a gas furnace or boiler needs to be replaced.

Housing Rehabilitation Resources. Housing rehabilitation grant and loan programs funded by various federal, State, and local agencies have enhanced the weatherization efforts of seven of the ten high performers. The Tucson Urban League, Denver ECA, and Ottawa County CAA use housing repair and rehabilitation funds in combination with weatherization funds on some of their clients' homes, so that more complete rehabilitation and weatherization can be accomplished. In four other programs, houses needing repair are referred to housing programs for rehabilitation either prior to weatherization or after the weatherization job is complete.[9]

Landlord Contributions. One of the high performers uses landlord contributions to leverage its resources. In particular, CAP Services requires a 25% cost share from landlords of all the rental units that it weatherizes.

Only one of the ten high performers does not leverage its resources — Clayton County CSA. It is also the smallest of the ten high-performing programs.

Cost Controls

A variety of cost control measures are used by the high performers. Two are described below: bulk purchasing and materials fabrication by agency employees.

Bulk purchasing of insulation, storm windows, and high-efficiency furnaces offers substantial discounts to at least five of the high performers.[10] As a result, more complete retrofits can be accomplished within their budget constraints. For instance, exterior storm windows are purchased by Scranton/Lackawanna HDA for an average cost of only $35, and CAP Services is able to purchase high-efficiency condensing furnaces for only $1,400 (including materials, labor, and overhead).

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[9] These other programs are Goldenrod Hills CAC, Columbiana County CAA, CAP Services, and Milwaukee OIC.

[10] Deeply discounted bulk purchasing is employed by: Tucson Urban League, Denver ECA, Columbiana County CAA, Scranton/Lackawanna HDA, and CAP Services.

Materials fabrication by agency staff is a strategy used by several high performers to re 'uce costs. The Tucson Urban Lea_ue, for instance, makes its own sun and bug screens, air-conditioner covers, and interior storms, at half the local retail price of these items. CAP Services makes much of its own sheet metal ducting and air returns, for the same reason. Scranton/Lackawanna HDA fabricates its own attic domes both to reduce costs and to have domes that precisely fit a home's attic hatch.

CONCLUSIONS

Table A.3 summarizes the most notable characteristics that distinguish the ten high-performing weatherization programs from less successful programs. These noteworthy features range from agency and staff characteristics to client recruitment and selection practices; weatherization measures; resource leveraging; and cost controls. Despite the commonality of the features shown in Table A.3, no single high-performing program has all of these features. The diversity among the high performers underscores the fact that excellence can be achieved in many different ways.

Table A.3 Notable Characteristics of the Ten High-Performing Weatherization Programs

Category	Characteristic of a Majority of the High Performers
Agency Characteristics	Large, multi-program community action agencies
Characteristics of Weatherized Housing	High levels of pre-weatherization energy use; older dwellings; more elderly occupants; fewer mobile homes; more central heating; fewer supplemental heating fuels
Weatherization Staff	Limited turnover and substantial weatherization experience
Delivery System	In-house crews supplemented by contractors for furnace work
Client Recruitment	Reliance on LIHEAP rosters for recruiting applicants
Selection of Clients and Investment Levels	Strong and increasing focus on high energy users
Blower Door Use	Limited use in 1989, extensive use in 1992 — during the audit, while air sealing, and as part of the final inspection
Weatherization Measures	More first-time attic insulation and wall insulation; furnace retrofits and replacements; and water-heater measures
Leveraging Home Repairs	Access to housing rehabilitation funds from non-DOE sources
Cost Controls	Effective cost controls such as bulk purchasing & in-house fabrication of measures

Table A.3 (Continued)

Category	Characteristic of Four of the High Performers
Client Education	Ambitious client education programs
Utility Leveraging	Funding and/or in-kind contributions from utilities to expand weatherization efforts

The challenge for federal, regional and State managers of the Weatherization Program is to help less successful agencies develop the characteristics described in Table A.1, while recognizing that some of the characteristics may not be advantageous for all local weatherization agencies. Diversity needs to be accommodated.

This "technology transfer" process should take place at each management level. Pilot programs could be implemented to demonstrate how the characteristics shown in Table A.1 can lead to improved savings and cost effectiveness. The encouragement of State and national peer networking and mentoring relationships could also be effective mechanisms. Regional and federal support for technology transfer might include supporting the development of the State demonstrations and networking, as well as supporting the development of guidebooks and focused hands-on training sessions. Through such mechanisms, DOE's cost-effective Weatherization Program could achieve even greater success.

I. COLD CLIMATE REGION

I. COLD CLIMATE REGION

The three high performers in the cold region significantly outperformed the sample of 32 agencies that represent the baseline characteristics of that region (Table I.1). In particular, they spent 19% more per dwelling than did the 32 agencies ($1,764 vs $1,483), but they generated 81% more energy savings. The three high performers achieved net gas savings of 361 ccf/year, on average, for each weatherized dwelling, representing a 34% reduction in gas use for space heat (and a 24% reduction in total gas use) over pre-weatherization consumption levels. In comparison, the 32 agencies saved 200 ccf/year, on average, for each weatherized dwelling, which is a 23% reduction in gas use for space heat (and a 16% reduction in total gas use). Accordingly, the cost effectiveness of the high-performing programs greatly exceeds that of the cross-section of 32 agencies, based on both the "program" and "societal" benefit/cost ratios.

Table I.1 Performance Indicators for the Cold Climate Region

	3 High Performers	32 Agencies
Pre-weatherization Normalized Annual Consumption (in ccf/year)	1,493	1,247
Gross Gas Savings (in ccf/year)	292	131
Net Gas Savings (in ccf/year)	361	200
Net Gas Savings as a Percent of Gas Use for Space Heat	34.1%	22.6%
Net Gas Savings as a Percent of Total Gas Use	24.2%	16.0%
Installation Costs (in 1989 $s)	$1,264	$983
Total Costs (in 1989 $s)	$1,764	$1,483
Program Benefit/Cost Ratio	1.79	1.05
Societal Benefit/Cost Ratio	2.34	1.75

Table I.2 shows that the measure installation rates for dwellings weatherized by high performers in the cold region differ from the installation rates of the sample of 32 agencies in the cold region. Further, the nature of these differences is generally consistent with the patterns described in the executive summary for the nation as a whole. The three high performers installed much more first-time attic insulation, wall insulation, furnace replacements, and hot water heater measures than is the case regionwide. In contrast, they installed fewer storm windows. They also repaired fewer windows and cleaned and tuned fewer furnaces, which are differences that were not

true of the national sample of high performers. The low rate of furnace cleaning and tuning (18%) is partly due to the high rate of furnace replacements (25% of dwellings).

Table I.2 Characteristics of Weatherized Dwellings, Occupants, and Measures Installed in the Cold Climate Region

Dwelling and Occupant Characteristics of Clients Served in Program Year 1989	3 High Performers	49 Agencies
Dwelling Type (percent):		
Single-Family Dwellings	55	65
Mobile Homes	11	19
Small Multifamily Dwellings	34	16
Age of Dwellings (years)	61	46
Area of Heated Space (square feet)	1,297	1,232
Central Heating Systems (percent)	94	92
Supplemental Heating Fuel (percent)	7	20
Occupants per Dwelling	3.2	3.1
Elderly Occupants (percent)	29	24
Household Income (in 1989 $s)	7,996	8,279
Owner-occupied Dwellings (percent)	53	61
Measures Installed (percent of dwellings that received measure)	**3 High Performers**	**49 Agencies**
Attic Insulation (first-time)	39	17
Attic Insulation (added to existing)	28	34
Wall Insulation (normal density)	38	27
Wall Insulation (high density)	5	8
Floor Insulation	5	17
Air Sealing with Blower Door	27	41
Furnace Cleaned and/or Tuned-up	18	27
Furnace Replacement	25	8
Hot Water Tank Insulation	63	50
Hot Water Pipe Insulation	60	45
Low-Flow Showerheads	30	18
Water Temperature Setback	7	11
Storm Windows	12	28
Window Repair	38	45

1. CAP SERVICES, INCORPORATED STEVENS POINT, WISCONSIN

by Laurence F. Kinney and Randall P. Nottingham

1.1 THE AGENCY AND ITS SERVICE AREA

1.1.1 The Agency

CAP Services, Inc. of Stevens Point, Wisconsin (CAP Services) is responsible for a large (five county) area in rural Wisconsin whose population is only 145,000. Karl Pnazek, CAP Services' Executive Director since 1976, operates a full-service community action agency whose annual funding is almost $5 million in the current program year, up from $3.2 million since 1983. (Over this same period, Mr. Pnazek reports, weatherization funding has decreased both absolutely and as a percentage of the whole.) He is an enthusiastic advocate of conservation work, and views weatherization as one of the most important programs CAP Services conducts.

CAP Services has always had a vigorous weatherization program that includes the use of in-house labor as far as possible, a decision management claims results in more cost-effective weatherization work and good quality control. Operations are conducted from two offices; one in Stevens Point, the other in Wautoma. Both offices have warehouse facilities, field coordinators, secretarial and outreach staff, and crews.

Although CAP Services produced as many as 500 weatherization completions per year in the early 1980's, the current rate of production is about 350 per year, and the agency projects only 310 completions for 1993. This diminution in production reflects decreased overall funding for weatherization. Costs per weatherization job in the current program year are averaging $2360, of which $724 is material, $1080 is labor, and $556 is overhead.

1.1.2 Organization

As shown in the organizational chart (Fig. 1.1), each of the two Field/Office Coordinators, as well as the Energy Projects Coordinator, are directly supervised by the Weatherization Director, Lee Duerst. Mr. Duerst's supervisor is Karl Pnazek, the agency's Executive Director.

1.1.3 Housing Stock

Most jobs are performed on single-family dwellings, about 22% of which are rental units. Mobile homes are increasingly weatherized; they are running 20% of total completions in the current program year. "Mobile homes constitute 16% of the total housing units in our service area, according to the 1990 census," Mr. Pnazek reports, "up from 8% in the 1970 census. This is an

interesting commentary on what's happening economically in our service area, since there are no rich people moving into mobile homes."

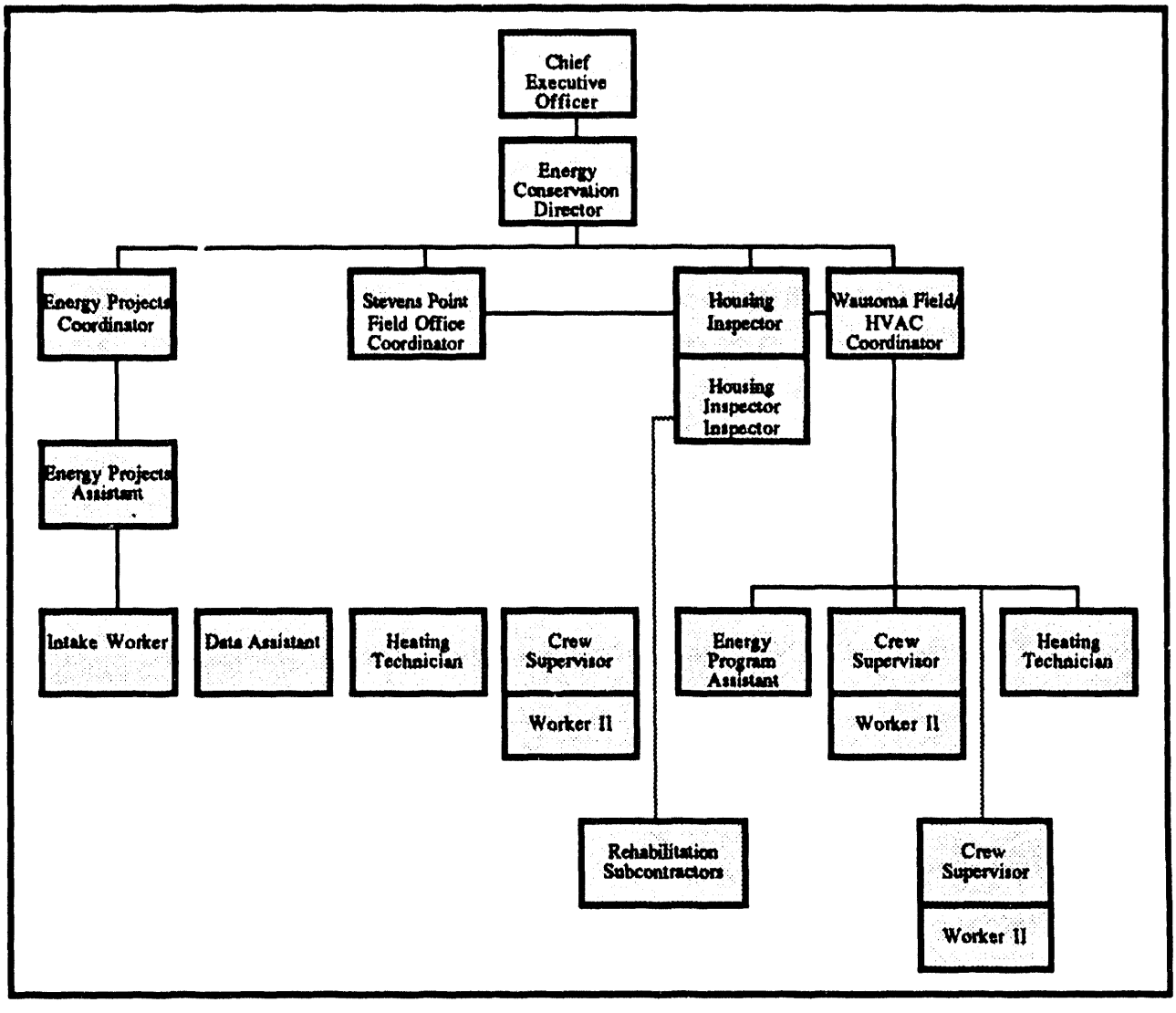

Fig. 1.1 Organizational Chart for CAP Services

Additionally, CAP Services weatherizes housing stock that is somewhat atypical compared to that found generally in the cold region, where the agency is located. CAP Services weatherizes a greater percentage of owner-occupied housing stock than is done in the region as a whole. Seventy-eight percent of CAP Services' weatherized dwellings are owner occupied, compared to 61% for the region. Also, CAP Services' weatherization clients are much less likely to supplement their primary heating fuel with an auxiliary heat source (e.g. woodstoves and electric or combustion space heaters) than weatherization clients in the Cold Region generally. One fifth of clients in the region use some supplemental fuel, while only 16% of CAP Services' weatherization clients use a supplemental heating fuel. These relationships are shown in Fig. 1.2.

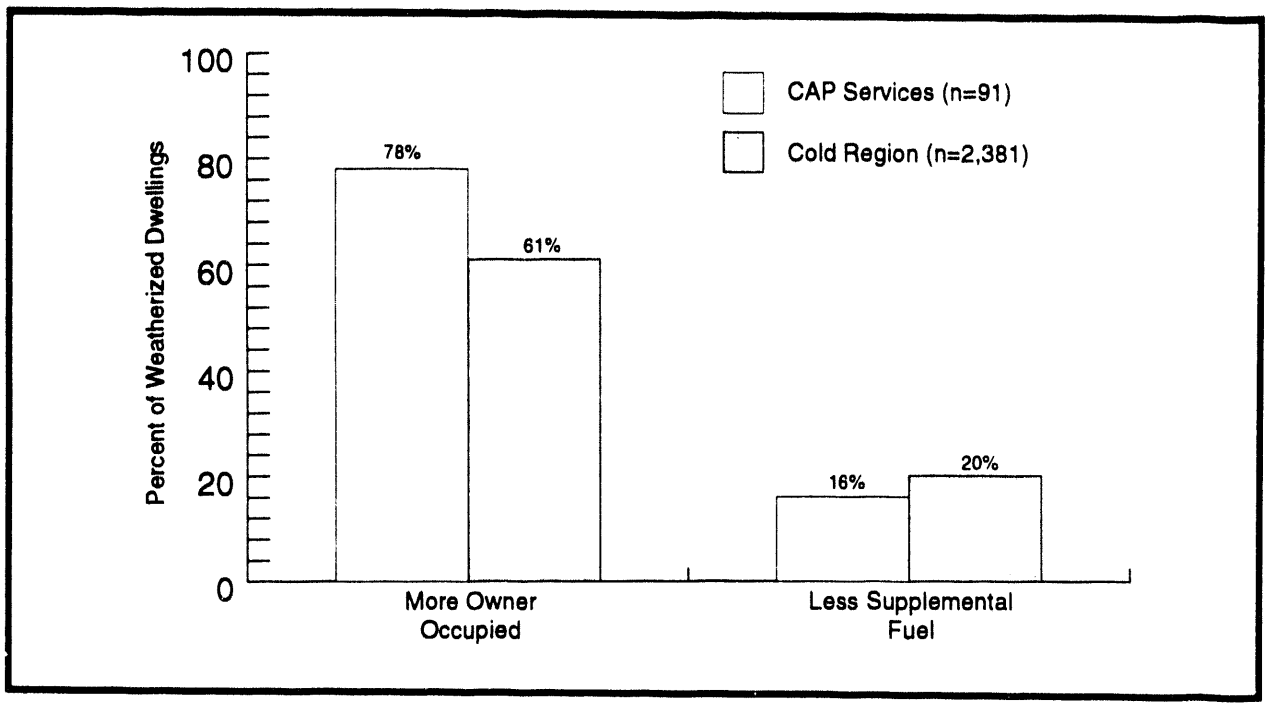

Fig. 1.2 Characteristics of the Housing Stock Weatherized by CAP Services

1.2 WEATHERIZATION STAFF AND TRAINING

1.2.1 Weatherization Staff

Mr. Duerst joined CAP Services as its Weatherization Director in July, 1992, but he is no amateur. "In the early '80's, I started out in weatherization as a field coordinator right here in Stevens Point," Mr. Duerst relates. "Since then, I've been the Weatherization Director in three different Wisconsin agencies before coming home to Stevens Point."

At present, the Stevens Point operation has a two-person weatherization crew and a furnace technician. In Wautoma, there are two two-person weatherization crews plus a furnace technician. Each of the furnace technicians were trained by Jerry Loker, who used to be a furnace technician but is presently the Field Coordinator in the Wautoma office.

"We were quite pleased to have Jerry join our staff," Mr. Pnazek reports. "Jerry owned his own heating system business before he joined CAP Services, and he not only brought his expertise with him, but also a lot of tools and special equipment."

In fact, the warehouse at the Wautoma office has a large sheet metal brake and metal cutting equipment used for forming large ducts. In addition, each of the furnace vans is professionally equipped, and has material, tools, and equipment on board for dealing both with heating system replacement work as well as emergency repair.

1.2.2 Training

Training and Technical Assistance is taken seriously by CAP Services. The State holds back about half of its DOE allocation of T and TA money, which frequently goes to the Wisconsin Energy Conservation Corporation (WECC) by a bidding process for conducting state-wide training, developing special purpose software, and the like. The other half goes to subgrantees (roughly $5,000 to CAP Services per year), almost half of which is used for travel and living expenses associated with the annual state training session. The remainder is used to send people to computer classes and management seminars, and to attend other special regional weatherization sessions.

As a management and evaluation tool, each employee of CAP Services has a six month quasi "contract" consisting of a document which specifies accomplishments expected over the period. This document, which is worked out with the employee's supervisor at the beginning of each period--and is signed by each--is used in the post-period review of performance. This reliance on quantifiable production contributes substantially to good management and to employees "knowing clearly what they are supposed to accomplish," observes CAP Services' supervisor of outreach services.

An additional staff management adaptation is the four-day work week. Since CAP Services is responsible for a large, five county area in rural Wisconsin with a highly-dispersed population, travel times to work and the job site can diminish the productivity of a standard work day. (Weatherization operations are conducted from two offices 45 miles apart, and driving times from warehouses to client's dwellings can be as long as an hour.) Accordingly, the weatherization program staff work a ten hour day, four-day week. All persons interviewed preferred this Monday-through-Thursday work week, and several reported a 20% increase in productivity over traditional five day work weeks.

1.3 ADMINISTRATIVE TOOLS

1.3.1 The Computer

The computer has made a lot of difference in the evolution of the weatherization program at CAP Services. It helps in targeting high users, in performing the energy audit, in tracking clients through the weatherization process, and in archiving records.

In particular, a Lotus program developed by CAP Services allows for the virtual instantaneous access of information on clients at each stage of the weatherization process. The system outputs a list of "Ready for Work to Start" clients, arranged by application date; "Jobs on Hold" by hold date; "Completed and Reaudited" jobs; "Jobs to be Reaudited;" "Jobs in Progress;" "Heating Task to be Done" jobs; and "Year to Date Completions." At the end of this latter file, total materials dollars for the year are summed, and the per-job average is printed.

1.3.2 WECC Audit

The WECC audit has been mastered by the energy auditors in each office and its output is used to guide weatherization work. One consequence is that people who initially resisted the use of a computer are now not only computer literate, but also skilled producers of special-purpose spread sheet applications such as the management information system described above.

In addition to producing work orders, the WECC audit also computes estimates of weather-normalized annual consumption, both before and after weatherization. Accordingly, it is a powerful tool for performing in-house evaluation.

1.3.3 Client Envelope

One additional noteworthy administrative practice is a clever tracking system which consists of a white, 9 x 12 inch envelope for enclosing all information on a client's weatherization job. The outside of the envelope includes a checklist of activities that take place from the beginning to the end of the weatherization process. Completed jobs have envelopes whose boxes are all checked, and which contain both all completed paperwork and a 5.25 inch floppy disk representing the result of the WECC audit, and a number of other pieces of information. "That way, we're not cluttering up files, but we have all the data in electronic form we need on a client in case we have to look up something," Mr. Loker explains.

This has proved to be a particularly effective administrative tool. The checklist is reproduced in Appendix I.

1.4 CLIENT RECRUITMENT AND SELECTION

Outreach activities are tied quite closely to Wisconsin's Energy Assistance Program using a state-wide electronic bulletin board, through which agencies can access a considerable amount of information on a potential client's social as well as energy consumption circumstances. Outreach workers at CAP Services also work closely with utility companies, which frequently results in the relevant utility paying for specified weatherization services. The agency has a policy of maintaining a waiting list of slightly more than three months of clients (about 100), reasoning that more may raise expectations unduly and that fewer can adversely affect effective planning and practical logistics.

As a consequence of a funding agreement with the Department of Social Services, Wisconsin's Low Income Home Energy Assistance Program (LIHEAP) grantee, 99% of the households weatherized come off of LIHEAP lists, which are listed on the electronic bulletin board accessed by CAP Services outreach staff. In practice, the Wautoma office accesses the bulletin board by modem and arranges the resulting files in several ways to allow easy access and further manipulation. They use the information locally and also send a floppy disk to the Stevens Point office for its use. Applicants are still taken "off the street," but if they don't happen to be LIHEAP recipients, they are

encouraged to apply--and to elect the option whereby their fuel bills are submitted with their application. The result is a more accurate adjustment of benefits for the LIHEAP office, and the ability to target for purposes of weatherization.

A very substantial majority of weatherization jobs are "targeted" in this way. That is, most work is performed on dwellings which are high users of energy--and are occupied by clients whose income makes them particularly vulnerable to high costs of home heating in Wisconsin's cold climate. "The ability to target is very important to us," Mr. Pnazek maintains, "both in securing funding and in maximizing energy savings benefits per unit of investment. Savings follows waste."

1.5 INSTALLATION OF MEASURES

1.5.1 Rates of Installation of Weatherization Measures

On the job, the weatherization crew follows the WECC audit work order quite closely. In practice, this means they deal with larger infiltration holes and do insulation work (high-density cellulose blowing) before even bothering with a blower door test. Then they clean up whatever air sealing work the blower door indicates has to be done to bring the structures down to 1200 CFM at 50 pascals--or get to the point where time on site is no longer cost effective according to the criteria established by the WECC audit.

In addition to the aforementioned wall and attic insulation work, sill box (band joist) insulation is installed, as is crawl space insulation. Large blanket insulation is used in both cases, and six mil vapor barriers are used on the floor of crawl spaces.

Although no blower door tests are conducted before weatherization, the crews take multipoint tests and enter information into a Sharp microcomputer when they do undertake blower door testing during the weatherization process.

Furnace work is emphasized at CAP Services, and in-house crews are used both to perform detailed clean-and-tune plus safety work and to replace furnaces. Furnace replacements are performed on about 45% of the 350 weatherization jobs CAP Services performs each program year. Gas furnaces are replaced with high-efficiency condensing furnaces whose steady state efficiency exceeds 90%. PVC plastic pipes are installed to bring in combustion air and to evacuate exhaust air (Photo 1.1). When these furnace jobs are associated with gas-fired domestic hot water heaters, the existing brick chimney is relined to prevent the deterioration of the chimney that would result from feeding only the DHW exhaust to the chimney. A secondary consequence of this practice is a substantial reduction of flue-effect infiltration, thereby achieving further fuel savings.

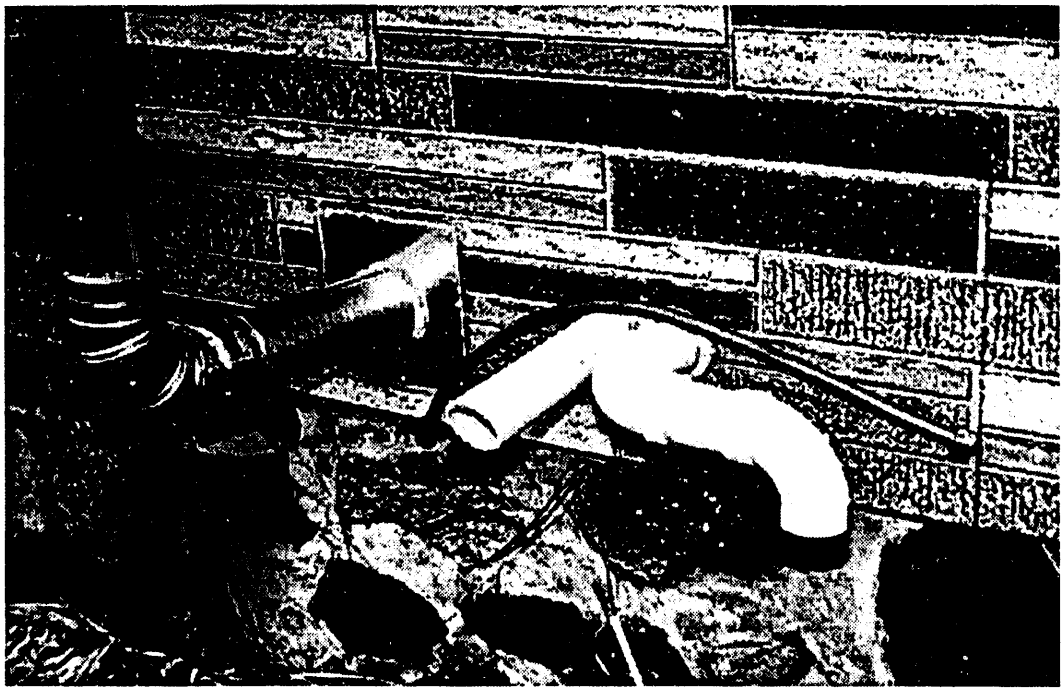

Photo 1.1 New HVAC plumbing was installed at this home. The sheet metal pipe is the new chimney for the hot water system, and the two PVC pipes are for combustion (on the right) and exhaust. Less overall annual infiltration losses are an important consequence.

About 20% of the replacement furnaces are oil-burning units, which are 82% steady state efficient systems the agency buys wholesale (Photo 1.2). Furnace replacements are achieved for an average of $1400, a figure which includes material, labor, and overhead. Similar jobs in the private sector cost $2300. Labor and service on the furnaces CAP Services installs are supplied for a year after installation, and parts for five years. Six new filters are given to clients in all weatherization jobs, whether or not furnace work is done (Photo 1.3).

In addition, CAP Services runs an emergency furnace repair service for lower-income families in their catchment area, so furnace technicians are on call throughout the weekends. "It gets cold in Wisconsin, and losing a furnace in a winter storm can be life-threatening," Mr. Duerst says. "That's why we keep tools and equipment on the vans, and require our technicians to drive them home on the weekend. It helps logistics during the week, too."

The organization operates two classes of large vans: those equipped with tools, material, and equipment for air sealing, insulating, and similar envelope measures; and those equipped for furnace work, which include brakes for bending sheet metal. Both classes of vans contain safety equipment, including fire extinguishers and first aid kits. The vehicles are well stocked and well maintained; one earned first prize in a recent weatherization vehicle contest held at a state-sponsored training session.

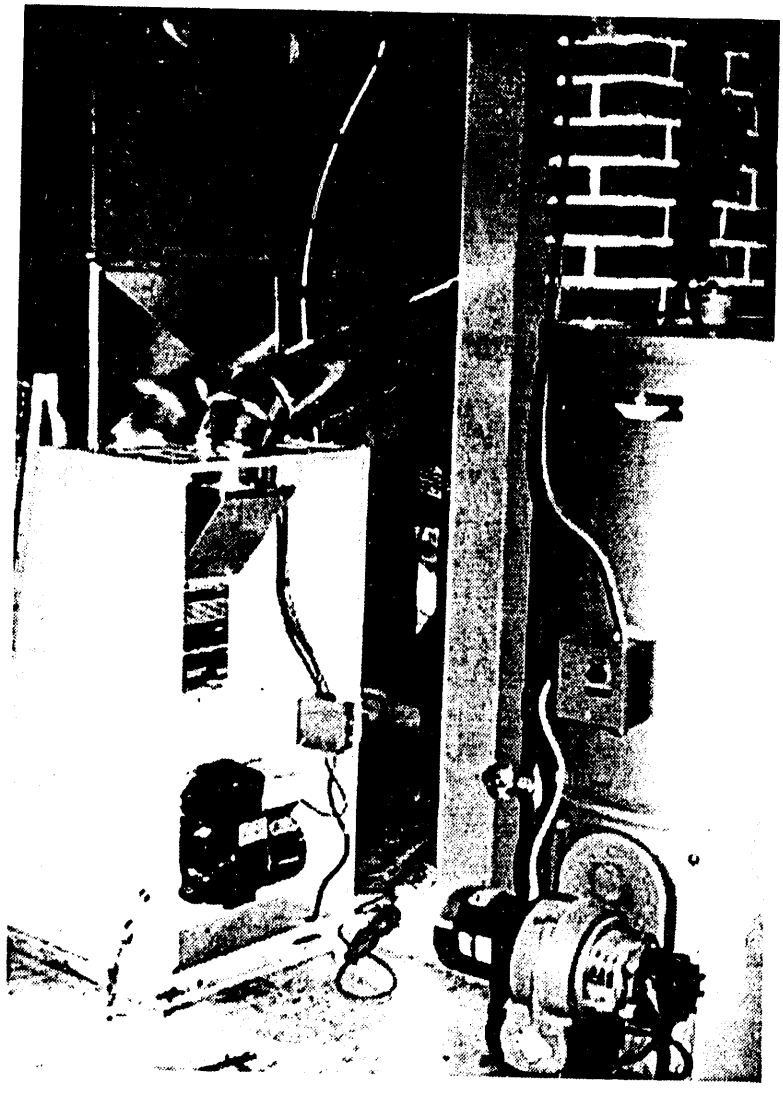

Photo 1.2 A new oil-fired furnace installed by CAP Services is in the background and the old oil-fired hot water tank is in the foreground. The new furnace achieves about 82 percent steady state efficiency.

Usually the weatherization crews and the furnace technician like to work on the same dwelling at the same time, particularly when heavy equipment has to be moved into or out of basements. "Moving furnaces is a two-person job," Jerry Loker reports, "and it would be ideal if we could have a second furnace technician to go along with the second crew we have in Wautoma." The anticipated 17% cutback in next year's funding makes this prospect slim.

Fig. 1.3 compares the frequency of implementation of two weatherization measures (space heating replacements and air sealing with blower door diagnostics) between CAP Services and the cold region taken as a whole. CAP Services conducts air sealing measures somewhat more frequently than the region in general, performing this class of operation on 48% of their weatherized dwellings, compared to 41% in the region. Even more noteworthy is the dramatic difference between CAP

Photo 1.3 Clients are given six new filters: they are shown how to replace them and are instructed to do so at least twice each heating season.

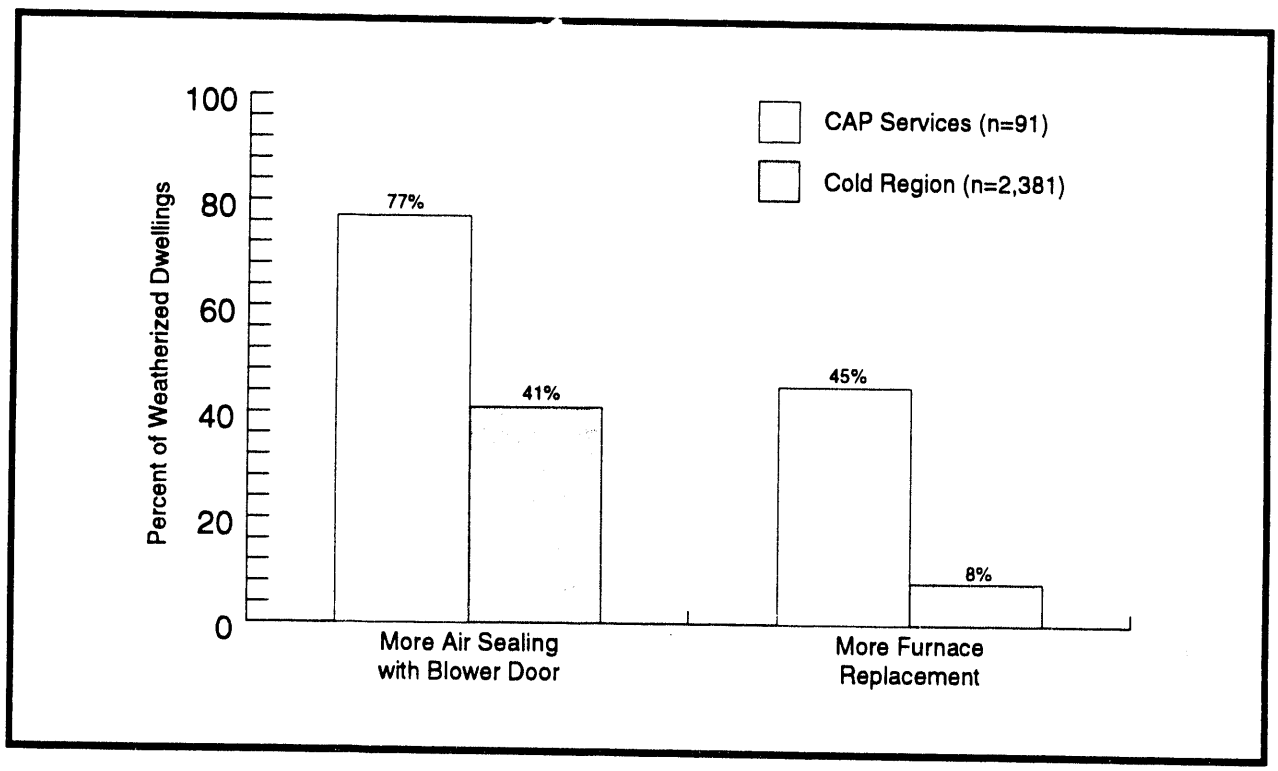

Fig. 1.3 Installation Rates for Selected Measures Installed by CAP Services

Services and its surrounding region in the percentage of weatherization jobs that include a space heating replacement. CAP Services implemented a furnace replacement in 45% of the gas-heated dwellings it weatherized, compared to only 8% in the region as a whole. This is noteworthy because it illustrates that CAP Services is able to conduct an otherwise cost-prohibitive weatherization measure efficiently and thereby realize both significant energy savings and a tangible client benefit (a new, safe heating system).

Of significance, CAP Services does very little window work, and work orders rarely call for window replacement or storm windows. "We have the materials and can do good window replacement work when it's really needed," Mr. Duerst relates. "It's just not cost-effective as strictly an energy savings measure."

1.5.2 Field Observations

In all three dwellings inspected during the interviewing for this report, the craftsmanship and attention to detail in the furnace and envelope work were excellent. Nonetheless, some distribution system leaks were apparent in each case. "We anticipate that duct work will become an increasingly important item of attention in the next program year," observes Dave Engstrom, Field Coordinator in Stevens Point. We recommend routinely checking for leaks using the blower door and chemical smoke early in the process, and the HVAC system fan toward the end, utilizing a pressure gauge to measure the basement-to-outside pressure difference under worse-case circumstances.

One weatherization job involved a very large dwelling which had a household size of 12. The principal weatherization work included attic insulation (which required gaining access by means of a reciprocating saw, the resulting holes being replaced by gable vents), extensive (and creative, in the case of a complicated basement door replacement) air sealing, and the installation of a condensing gas furnace. Another job observed was being performed on a more conventional farm house, and entailed attic insulation, conventional air sealing (which brought the dwelling from 2200 CFM_{50} to 1400 CFM_{50} in less than an hour), and the installation of an oil furnace. Extensive attic venting was accomplished on both jobs.

1.6 LEVERAGING AND COOPERATIVE EFFORTS

The Low Income Home Energy Assistance Program in Wisconsin typically works by having the state grantee write a check for some portion of a client's energy bill directly to the utility company. However, since August 1981, states have been allowed to set aside up to 15% of their LIHEAP funds for weatherization. "The quid pro quo for receiving the full 15% from the Department of Health and Social Services, Wisconsin's LIHEAP grantee, was for weatherization to target the top 20% (quintile) of highest-consuming eligible households," explains Mr. Pnazek. "The

reasoning is that weatherization would reduce consumption, thereby reducing the need for LIHEAP. We regard this as a classic win-win situation."

As the range of services CAP Services offers expands, increasingly, housing rehabilitation work is combined with weatherization work to produce rehabilitated, energy-efficient housing. The rehab/weatherization job illustrated in Photo 1.4 is for a dwelling slated for occupancy by a "to be named" weatherization client. "When Federal funds are involved [in this case, rehab money came from HUD], we can use weatherization funds to do the energy job right, then certify the client later," Mr. Duerst explains.

Photo 1.4 This rehabilitated home had new windows installed with HUD funds, and insulation installed with DOE funds.

Mr. Pnazek also was successful in developing a policy through which landlords are required to pay 25% of the cost of weatherizing the dwellings they own. Since approximately 25% of CAP Services' weatherization clients are renters, this leveraging of landlord funds makes a real difference. Although the landlords would no doubt prefer to have the work fully subsidized, and the agency might like to see more than 25% cost-sharing, this seems to be a workable arrangement for all parties. The client gets the benefits of weatherization, the landlord effectively saves 75% on much-needed home improvements (capital investment), and the agency is able to leverage 25% of the job costs.

The politically active Mr. Pnazek played a leading role in promoting the development of utility-sponsored low-income weatherization work in Wisconsin. At present about $40,000 of weatherization program funds are supplied by utilities in CAP Services' area.

Mr. Pnazek, along with Tony Maggiore, an articulate advocate for low-income programs long associated with the community action agency in Milwaukee, were instrumental in persuading the Joint Finance Committee of the Wisconsin State Legislature to set aside 75% of Exxon Oil Overcharge monies in a trust fund for weatherization, and 25% for Fuel Assistance. Although these funds are drying up, they were responsible for CAP Services, and other weatherization providers in Wisconsin, being able to maintain a reasonable level of service during the last decade.

1.7 PROGRAM SAVINGS, COSTS, AND COST EFFECTIVENESS

Pre- and post-weatherization consumption data was available for a random sample of 29 gas-heated dwellings weatherized by CAP Services during PY 1989. These billing histories were weather-normalized using PRISM in order to estimate the normalized annual consumption (NAC) of homes before and after weatherization by CAP Services (Table 1.1). This data is summarized, and presented along with a region-wide comparison, in Fig. 1.4.

Table 1.1 PRISM Model Parameters for CAP Services

	Intercept (ccf/Day)	Heating Slope (ccf/^{o}F Day)	Temperature Dependent Use (ccf/Year)	R^2	Reference Temperature (^{o}F)
WEATHERIZED GROUP (N = 29)					
Pre-Weatherization	0.77 (0.47)	0.17 (0.02)	1207 (123)	.91	61.05 (4.21)
Post-Weatherization	0.41 (0.52)	0.13 (0.01)	948 (102)	.93	63.72 (8.01)

The results indicate that the weatherization clients of CAP Services consumed somewhat more natural gas prior to weatherization than did clients in the cold region (1,404 ccf/year compared to 1,247 ccf/year in the region generally). However, after weatherization, CAP Services' clients had an average NAC of 1,070 ccf compared to 1,116 ccf in the post-weatherization dwellings of the whole region. This amounts to a gross savings of 23.8% for CAP Services, and 10.5% for the rest of the region (nearly a two-fold difference).

Also shown by Fig. 1.4 is a comparison between the net gas savings realized by CAP Services and the cold region as a whole. On average, gas heated dwellings weatherized by CAP Services reduced their gas consumption by 334 ccf/year, compared to 131 ccf/year for the cold region generally. These estimates represent gross savings. However, over the same period, gas consumption by the control population increased by 69 ccf/year, which raises the *net* savings for both groups. CAP Services realized an average net savings of 403 ccf/year (28.7% of pre-weatherization gas consumption), compared to 200 ccf/year (16.0% of pre-weatherization consumption) for the cold region taken as a whole.

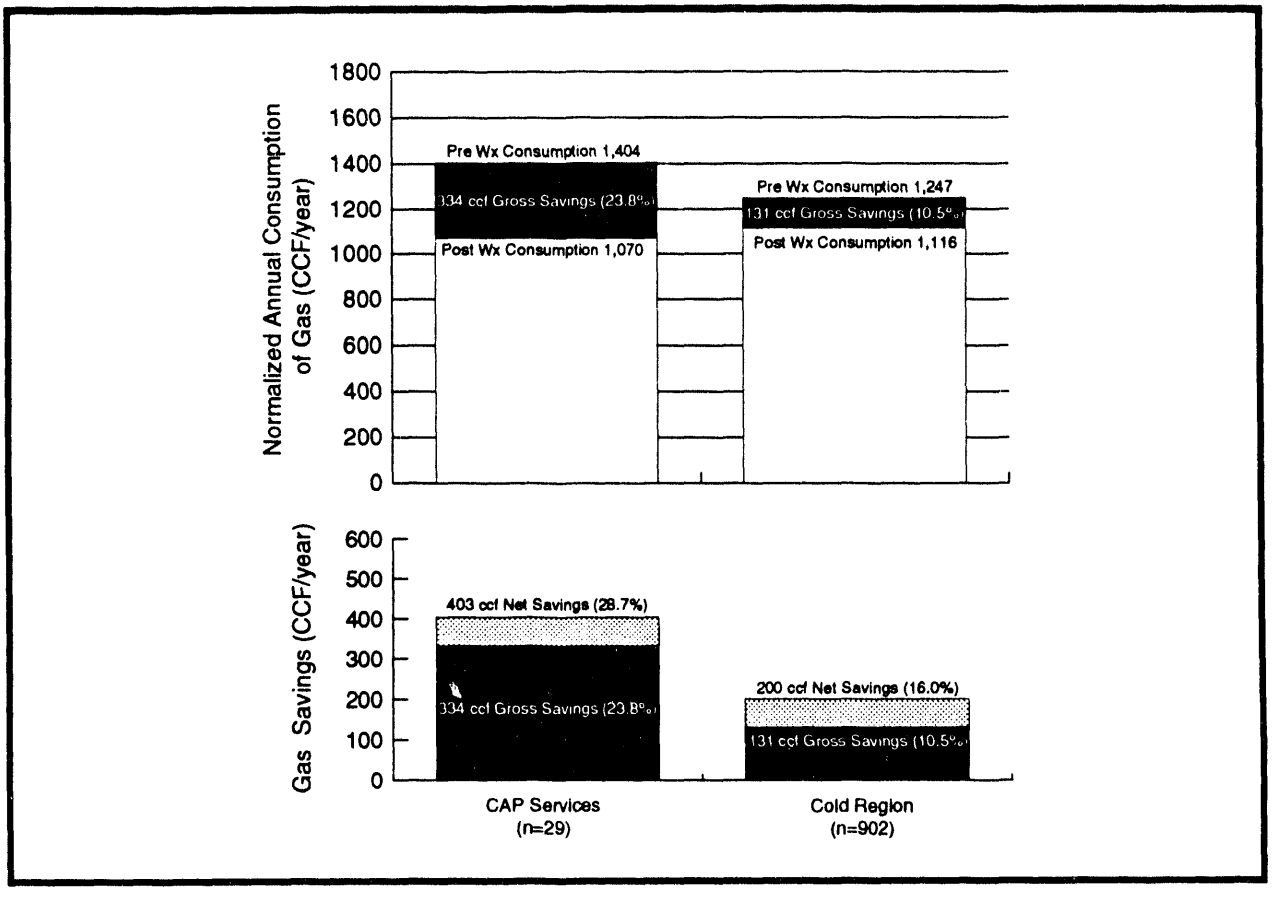

Fig. 1.4 Normalized Annual Consumption and Savings of Dwellings Weatherized by CAP Services

In addition to achieving a significantly higher average net savings than the cold region generally, CAP Services also had a much greater percentage of "big savings" (>500 ccf/year) weatherization jobs. As illustrated in Fig. 1.5, comparatively few of CAP Services' jobs had a "negative savings" (as measured by NAC), and a significant percentage of the jobs (over one-third) realized normalized savings of at least 500 ccf/year.

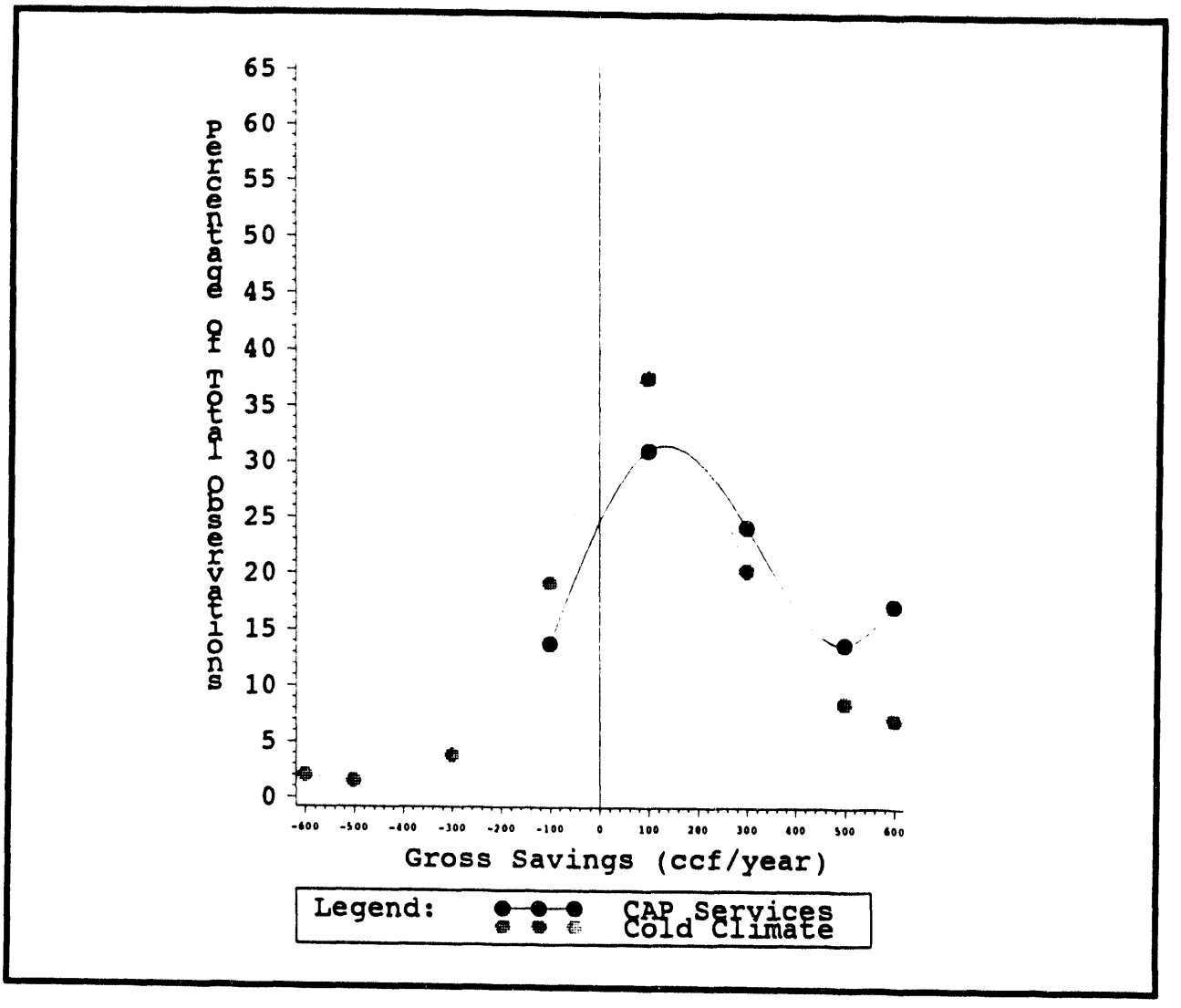

Fig. 1.5 Distribution of Gross Savings in Dwellings Weatherized by CAP Services

Although CAP Services was able to realize greater savings than the cold region as a whole, they also had somewhat higher costs than the rest of the region. Installation costs (materials and on-site labor) for CAP Services averaged $1,284 for each job, compared to $983 in the cold region. One reason for CAP Services' higher-than-average costs is that they perform more than five times as many space heating system replacements as the regional average. The average total cost for these jobs is $1,400, which although remarkably low for such work (averaging approximately $2,300 in the private sector), it nonetheless has the inevitable effect of raising the average job-completion cost.

However, even the greater average cost of CAP Services' weatherization measures does not diminish the cost-effectiveness of the agency in comparison with its region. This is due to the fact

that although CAP Services' weatherization jobs cost a bit more than average, they achieve significantly greater savings than the rest of the region. These relationships are presented in Fig. 1.6.

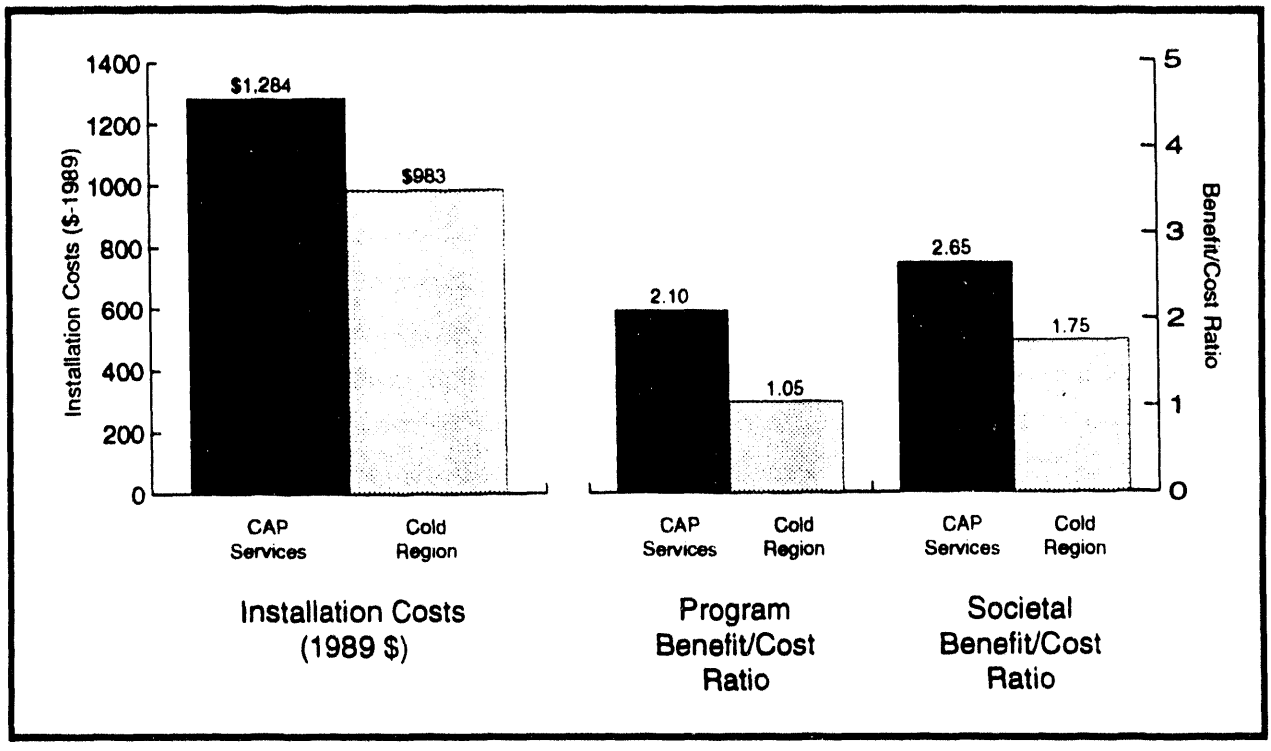

Fig. 1.6 Costs and Benefit/Cost Ratios for Dwellings Weatherized by CAP Services

The program benefit/cost ratio represents the present value (benefit) of gas saved by the agency's weatherization activities,[1] divided by all of the program costs (materials, labor, and overhead). This is defined by Brown et al. (1993) as the "program perspective." It represents the "worst case" estimate since the only benefit from weatherization expenditures it considers is the value of conserved energy, while it takes into account all of the associated costs. From a program perspective, CAP Services has a benefit/cost ratio of 2.10, compared to 1.05 for the cold region as a whole. Although any value greater than 1.00 indicates that benefits outweigh costs, the significantly greater ratio for CAP Services illustrates why it was chosen as a "high-performing agency" — CAP Services' benefits outweigh its costs to a much greater degree than they do for the cold region in which it is located.

The societal benefit/cost ratio represents all of the benefits associated with weatherization, divided by all of the costs. In this case, benefits include not only the easily quantifiable energy

[1] Avoided energy costs and other long-term benefits are assumed to have a lifetime of 20 years. This assumption is based on an analysis of the following: (1) the frequency of installation of various packages of measures, (2) the average lifetime of the energy conservation measures included in the package, and (3) the measured gas savings of each package. The net present value of these benefits has been calculated with a discount rate of 4.7 percent.

savings, but also an approximation of the "non-energy" benefits derived from weatherization. These include enhanced property values, income generated from indirect employment (the "multiplier effect"), income taxes generated from direct employment, and avoided environmental externalities. These benefits have been estimated to have a dollar value of $976 per weatherization job, and when they are included in a benefit/cost analysis (termed the "societal perspective"), the benefits of weatherization outweigh costs to an even greater degree.

Under this societal analysis, CAP Services has a benefit/cost ratio of 2.65, compared to 1.75 for the cold region generally. This illustrates that CAP Services' societal benefits outweigh its costs to a greater degree than they do for the cold region as a whole. However, since the non-energy benefits are assumed to be the same for all weatherization jobs, they do not effect the absolute difference in the ratio of CAP Services and the cold region. (CAP Services' program benefit/cost ratio and societal benefit /cost ratio are both greater than the respective ratios for the cold region as a whole by the same amount [.70], allowing for a rounding error.) Therefore, the point is not to compare the two separate ratios, but rather to see that from each perspective, CAP Services performs at a level significantly higher than its fellow agencies in the cold region.

1.8 REASONS FOR SUCCESS

The success of CAP Services in cost-effectively saving energy can be largely attributed to three key factors: (1) they target high users--savings follows waste; (2) they replace inefficient furnaces with high-efficiency gas condensing furnaces, and they do it cost-effectively; and (3) they have an excellent, committed management team that is able to organize and motivate the staff. Although every agency is in a unique situation, there is a lot that can be learned from the way CAP Services conducts its weatherization operation.

"We're leaner and meaner, stronger and better, and more effective than we've ever been," observes Mr. Pnazek, who is obviously proud of the accomplishments of the agency's weatherization program. We're more cost effective and more enthusiastic, yet we are not receiving adequate funding to weatherize more than 5% of eligible units each year."

2. OPPORTUNITIES INDUSTRIALIZATION CENTER OF GREATER MILWAUKEE MILWAUKEE, WISCONSIN

by Tom Wilson

2.1 THE AGENCY AND ITS SERVICE AREA

Opportunities Industrialization Center of Greater Milwaukee (OIC), has a long history of providing a wide variety of development services to this urban center. Although this group is firmly grounded in its own local community, the agency also has strong ties to a larger organizational structure that wages national and international efforts to combat poverty and hardship on many fronts.

Originally and primarily observing a job skills/employment focus, OIC has had a long connection with the weatherization program in the production and installation end of the business. In fact, up until quite recently, significant responsibility for providing weatherization services to Milwaukee, including both auditing and quality control inspections, were in the hands of the City Department of Building Inspections.[1] OIC was largely relegated to providing weatherization installation services on contract to the City, which held the prime contract with the State.

In 1990, it was recognized that the present structure was inadequate to the task and the State gave OIC the full responsibility for all phases of the weatherization operation. In their move to absorb both components of the delivery process, the OIC Weatherization administration chose to maintain a separation of effort between the two divisions in the organization: the Auditing and Monitoring Division and the Production Division (Fig. 2.1).

2.1.1 Agency Goals

As a diverse, multi-faceted development agency, OIC has, over the years, directed its energies towards many goals. The weatherization program in particular, having grown out of 1979 Community Service Administration and CETA labor forces, has traditionally had a larger agenda than simply saving Btu's. Although our respondents clearly identified energy conservation as *the* primary focus of the program, the financial and social benefits to their low-income clientele as well as the provision of meaningful employment and job training for inner-city people were important objectives as well.

[1] The outlying area of Milwaukee County is serviced by La Casa, a separate non-profit organization.

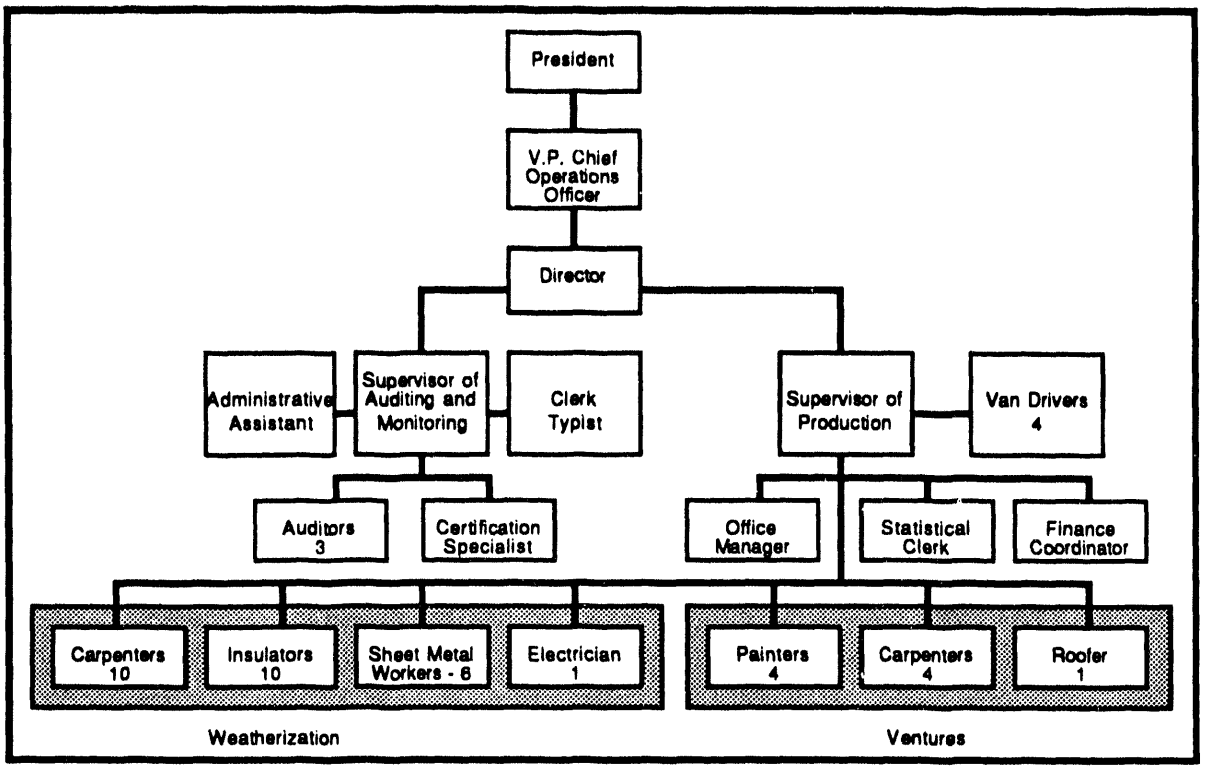

Fig. 2.1 OIC Organizational Chart with respect to Weatherization and Home Improvement Programs

OIC runs two housing programs: Weatherization and a HUD-sponsored program, Ventures in Community Improvement. "Ventures" provides more comprehensive housing rehabilitation services for low-income clients. Where possible these two groups coordinate efforts using separate crews and organizations to meet both the energy and housing rehabilitation needs of its clients. Latest statistics indicate that there are about 40,000 clients who are eligible for weatherization, but last year OIC served only 1,450 families (down from 1,650 in the year before).

2.1.2 The Housing Stock

Virtually everyone agrees that the housing stock in the greater Milwaukee area is the greatest contributor to the agency's high energy savings performance (Fig. 2.2). The Greater Milwaukee urban area has some of Wisconsin's oldest housing, averaging approximately a century in age. There is a preponderance of duplexes (typically over-under configurations) that are densely situated (Photo 2.1). The heating systems tend to be furnaces that have been converted to natural gas, and often, converted from convection units to forced air units with or without total replacement of original ducting.

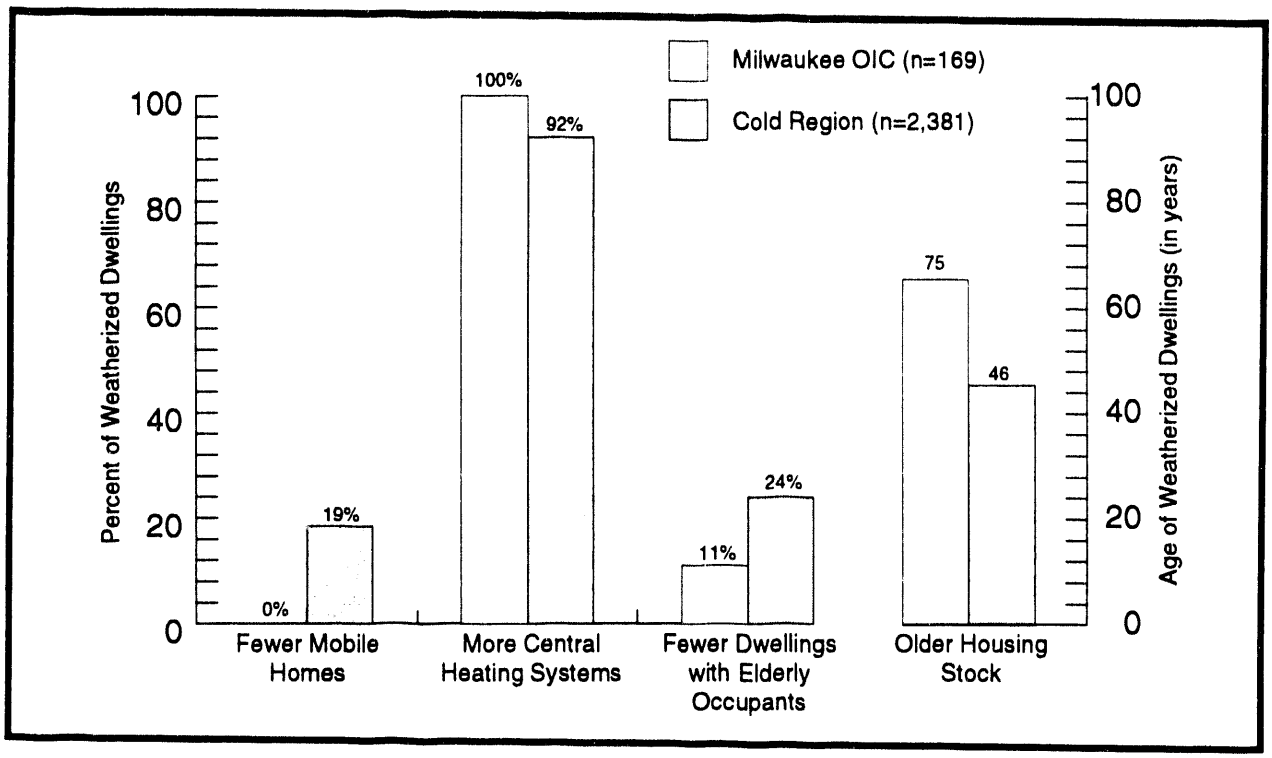

Fig. 2.2 Characteristics of the Housing Stock Weatherized by OIC

There is also a much greater percentage of homes that contain significant amounts of asbestos (estimated at greater than 50%). The State has additional funds and a fully operational program to perform abatement procedures using special licensed contractors. This is usually only necessary when heating units are being replaced. In most cases, the entire duct system is replaced.

In addition, urban populations typically have been less diligent in their home maintenance than the more rural homeowners. There is typically a high level of airtightness and general maintenance found in many rural areas of the upper Midwest. In the urban condition, with much more transient populations and fewer maintenance skills, by contrast, the housing stock often suffers from extremes of deferred maintenance.

It is generally agreed that under present quota requirements, the agency couldn't meet its goal without doing a certain number of multifamily buildings. In the last year or so, OIC officials report that most referrals have been for single-family units, especially from the LIHEAP lists, and this condition is seriously jeopardizing the fulfillment of their production requirements. Mobile homes are virtually nonexistent in the city.

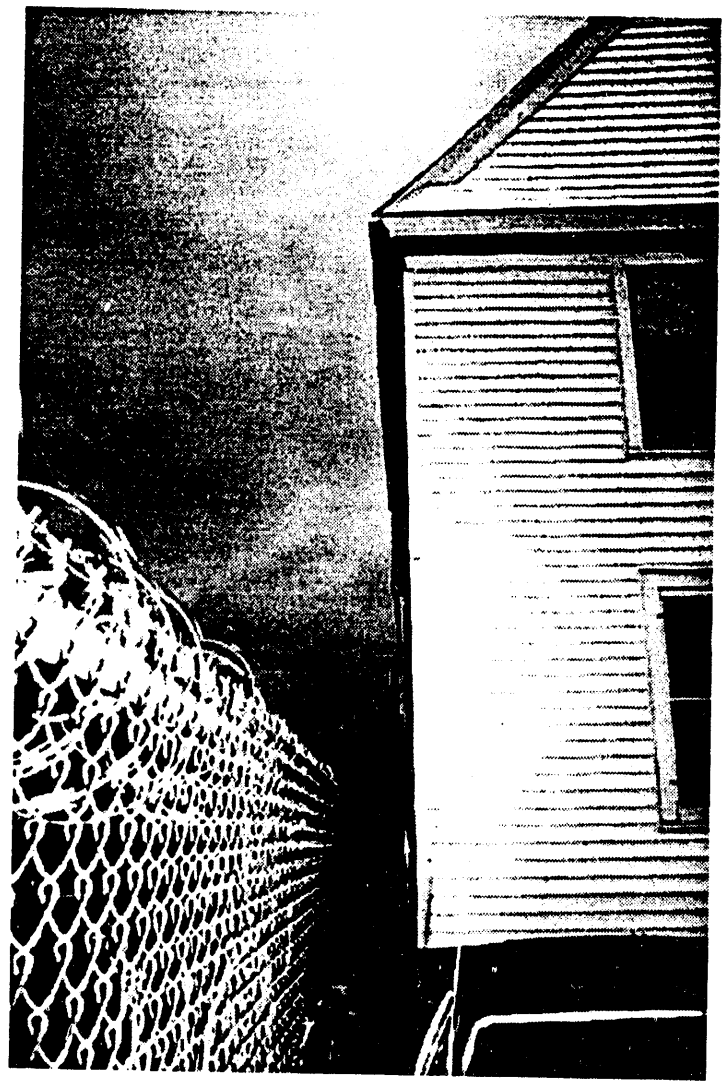

Photo 2.1 Urban density can sometimes make access for sidewall insulation difficult at best.

2.2 WEATHERIZATION STAFF AND TRAINING

2.2.1 Weatherization Staff

At present, the agency is running ten basic weatherization crews. Some have three, some have four workers—typically two journeymen (one insulator and one carpenter) and two trainees. The union carpenters receive an average of $25.85 per hour and the union insulators earn $21.41 an hour which includes benefits. Trainees are paid $5.50-6.00 per hour plus 30% benefits.

All full-time employees are union and "come from the bench." The agency has little say in who is hired. On the other hand, the unions provide important training and quality control functions.

Agency officials consider the union labor as both a negative and a positive element in the work force. The quality of the workmanship is high in most cases, but on some jobs, these skilled technicians feel they are wasting their skills. Mr. St. Lawrence reports, "They have gone through so much to get their training, they take pride and do a good job. The down side is that it can sometimes take a long time to get people to change their attitudes, and there is always the 'that's not my job...get

someone else' response." Crew acceptance of the introduction of new approaches is often a challenge. Several of the carpenters indicated that they would rather still be hanging doors.

Raw trainees are recruited through Weatherization's sister organization, Ventures in Community Improvement, which does a wide variety of housing rehabilitation services using CDBG money. At Ventures they are given a wide range of introductory skills in the building rehab trade, monitored for one year, and then moved into weatherization.

The ten crews do air sealing and insulation using blower doors. In the past, auditors took pre-tests with the blower doors and told crews what to do. There was a lot of resistance and the quality of work was not as high. Now crews perform both pre- and post-weatherization tests.

OIC does not designate weatherization crews for different type of units; there are no special multifamily crews.

The agency does run five furnace crews, each of which is usually made up of one journeyman and a trainee. One person does all the measuring and ordering for the furnace crews and one licensed electrician does all the electrical work. It takes the furnace crews an average of a little over half of a day to complete an installation. OIC Weatherization subcontracts out all boiler and space heater replacements as well as chimney work.

2.2.2 Training

The primary training operation is provided by the State through an open bid process to private and/or non-profit consultants. For most of recent history, the Wisconsin Energy Conservation Corporation (WECC), whose staff have also been responsible for creating and providing technical assistance on the Model Audit used for all single-family weatherization, has been awarded these contracts.

Training needs are identified via periodic training and technical assistance (T&TA) needs assessments. WECC's technical personnel or their sub-contractors provide training through annual state-wide conferences, smaller regional conferences, classroom training, on-site hands-on training, and agency site visits. Among the advantages noted in this arrangement is the consistency of information across the State's agencies, the State monitors, and policy-making personnel.

A certain percentage of the State's T&TA budget is shared with the local agencies to use for travel costs to state-wide training and additional on-site or other specific training they feel is required. For years this hasn't been sufficient. Usually 10% is allocated.

All inspectors have also received training and updates from the Department of Labor, Industry, and Human Relations which is responsible for mandatory licensing in the areas of Construction Building Code, HVAC, and Rental Energy Code. The Department of Health and Human Services provides training and licensing for auditors in the field of asbestos removal.

In addition to external training opportunities, OIC Weatherization provides its own motivational retreats and significant informal on-the-job training opportunities for trainees. Since the journeymen are hired off the bench, they are expected to know the essential materials of their trade from their union training. They recognize, however, that there is always room for specialized learning. Crews have received significant blower door training this past year.

All heating crews have had training in the area of heating system repairs and retrofits through the contractors. They go to the manufacturers for basic installation training and went to COAD in Ohio several years ago for training in clean and tune.

Perhaps among the most important mechanisms for the dissemination of technical knowledge is the very active Weatherization Operators of Wisconsin (W.O.W.), which gets together—usually once a month—to hash out both technical and administrative problems common to operators across the State.

OIC Weatherization maintains a fairly comprehensive technical library including all of the major periodicals directed towards weatherization: *Energy Exchange, Energy Design Update, Home Energy*, as well as *ASHRAE Fundamentals* and updates from GAMA (the Gas Appliance Manufacturers Association), DLHR (Wisconsin Department of Labor and Human Relations) which licenses various building inspector trades, and the DOA (State Department of Administration) that funds and promulgates rules for the weatherization program.

Ideas offered included the establishment of a national new technology clearinghouse. The Federal government should step up the R&D effort and look at what they are doing in Canada and in other countries. All in all, however, the agency seemed fairly pleased with the State T&TA program with WECC. They would just like to see more of it.

Perhaps most successful is the Thursday afternoon gathering of the entire production department when the crews get their checks, fill up their trucks with gas, turn in their time cards, get their assignments for the following week, and spend a half hour meeting as a group to work things out. "They talk about production, tools, and problems. It's the best thing I've ever done," reports St. Lawrence.

2.3 CLIENT RECRUITMENT AND SELECTION PROCEDURES

2.3.1 Client Recruitment

Client recruitment has traditionally relied on the LIHEAP lists from the state energy assistance office. The actual availability of eligible applicants has varied over time. In 1990, OIC Weatherization used a lot of recruitment mailings and had staff on board to certify client participation in multifamily buildings. As a result, they essentially overproduced. At one point, they had a pool of clients that exceeded 2,400 and it would take from six to nine months to service them all. The new

(temporary) director who came on at that time essentially "threw out the list" and they had to start over. The agency has been struggling to try to build it up ever since.

Currently they have less than a one-month waiting period with production at 100-to-125 jobs per month. Since most of their client referrals come from the State LIHEAP list, OIC would certainly like to have a bigger pool as the LIHEAP list hasn't been as large as they would like.

2.3.2 Client Selection

Priorities for client selection among eligible clients follow standard State and federal guidelines. First come the elderly (about 11% of the clients served) and persons with disabilities (about 5%). The rest are ordered by date of application.

At least 40% of the clients served have to be defined as high energy users, but that is not difficult to achieve since production always seems to exceed that percentage. Thus, energy use is not a formal criterion for client selection, but it does affect the level of investment in each house as the State-mandated audit selects measures based on their return on investment based on present energy use.

2.4 USE OF DIAGNOSTICS AND COMPUTERS

2.4.1 Use of Diagnostics

The use of diagnostic equipment has steadily grown over the years. Blower doors and furnace diagnostic equipment are used with increasing sensitivity and sophistication as training and Program work changes. At present, the following types and manufacturers of equipment are used:

Furnace efficiency tester	Bachrach 300
Heat exchanger leak detector	Sensit Leak Seek
Combustion gas detector	Tiff 8800
Live electric line detector	Tick Tracer
Blower doors	Minneapolis and Detechdoor

Infrared scanners are available to the agency on a loan basis from the State monitors' office. Just the week previous to our visit, the agency used a scanner in conjunction with a local utility to compare wall insulation installed with the tubing method versus that installed with the two-hole blowing method.

In most cases where the age of the equipment or other considerations indicate that a furnace or boiler is going to have work done on it anyway, the agency does not bother to do a pre-test on that equipment. For conversion boilers, they just do post-retrofit testing. The same is true for oil burners, since they assume the normal clean-and-tune process for units will be done with real-time, digital

efficiency-testing equipment. When new furnaces are being installed, the inspectors don't do post-installation tests either, as they rely on the superior skills and training of their journeyman furnace crews.

The agency tests for carbon monoxide (CO) as a regular part of furnace efficiency testing, but will do CO testing in basement areas and registers only if there is a problem in the flue gas or a cracked heat exchanger. If asbestos is identified in the house, separate abatement contractors funded under another State program will be called in and OIC auditors (who are licensed as asbestos abatement supervisors) sample for asbestos after the abatement has been completed.

In 1989, only the auditors had blower doors. They did a pre-weatherization test, but no post-work tests. Despite extensive training this year, the agency leaders still feel there is room for improvement. The crews have also recently received training on pressure testing of furnace distribution systems, but to date most distribution auditing is purely visual in nature.

Under present audit guidelines, the crews conduct sequential blower door testing during the air sealing process, and monitor the time spent on air sealing along with their success rate to determine a cut-off point. In 10% of the jobs, it is claimed the minimal air leakage rates mean that they can't do anything. "Fifteen minutes of comfort air sealing and we're done. We're walking away from a bunch of houses having done nothing at all to help these folks. In one case a missing lock on the front door couldn't be replaced because the blower door numbers said the house was too tight."

2.4.2 Computers

The agency has been increasingly integrating computers into their work flow. The audit procedure uses the WECC software and many functions of inventory and demographic tracking are also done on computers. To date, however, all of these different functions are essentially running separately. OIC Weatherization plans to set up a Local Area Network that will link all the various computers together so they can integrate files. It is hoped this will diminish duplication of data entry and redundant paperwork.

The bottom line, however, is that all investment in computer hardware, software and systems development has to come out of the 7.75% Administrative overhead and this is seen as inadequate. Hence, other components of the program operate at reduced efficiency for lack of this organizational tool.

2.5 INSTALLATION OF MEASURES

2.5.1 Selection of Weatherization Measures

The selection of measures to be applied to each house is largely prescribed by the State-mandated WECC computerized audit. The audit procedure is based on the energy use recorded from the client's previous year's energy bills. For gas and electric homes, this data comes directly from the utilities. The OIC Weatherization staff reports that in most cases they find that clients with oil furnaces maintain sufficiently accurate records of their fuel bills for use in the calculations. The audit does not attempt to model the overall energy consumption of the residence, but uses the actual pre-retrofit consumption to calculate savings based on percentage reductions.

Once individual measures are weighted as to their own individual cost-benefit potential, they are ranked from greatest to least and the savings potential for each is subtracted from the initial consumption. Measures which continue to meet the cost-benefit criteria and are deemed feasible by the auditor are indeed prescribed in the computer generated work order, irrespective of total costs. Those measures which do not meet the cost-benefit criteria are disallowed.

The audit is also subject to the prior decisions of the State agency as to allowable measures. For instance, in response to the overuse of storm windows as a primary weatherization measure by some agencies, the State totally prohibited storm windows as an allowable measure. Although few would deny that restricting the wholesale installation of storm windows as a primary weatherization measure at the expense of other more cost-effective retrofits is probably advisable, Production Supervisor Al St. Lawrence feels that this and other measures are legitimate options which are not presently allowed under the present system.

The largest frustration with State procedures among OIC Weatherization staff was the inability to provide measures to deserving clients because of their present low energy use. It was felt that even if the work was not totally cost effective, penalizing a client for their extreme frugality—even to a point of deprivation of health and safety considerations—was not in the community's best interest. It was suggested that there be some minimal energy efficiency standard to which a house is raised, rather than simply walking away from a house and penalizing the homeowner for being conservative based solely on economic considerations.

2.5.2 Installation of Measures

The agency has elected to use its own crews for all functions except boiler replacements, space heaters, and chimney repairs. With their own crews they can address emergency furnace situations faster since they don't have to wait for three bids to come in for each one. Additionally, they feel that they can compete successfully with contractor-based programs because there is no profit included in their costs.

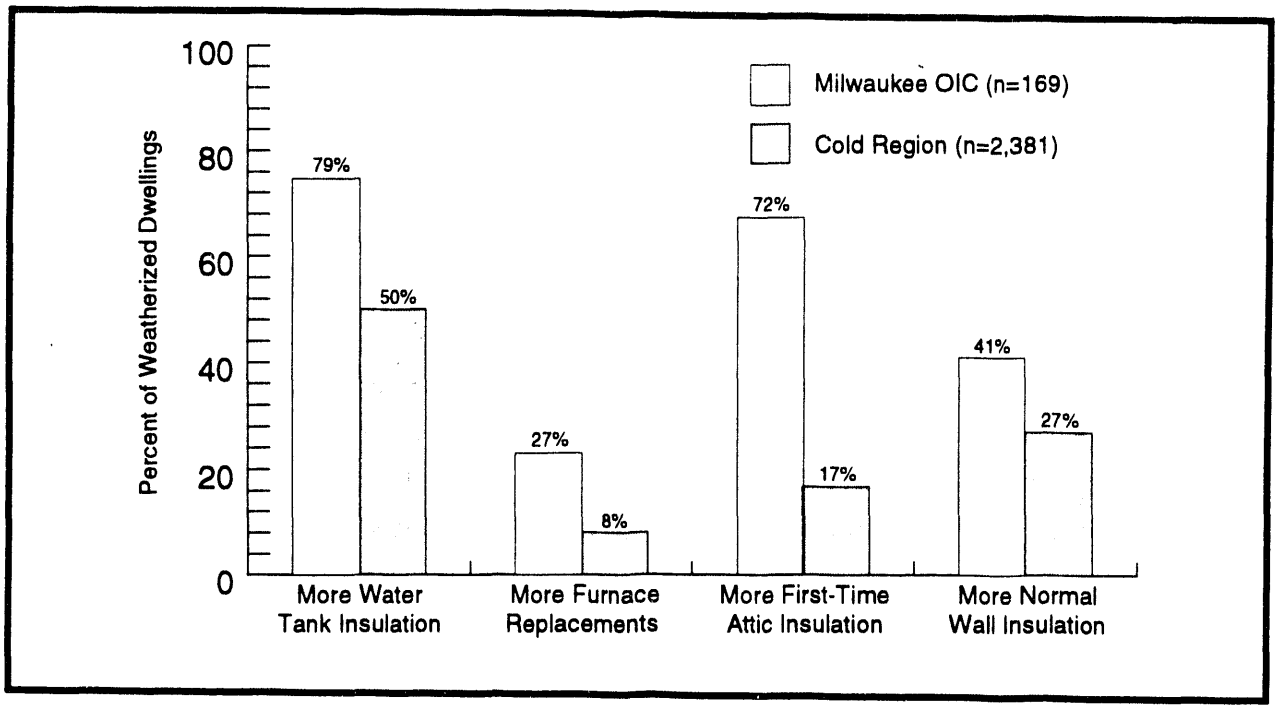

Fig. 2.3 Installation Rates for Selected Measures Installed by OIC

The crews work eight hour days, five days a week. Although the program operators realize that there are benefits to working, say, four 10-hour days, the union would see it as eight hours plus two hours overtime which would be cost-prohibitive.

At the beginning of the work day, the crews do not arrive at the office or warehouse, but rather show up directly at the job site where the materials to be installed are already awaiting them. If there are additional materials needed, the crew simply calls back in to the warehouse. Additional materials are only released on the auditor's approval. They are then immediately trucked out to the job site. Any materials that are not used are returned at the end of the week and reinventoried.

Since 1988, this agency has been doing a great deal of sidewall insulation (Photo 2.2). More recently, they been using the tubing method to achieve high density, but the feedback was mixed. One report was that the crews like the tubing method, but they are using more cellulose. There is a trade off with labor — less time per job is possible only through an investment in better equipment. Most crews have two Force-2™ blowers (Photo 2.3).

The most innovative technology seen in this survey was a design by OIC Weatherization personnel. It's a variable air pressure switch which senses when a hose begins to back up and clog and shuts down the machine before the entire hose gets clogged. For anyone who has done high-density cellulose blowing, this is obviously a great time saver—not to mention the impact on crew morale as this inevitable source of frustration is eliminated. Also impressive is a spring loaded hole-saw drill bit which automatically removes the wooden plug after drilling an insulation fill hole.

Photo 2.2 A thorough job of accessing floor and wall cavities for blowing insulation.

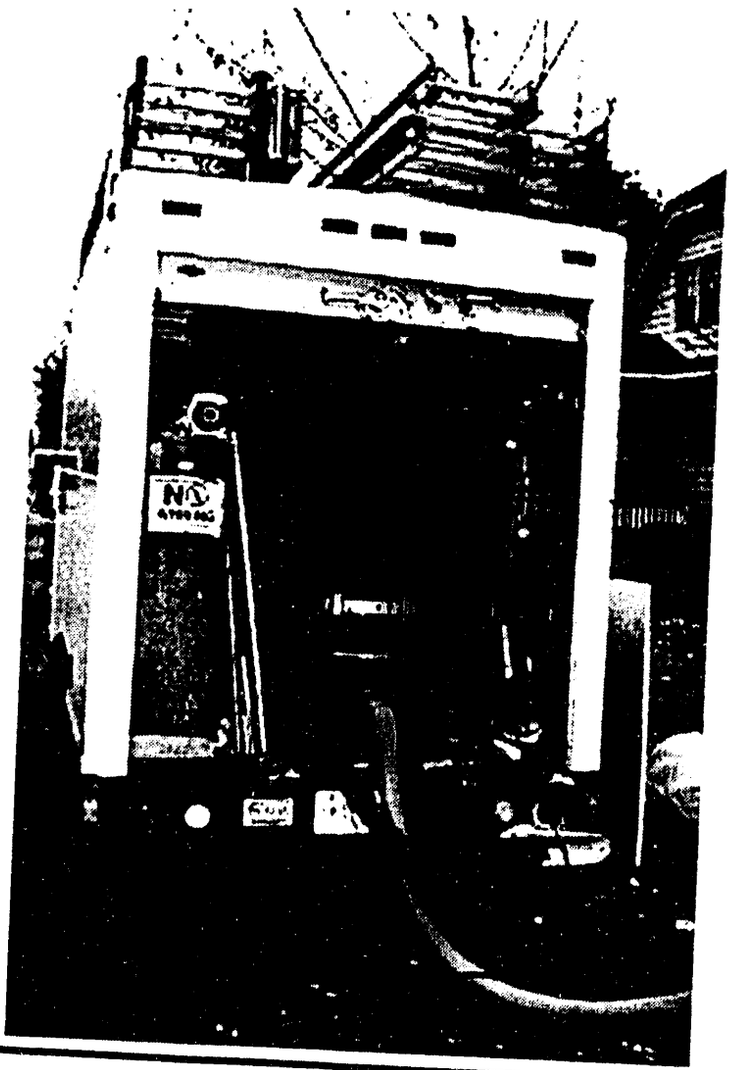

Photo 2.3 Two insulation machines running simultaneously for a three-man crew.

Another interesting technique for accessing sidewalls with fake-brick cellulosic board siding is to carefully cut out an individual brick with a razor knife and then drill the sheathing. After insulating, the hole is covered with the "brick" cut-out, being glued in place with roof cement. A good materials use is the application of Microlite™, a reinforced, foil-backed ductwrap material, as stuffage in a variety of situations including air sealing above a built-in pocket door. FSK™, a reinforced foil tape, was also effectively used as an air barrier. The cavity behind a built-in closet in a kneewall attic was effectively sealed and insulated by blowing the entire cavity tight with cellulose, an innovative solution for major problem area.

2.5.3 Client Education

At the time the data was being collected for the Single-Family Study, there was no formal client education program in effect at OIC Weatherization, although numerous individuals recognized the importance of this component. Several people at OIC Weatherization expressed a concern regarding the present investment formula whereby those clients who live energy-conserving life styles are effectively penalized as compared to the "wastrels" who neither seem to know or to care about saving energy.

In 1992 (after this study was essentially complete) an innovative, energy education pilot study program was instituted. Under the new pilot, a group of weatherization eligible clients receives one of three packages:

- both weatherization and in-the-home energy education;
- only weatherization; or
- neither weatherization nor energy education.

Since this is apparently the first program of this nature associated with Wisconsin's Low-Income Weatherization Assistance Program, the results are eagerly awaited.

2.5.4 Warehousing and Materials Procurement

The agency realized early that the combined forces of a strict 60/40 material/labor split and the political necessity of working with union carpenters and insulators was not going to work. The way most urban programs across the country deal with this contradiction is to strip off the labor component from their operation and rely solely on subcontract labor. That ran contradictory to OIC's goal of providing training and meaningful labor and also meant a significant percentage of the weatherization dollars would be absorbed as contractor profit, which is in essence only an increase in the labor portion of the formula. Instead St. Lawrence kept the installation function under his own control but subcontracted out the materials purchase, warehousing, and inventory—where any external profit is counted on the materials side of the equation.

In practice, this seems to be working out quite satisfactorily. The materials warehouse is, in fact a section of OIC Weatherization's production facility which is rented out to their contract supplier, a local franchise of Reynolds Metals Company. Insulation materials are stored in a tractor trailer rig outside, but the large, heated warehouse was well stocked with all the usual weatherization items and a supply of replacement furnaces, ductwork, controls and associated plumbing and electrical supplies. Whatever isn't in inventory is readily available from other local wholesalers or the abundant manufacturing base in the city.

2.5.5 Quality Control

Quality control is maintained by having every job signed off by the inspector/auditor. Since the auditing function is in a different department of the agency, there is a certain separation of powers. Productivity and rapid remediation of any shortcomings is assured by having the final inspection done while the crew is still on the job. If everything is O.K., the inspector signs off. If not, the crew makes the corrections on the spot without having to make a special return trip. This system works efficiently in an urban setting where distances are not great. The production chief checks on the jobs in progress. The auditor checks every job for the sign-off, and then the head of monitoring and inspections checks out the jobs in progress or completions two or three times a month.

When the city had the inspections portion of the program, it was standard city building inspectors who did the monitoring. They were not necessarily well versed in the subtleties of either weatherization requirements or of the realities of energy retrofit. Now it is OIC Weatherization's own inspectors who write off each job, and when they do so, it is counted as <u>their</u> responsibility if something isn't right. It is generally agreed that this has greatly tightened up the quality of both the inspections and the work being done.

State materials and installation standards are updated periodically and loose-leaf revisions are circulated to the agencies. Apparently some inconsistency exists between State monitors, depending on how each one interprets the State standards. In addition, each agency may impose its own standards (to a degree) that are more stringent than the State standards. Warren Jones, Supervisor of Auditing and Monitoring, observes, "I am usually a proponent of change, but when it comes on a yearly—or even quarterly—basis it is hard to work with." The State monitor, drops in anytime for unannounced spot inspections, which are done with an informational/educational attitude.

2.6 COSTS

Agency personnel estimate that their materials costs are probably average or above average compared to the rest of the state (see Fig. 2.6). Transportation costs are probably lower but city costs are always higher. Now they spend about $2,200 to $2,400 for materials and labor per job but feel they could probably go down to about $1,500 for the same quality of work if there was any incentive

to get better prices on their materials and furnace equipment. The agency could go directly to either the wholesaler or the manufacturer and demand a price break but they haven't done so to date. St. Lawrence observes, "If they eliminated the 60/40 price split, we could operate a much better program.... Then we would be going for the best price. Now there is no incentive."

On the other hand, the administrative funding under the State is less than the agency used to get when they were operating under subcontract to the City. Now they get only 7.75% which is based on 5% of their DOE money (with the other 5% going for State administration) and the balance coming from LIHEAP funds. For the last several years, although the program was largely subsidized by non-DOE funding through the oil overcharge funds, no administration dollars came out of these Exxon dollars.

With limited, capped administrative costs, the OIC Weatherization administration has long attempted to apply cost-cutting strategies to their overhead functions. They are now networking computers. This will improve administrative time costs and reduce multiple paperwork. Whereas once they were the smallest program in the State, now they are the largest and they feel a need to streamline their operation to keep up with the increased workflow.

One recent efficiency improvement is the purchase of mini-vans for the auditors. With the increased use of diagnostic tools, the daily transfer of equipment into private vehicles is not practical. This way both the van and the tools can be secured at the end of the day and be ready to go the first thing in the morning.

2.7 LEVERAGING AND COOPERATIVE EFFORTS

OIC Weatherization's sister program 'Ventures' and other city programs use HUD and other State dollars to accomplish many of the larger renovations which otherwise would not be accomplished under the current weatherization guidelines and funding. The new 'HOME' program in the State reportedly has over $6 million available to rehabilitate homes. Many of the weatherization referrals come from the sister operation Ventures, and weatherization, in turn, refers many clients to Ventures for more extensive renovations. Ventures gets most of its referrals, however, from the city building inspectors.

Weatherization also gets many referrals from neighborhood programs and the local utilities. Here, too, the referrals seem to go both ways; sometimes the utility provides the weatherization services and sometime OIC Weatherization does the work. This cooperation is basically an informal trade-off depending on resources available, restrictions of various funding sources compared to clients' needs, eligibility, and scheduling. OIC Weatherization also cooperates with La Casa, the other service provider for Milwaukee County outside of the City proper. They recently helped La Casa make their annual completion quota. The result is that the client is serviced one way or the other.

The disadvantage is that the gas company doesn't move as fast as OIC does, so some clients may have to wait longer for service.

With possible new job training funds becoming available under the new administration, OIC Weatherization staff is hoping that some JETPA or other skills training funds can be merged with their program.

2.8 ENERGY SAVINGS AND COST EFFECTIVENESS

Pre- and post-weatherization consumption data were available for a random sample of 143 gas-heated dwellings weatherized by OIC during 1989. These billing histories were weather-normalized using PRISM, in order to estimate the normalized annual consumption of these homes before and after weatherization (See Table 2.1 and Figs. 2.4 and 2.5).

The results indicate that OIC's clients consumed more home heating fuel (1,543 ccf/year of natural gas) prior to weatherization than other clients in cold regions (who averaged 1,247 ccf/year) (see Fig. 2.6). On the average, houses weatherized by OIC reduced their gas consumption by 251 ccf/year or 16.3% of pre-weatherization consumption. These estimates represent gross savings. When the increased consumption of the control group is considered, the net savings for OIC increases to 320 ccf/year (or 20.7%). A similar control group adjustment can also be made to estimate the cold region's total energy impact. The result is an estimated net savings of 200 ccf/year (or 16.0% of pre-weatherization consumption.

Although the sample of dwellings weatherized by OIC typically had higher installation costs (see Fig 2.6) than other cold region agencies in this study ($1,289 versus $983), their significantly increased energy savings resulted in a program benefit/cost ratio of 1.66 compared to the average for cold region agencies of 1.05. These benefit/cost ratios are a "worst case" estimate because they reflect only the benefit of reduced gas consumption but include all costs associated with measures installation including both materials and labor as well as an additional $500 attributed to installation-related overhead and management costs.[1] If the estimated non-energy benefits such as employment and reduced environmental damages are also included (i.e., the "societal perspective"), the benefit/cost ratio increases to 2.21 for the OIC program versus 1.75 for the cold region programs at large. Thus the cost effectiveness of the OIC program, no matter how you define it, far exceeds that of the average weatherization agency operating in the cold region.

[1] This is defined in Brown et al (1993) as the "program perspective."

Table 2.1 PRISM Model Parameters for OIC

	Intercept (ccf/Day)	Heating Slope (ccf/°F Day)	Temperature Dependent Use (ccf/Year)	R^2	Reference Temperature (°F)
WEATHERIZED GROUP (N = 143)					
Pre-Weatherization	1.05 (0.78)	0.19 (0.03)	1180 (249)	.85	63.34 (7.49)
Post-Weatherization	1.16 (0.57)	0.15 (0.02)	897 (102)	.87	61.55 (7.82)

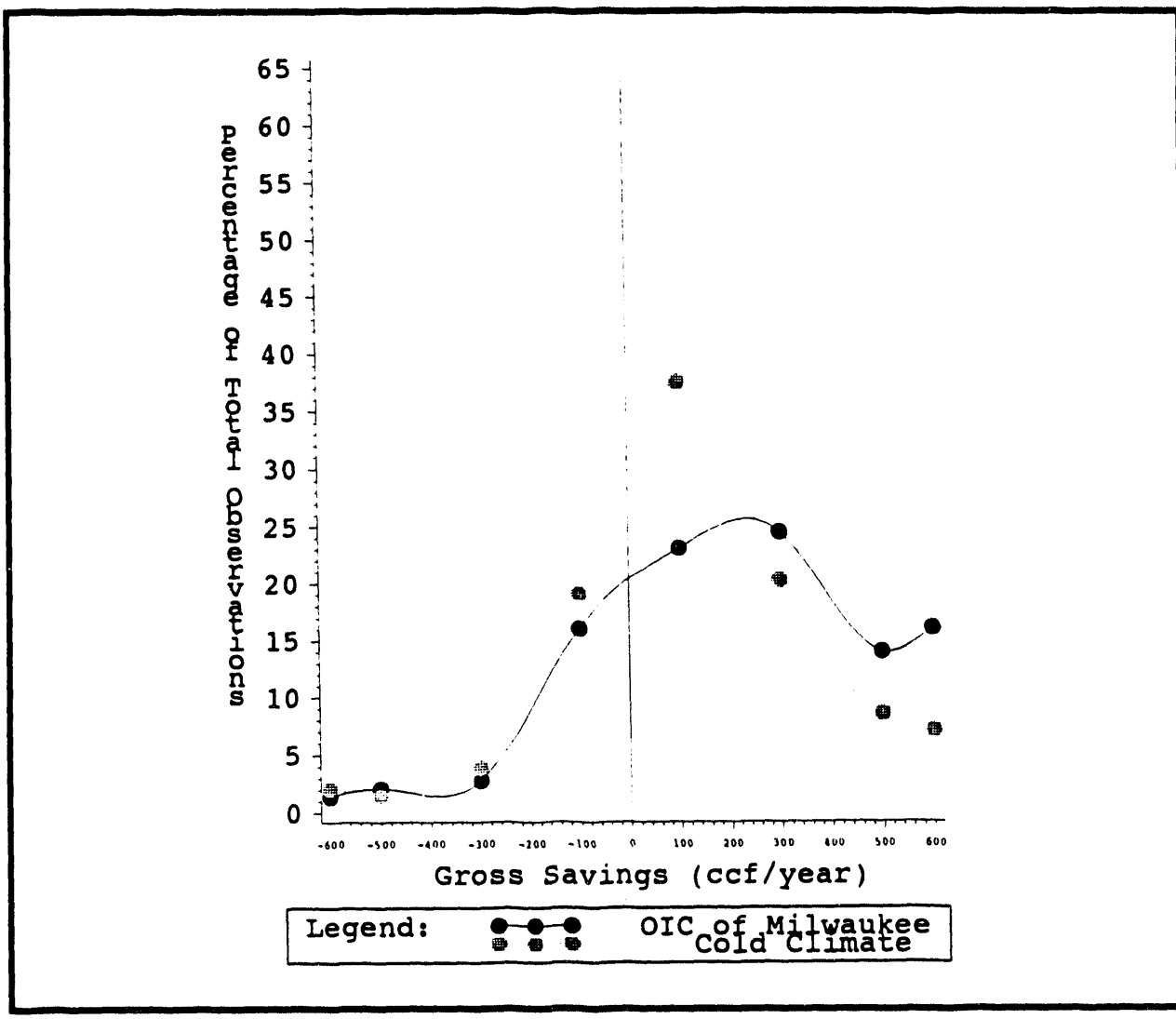

Fig. 2.4 Distribution of Gross Savings in Weatherized Dwellings

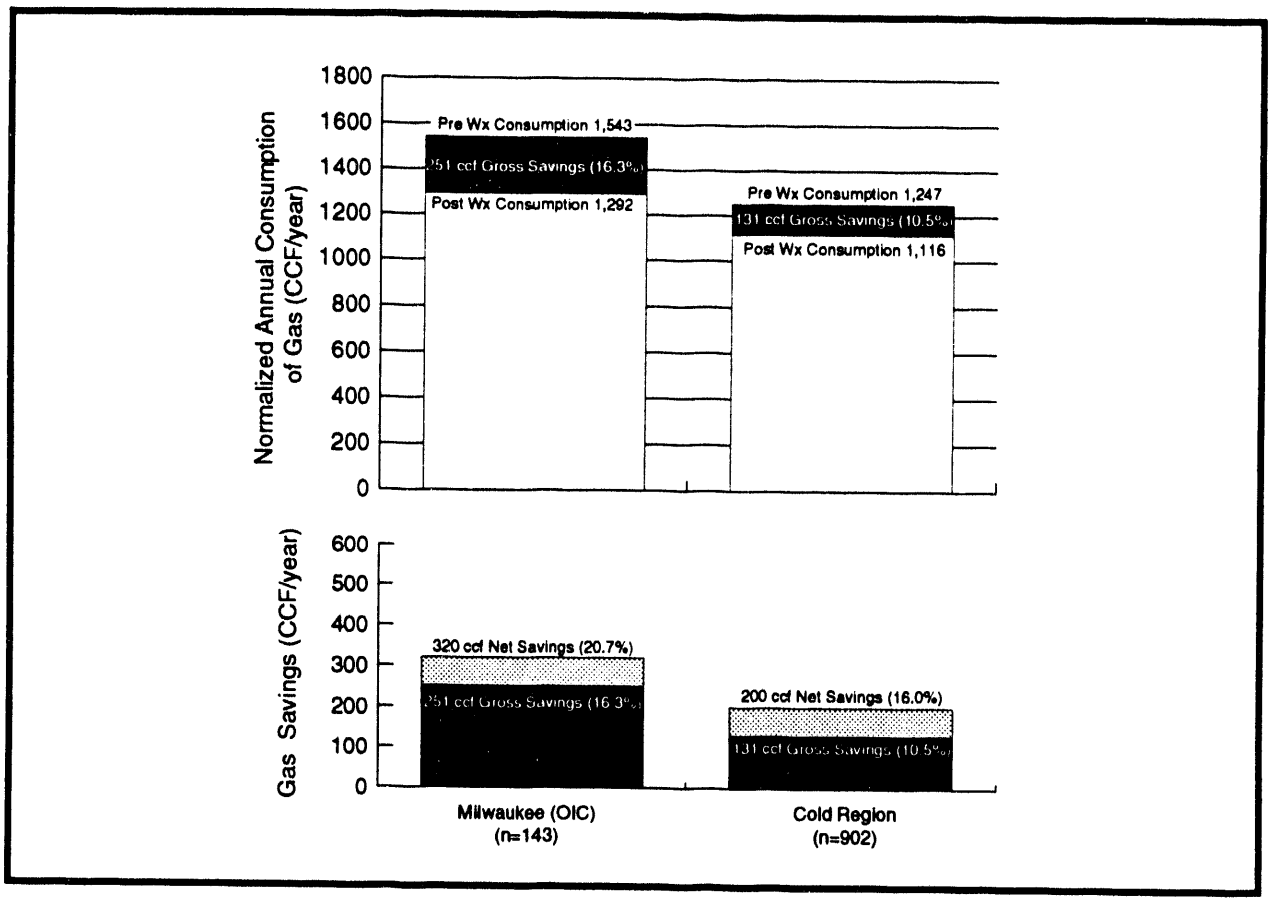

Fig. 2.5 Normalized Annual Consumption and Savings of Dwellings Weatherized by OIC

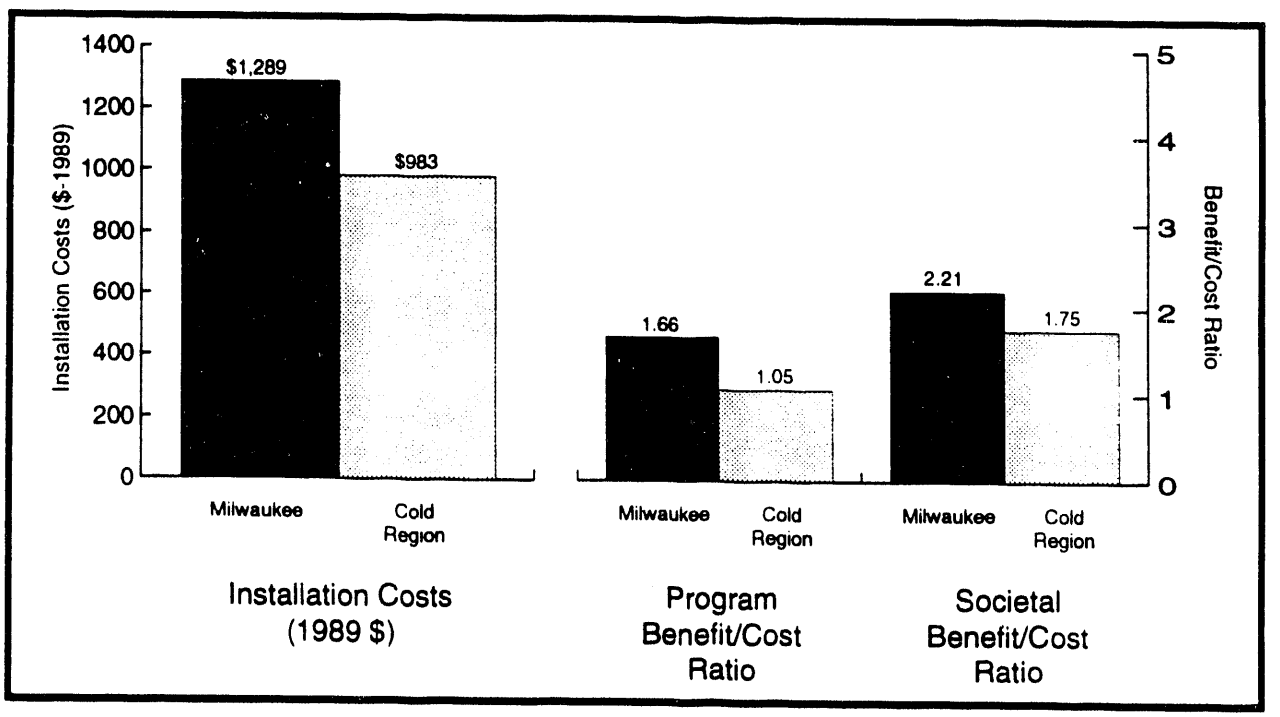

Fig. 2.6 Costs and Benefit/Cost Ratios for Dwellings Weatherized by OIC

2.9 REASONS FOR SUCCESS

The savings of this program has mainly been attributed to the poor quality of the housing stock. The greatest energy savings can come from houses with the biggest problems. And although these jobs may be particularly difficult to work on and thus take more time and materials investment to bring them up to standards, the opportunity for savings with older deteriorated housing stock in a cold climate is a major contributor to high savings.

In addition, a change in emphasis occurred just about the time of this study that helped OIC achieve cost-effective savings. In 1982, caulking and minor air sealing were the major measures. Only in 1989/90 did the numbers and the per unit costs change when emphasis was placed on attics and sidewalls and replacing furnaces. High energy savings is likely related to these measures.

Credit is also given to OIC's qualified, trustworthy, and efficient work force, as well as the quality materials which are provided. This organization is innovative and responsive to changing needs and opportunities. Throughout the organization, a high level of intellectual curiosity and a free exchange of technical information was evident. Everyone seemed proud to have been included in this study and were expectantly awaiting the results of the evaluation. As leaders in a progressive operation, they looked forward to future improvements in the program and expressed a desire to participate in future studies and field research projects.

All in all, within the weatherization program of Opportunities Industrialization Center of Greater Milwaukee there seems to be a good mix of varied talent and resources that are bound by a common goal of providing comprehensive services in a challenging urban environment. This dedication has allowed the agency staff to refine their systems and resources to produce a program from which all weatherization providers, especially those located in similar dense, urban environments, can glean both inspiration and practical ideas to further their own efforts.

3. OTTAWA COUNTY COMMUNITY ACTION AGENCY
Holland, Michigan

by Linda Berry

3.1 THE AGENCY AND ITS SERVICE AREA

3.1.1 The Agency

The Ottawa County Community Action Agency (CAA) is located in western Michigan in the city of Holland. Holland, with a population of about 45,000, is an attractive resort town, located on the shores of Lake Michigan. Holland is the only urban area in Ottawa County, which has a total population of 187,768. The rest of the county consists mainly of small towns and villages with some suburban areas (near Grand Rapids) and some rural areas.

The Ottawa County CAA operates a variety of social service programs, including food programs, assistance with utility bills, job training, and budget counseling and is housed in a modern, attractive building. It has a medium-sized weatherization program that completed 221 houses in the 1989 Program Year (PY 1989), with a total budget of $301,000 which consisted entirely of DOE funds. The agency has been operating continuously since 1984.

3.1.2 The Housing Stock

About 14% of the dwellings weatherized in PY 1989 were mobile homes, which is less than average for the cold region (19%). Only 3% of the homes in the agency sample used supplemental heating fuels, although about 20% of the homes weatherized in 1989 by agencies in the cold region did (Fig. 3.1). The dwellings served by this agency were smaller (958 square feet) than was typical for the region (1,200 square feet). Ninety-eight percent of the homes had central heating systems, which is higher than the region-wide average of 92%.

Most of the Program-eligible houses in this agency's service area were in good condition (Photo 3.1). The agency director observed that the reasonably good condition of the dwellings usually makes it possible to do a complete job of weatherizing and tightening the houses. She contrasted their situation to that of agencies operating in Michigan'a urban areas, where the existence of large houses in very poor repair makes it impossible to completely weatherize a dwelling with the available dollars.

The audit/inspection contractor agreed with the weatherization director's assessment. He stated that many of the homes he inspects are in good condition. He noted that his agency can almost always afford to insulate all four walls in the dwellings they serve. In contrast, agencies in Detroit or Grand Rapids, often are able to insulate only two walls because funding limits make it impossible to do all four walls in the larger and more dilapidated low-income housing in their service

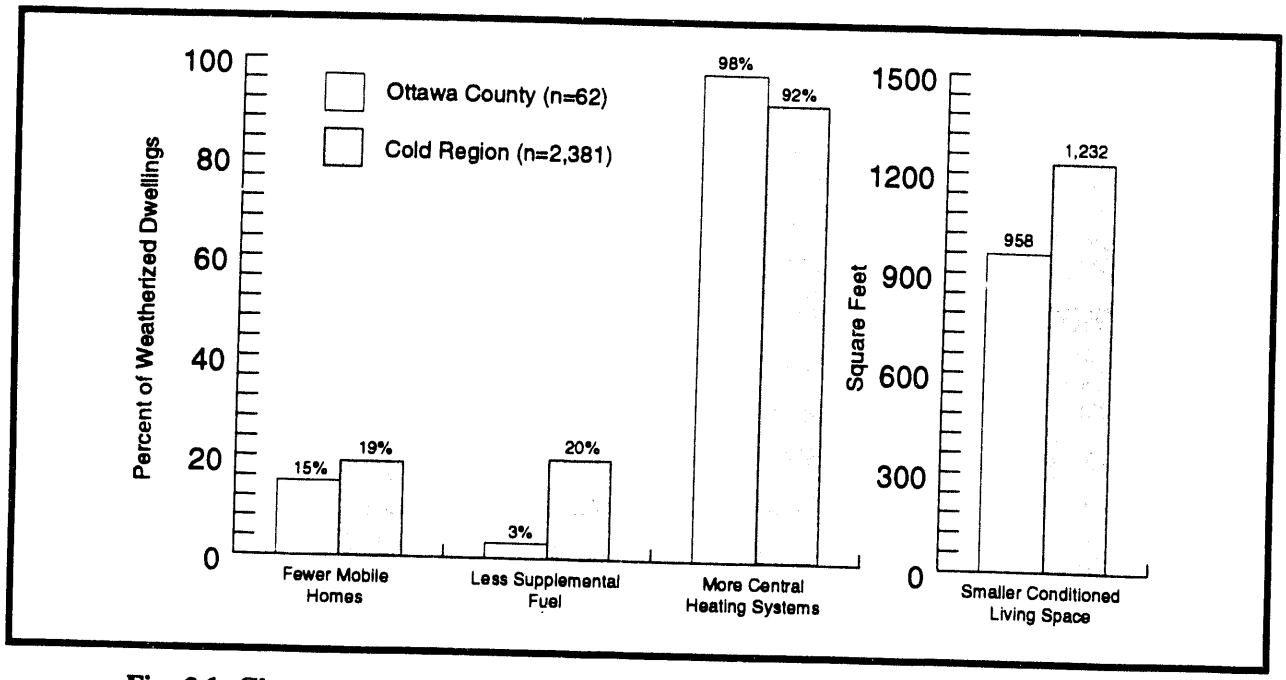

Fig. 3.1 Characteristics of the Housing Stock Served by the Ottawa County CAA

Photo 3.1 Most of the eligible homes are in good condition.

areas. He observed that two major groups among his agency's clientele, the elderly and families suffering unemployment, often have basically sound dwellings, even though their incomes are very low.

3.2 WEATHERIZATION STAFF AND TRAINING

3.2.1 Weatherization Staff

In PY 1989, all field work was done by contractors. At that time, the agency had 2.3 full-time equivalent employees (the director and staff members who did in-take interviews with clients) plus six non-agency personnel (an audit/inspection contractor and installation contractors). Currently, the number and composition of the personnel is almost the same as it was in PY 1989 (Fig. 3.2). The current director replaced the former director in 1990, while the in-take interviewer and the contractors have worked in weatherization for three to eight years.

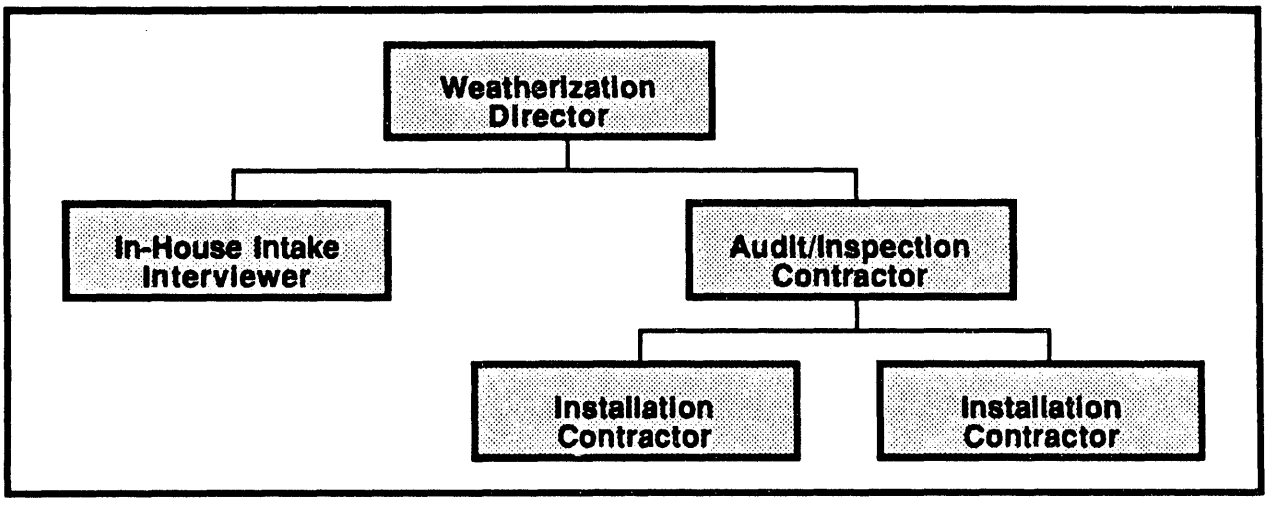

Fig. 3.2 Organizational Chart of the Ottawa County CAA Weatherization Program

Pre- and post-weatherization inspections are performed by the audit/inspection contractor, who is not one of the contractors that install the measures. At the time of the pre-weatherization inspection, the audit/inspection contractor writes a job order instructing the contractors to install the selected measures. A blower-door is used during the pre-inspection visit to identify the areas that will be sealed by the envelope contractors. After the installation is complete, the same individual who wrote the job order, returns to the dwelling and does a post-inspection to see if his instructions were followed. If there are any problems the installation contractors must correct them, before receiving payment.

The same two installation contractors have worked for the agency for eight years. Great care was taken in selecting these contractors. The selection process involved extensive reference checks, competitive bidding, and a point system for scoring the competitors. Contractor selection is rebid every two years; however, the same two installation contractors have consistently won the bidding competition at this agency.

This agency prefers to rely on contractors for several reasons. First, Ottawa County encourages privatization of as many government services as possible. Hiring contractors employed by private companies was consistent with this County-level policy. Secondly, this agency expected less employee turnover, and less total expense with contractor labor. In addition, limited space in County buildings made private warehousing of materials desirable. The director noted that this agency was one of the first in Michigan to use contractor labor, but that now most of the agencies in the State do so.

3.2.2 Training

The contractors that were selected participated in State-sponsored training sessions, which are required of all installers. These sessions are on-going, one-time, one-day classroom training programs. They include an in-depth slide presentation on the Michigan priority list, and discussions of what can and cannot be done in houses, and why. The contractors also participated in a State-sponsored training session on blower doors (half a day of classroom and half a day of field work) that was offered in 1990. The contractors are certified by the State.

The audit/inspection contractor, who does pre- and post-inspections, seems to be especially well-qualified. The current audit contractor and the previous audit contractor both worked for the agency during part of the 1989 Program Year. The current audit contractor was preceded in the job by his brother, who was a State building inspector. His brother provided the current auditor with a good deal of on-the-job training. In addition, both of them attended three days of training provided by the State, and passed the required tests.

3.3 CLIENT RECRUITMENT AND SELECTION

This agency has an extensive client recruitment effort, using a variety of means. Public service announcements are placed regularly on local radio and television stations, and in newspapers. Every year the weatherization program is advertized in Food Stamp inserts. The program manager attends various meetings (such as a bimonthly series of CAA-sponsored landlord/tenant meetings, covering topics such as equal housing opportunity laws, rental housing maintenance responsibilities, and available housing assistance programs) where client recruitment takes place. In addition, all clients receiving assistance with utility bills (i.e., LIHEAP payments) from the CAA are required to apply for weatherization. This may tend to produce a high proportion of the highest energy users

among the weatherization applicants. The waiting list for weatherization is usually between 20 and 30 dwellings

Priority is given to applicants who are elderly or disabled, and to families receiving Aid for Dependent Children (ADC). The agency must meet State-required goals of 15% elderly, 15% handicapped and 40% ADC among their clients. Priority is given to applicants in these categories until the goals are reached. The goals for Ottawa County are lower than the State-wide goal of 20% elderly, due to local demographic conditions. Nearly all eligible applicants receive weatherization services. A very few dwellings are not weatherized because their condition is too poor.

3.4 INSTALLATION OF MEASURES

3.4.1 Selection of Weatherization Measures

A modified DOE priority list, which was tailored to Michigan conditions in research conducted by the Michigan Energy Agency for the State Weatherization Assistance Program office, is the required audit procedure for all Michigan agencies. A copy of Michigan's priority list is shown in Appendix D. The priority list is organized into above- and below-the-line measures, with above-the-line measures being installed first. The above-the-line measures include water heater treatments; ceiling, wall, duct and floor insulation; and major infiltration measures. These measures are required whenever they are applicable. The State also requires the use of high-density blown-in cellulose insulation for walls.

Although heating system repairs and replacements are included in the State's below-the-line list of measures, this agency does not do any work on heating systems. Heating system work is not performed here because it is legally required in Michigan that all such work be done by a licensed mechanical contractor. The agency's contractors specialize in envelope work. Hiring an additional mechanical contractor to inspect each house is considered prohibitively expensive. State-wide, approximately 25% of agencies have mechanical inspectors who do heating system work. Furnace repair and replacement is usually not supported by DOE Weatherization Program funds. Agencies that do provide heating system measures try to pay for them with utility, Community Development Block Grant, or Michigan State Housing Development Authority funds.

3.4.2 Rates of Installation of Weatherization Measures

For most measures, installation rates in PY 1989 were either about the same as regional averages (e.g., for attic insulation, floor insulation, caulking, and air sealing with blower door) or higher. Much higher proportions of Ottawa County dwellings received normal wall insulation (45%), than was typical of agencies in the region (27%) (Fig. 3.3). In addition, 16% of this agency's weatherized dwellings received high-density wall insulation compared to 8% for the cold region (Photo 3.2). Currently, the use of high-density blown-in cellulose insulation for walls is required by

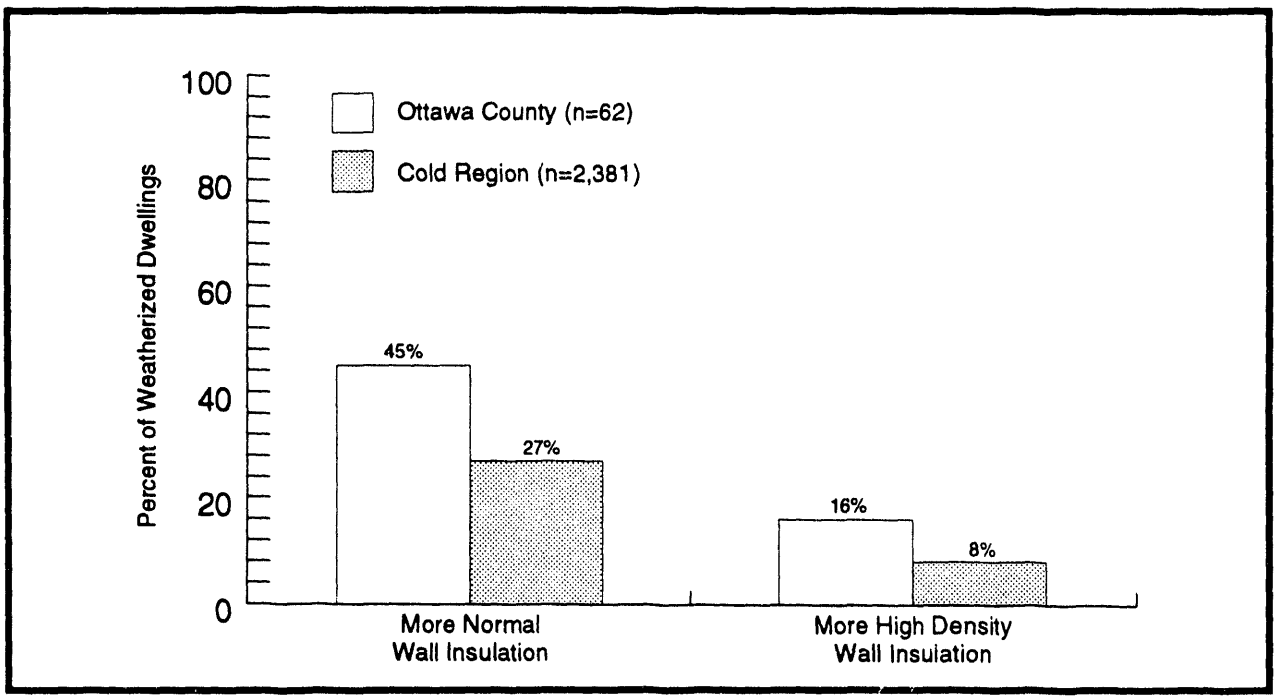

Fig. 3.3 Installation Rates for Selected Weatherization Measures Installed by the Ottawa County CAA Weatherization Program vs Cold Region

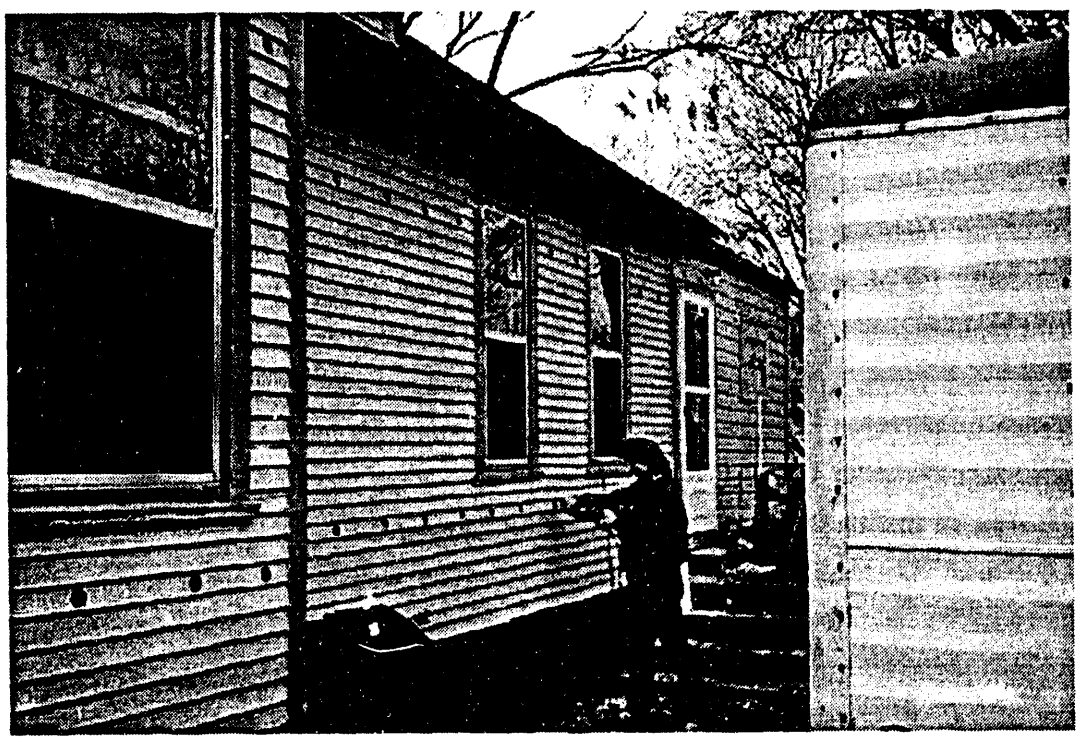

Photo 3.2 Wall insulation is installed frequently.

the State. In PY 89, more of this agency's dwellings received water-heater tank insulation (76% vs. 50%), pipe insulation (73% vs. 45%), low-flow showerheads (47% vs. 18%), and storm windows (38% vs. 28%) than was typical for the cold region.

Only a few measures were installed at lower rates (water heater temperature reduction, attic ventilation) than was typical for the cold region. Structural repairs, such as replacements of windows and doors, also were installed at lower rates for most categories. No heating/cooling measures were installed by this agency in PY 1989, in contrast to a high regional average of over 20% of dwellings receiving heating system measures.

3.4.3 Use of Diagnostics

The audit/inspection contractor conducts blower door tests before completing job orders. He also conducts post-weatherization blower door tests. Blower door testing to find leakage areas for sealing was conducted on 36% of the dwellings weatherized in PY 1989. It is used on nearly all dwellings now. Infrared scanning is performed by the State on a sample of houses each year. Nearly all of this agency's dwellings that were tested perfomed very well. Distribution system testing, and heating/cooling diagnostics were not performed on any of the dwellings this agency weatherized in PY 1989.

3.4.4 Quality Control Procedures

The audit/inspection contractor conducts post-weatherization inspections of 100% of the dwellings. The density of the blown-in wall insulation is checked, as well as the correct implementation of all other aspects of the job order. If any of the work does not meet standards, the contractors must correct the problem before they receive payment. Callbacks are rarely necessary, however, because of the long-term working relationship between the agency and its contractors. Everyone knows what is expected and there is a highly cooperative atmosphere. The frequent and effective communication between the auditor/inspector and the installation contractors is probably important to this agency's success. Meetings are held every week to review any problems that have developed. The problems are generally resolved to everyone's satisfaction.

3.5 LEVERAGING AND COOPERATIVE EFFORTS

There were no leveraged funds or cooperative efforts in PY 1989. In 1991 federal, State and local housing rehabilitation grant and loan programs became available. These funds are used in combination with weatherization funds on some of the dwellings, so that a more complete rehabilitation and weatherization can be accomplished.

3.6 PROGRAM SAVINGS, COSTS, AND COST EFFECTIVENESS

Pre- and post-weatherization consumption data are available for a random sample of 38 gas-heated houses weatherized by Ottawa County CAA in PY 1989. Utility billing histories for these dwellings were weather-normalized using PRISM, in order to estimate the normalized annual consumption of these houses before and after weatherization (Fig. 3.4 and Table 3.1).

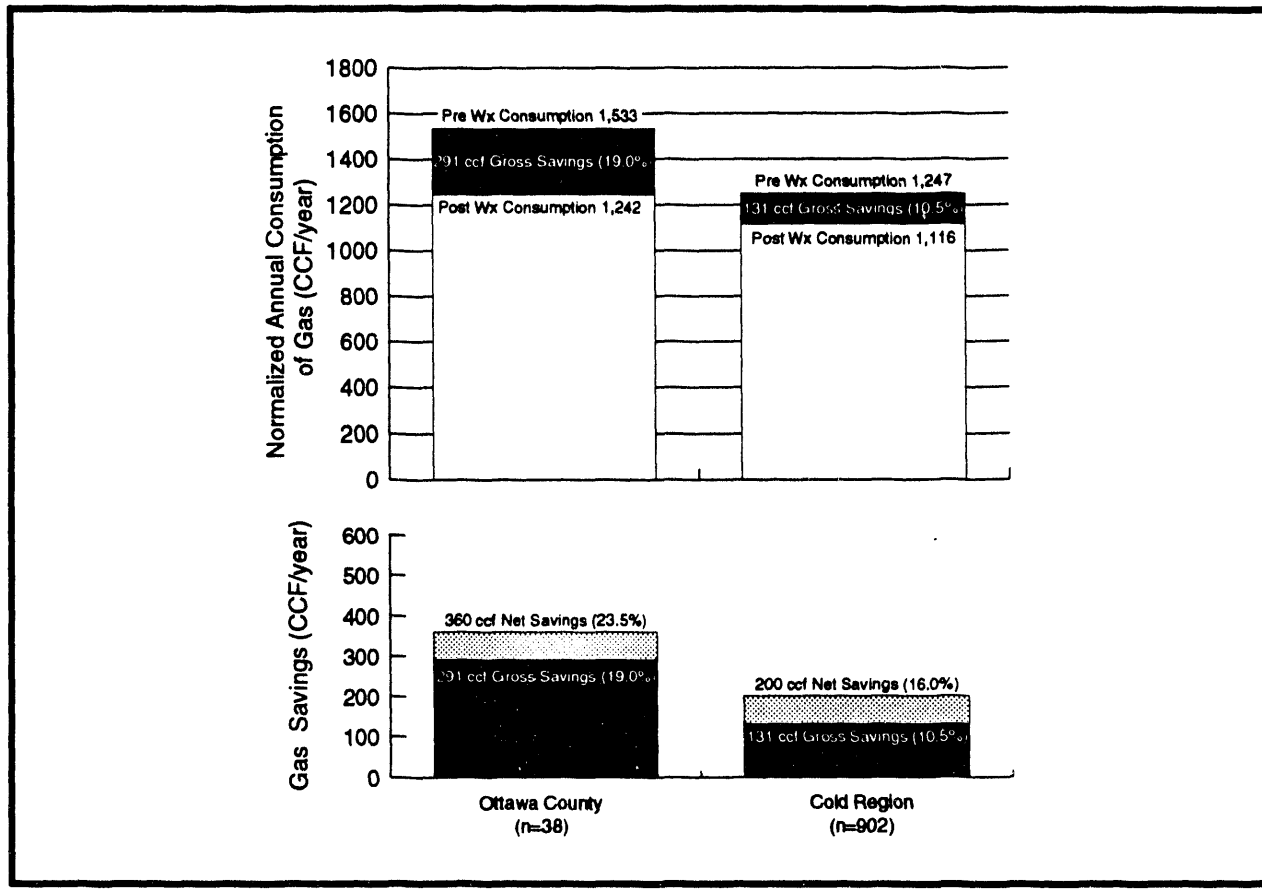

Fig. 3.4 Normalized Annual Consumption and Savings of Dwellings Weatherized by the Ottawa County CAA

The results indicate that Ottawa County's weatherization clients consumed more natural gas prior to weatherization than was typical of gas-heated homes weatherized by other agencies in the cold climate region. This is the case even though the Ottawa County area has fewer heating degree days (6,569 HDD) than the cold region as a whole (7,616 HDD).

Table 3.1 PRISM Model Parameters for Ottawa County Community Action Agency

	Intercept (ccf/Day)	Heating Slope (ccf/°F Day)	Temperature Dependent Use (ccf/Year)	R^2	Reference Temperature (°F)
WEATHERIZED GROUP (N = 38)					
Pre-Weatherization	0.92 (0.61)	0.20 (0.03)	1210 (164)	.87	63.94 (6.02)
Post-Weatherization	0.74 (0.50)	0.17 (0.02)	971 (133)	.92	62.67 (5.73)

On average, the 38 weatherized dwellings had an annual gross savings of 291 ccf, for a 19.0% reduction in consumption. This is more than twice the annual gross savings of 131 ccf (10.5%) for the cold region, and gives this agency one of the highest levels of savings in the cold region. Because the control group in the cold region increased its consumption by 69 ccf in PY 1989, the net (or control-adjusted) savings were a good deal higher: 360 ccf (23.5%) for Ottawa County dwellings and 200 ccf (16.0%) for other agencies in the cold region.

As Fig. 3.5 illustrates, very few of the dwellings weatherized by Ottawa County CAA consumed more gas after weatherization than before. This pattern along with a very high average savings justifies Ottawa County CAA's weatherization program selection as a high performing agency in its climate region.

In addition to their higher-than-average gas savings, dwellings weatherized by Ottawa County CAA also had higher-than-average on-site installation costs. On average, $1,219 in materials and labor were spent on each dwelling weatherized by the agency during PY 1989. This compares to an average installation cost of $983 for agencies in the cold region. It is estimated that an additional $500 is spent in installation-related overhead and management costs, per dwelling, for both the Ottawa County CAA program and the cold region as a whole.

These costs combined with this agency's higher energy savings result in a "worst case" benefit/cost ratio of 1.95 for the Ottawa County CAA weatherization program compared to a benefit/cost ratio of 1.05 for the cold region. These benefit/cost ratios are a "worst case" estimate because they reflect only the value of reduced gas consumption but include all costs (this is defined in Brown, et al. 1993 as the "program perspective"). If the estimated $976 of nonenergy benefits such as increased employment and reduced environmental damages are also included (defined by

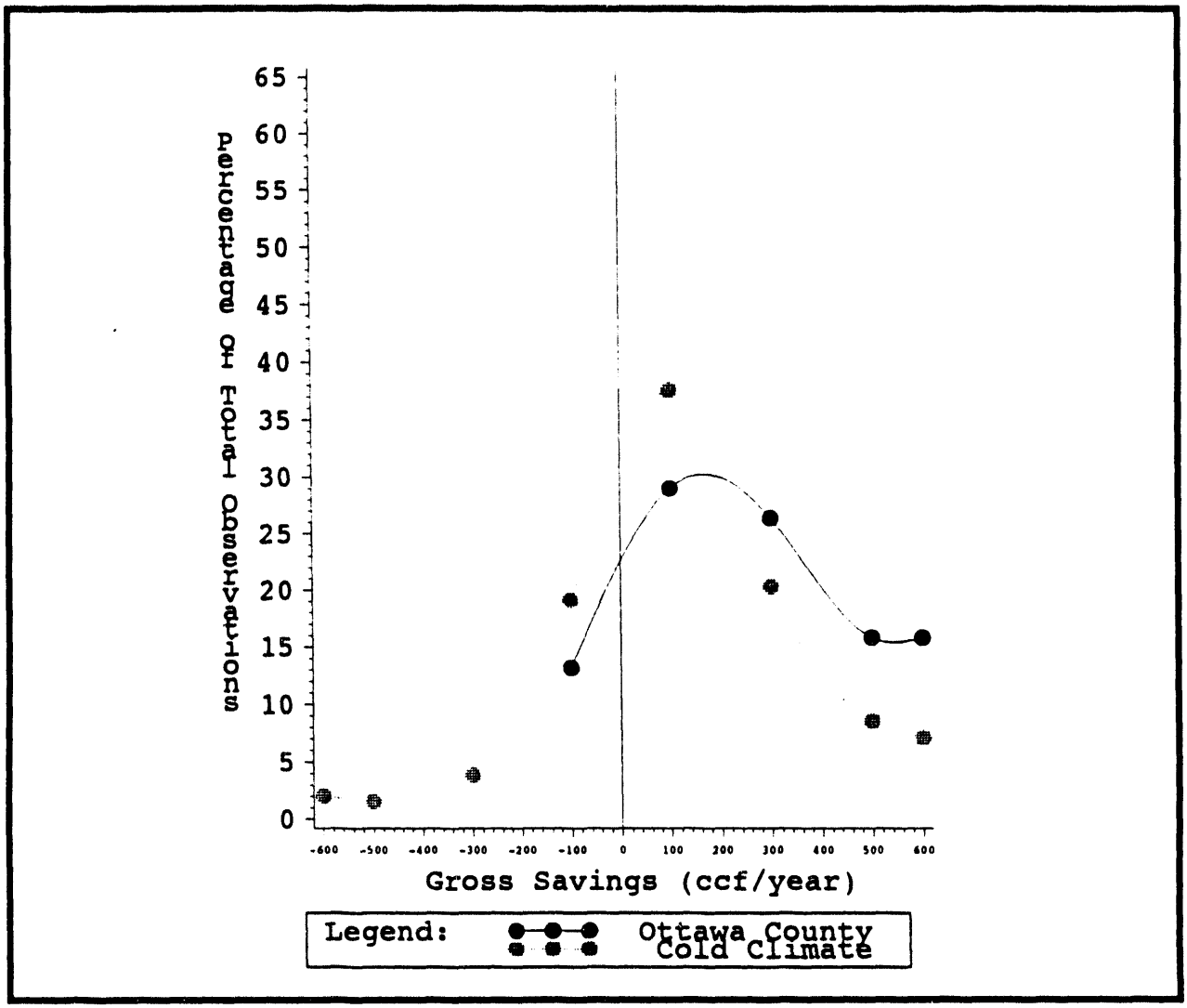

Fig. 3.5 Distribution of Savings in Dwellings Weatherized by the Ottawa County CAA vs. Cold Region

Brown et al. 1993 as the "societal perspective"), the benefit/cost ratio increases to 2.51 for Ottawa County and 1.75 for the cold region. Thus, the cost effectiveness of the Ottawa County CAA program clearly exceeds that of the cold region (Fig. 3.6).

3.7 MONITORING AND EVALUATION

No formal evaluations or measurements of energy savings have been conducted by the agency. State monitors check weatherization jobs and recordkeeping about every six months.

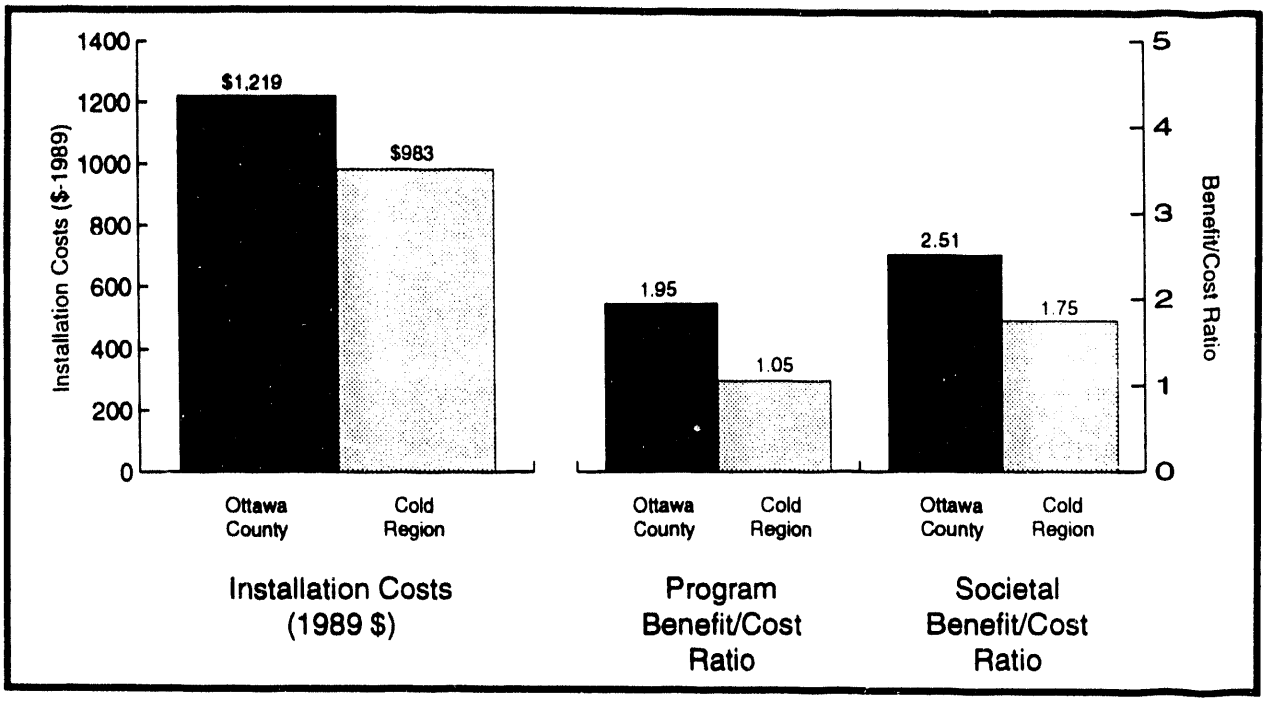

Fig. 3.6 Cost Effectiveness of Ottawa County Program vs. Cold Region

3.8 REASONS FOR SUCCESS

The careful selection of contractors and these contractors' extensive experience and training probably accounted for much of this agency's success. The high installation rates of wall insulation, and the strong effort to invest as much of the available money as possible in energy conservation measures instead of in repairs, were probably important factors as well. This agency did not use highly advanced audit techniques, but it did make extensive use of blower doors for identifying air leakage areas for sealing. It also strove to ensure high quality in all of its installations, inspecting all of its weatherization jobs and requiring correction of any problems before contractor payment. The frequent and effective communication between the auditor/inspector and the installation contractors is another key factor in this agency's success. An additional factor is the relatively good condition of the housing stock being weatherized in this area. Because the Program-eligible dwellings are generally in good condition, it is possible to do a complete job of weatherizing and tightening them.

Today, this weatherization program may be producing even better results than in PY 1989. Since 1989 a stong client education component has been added to the program, involving two personal counseling sessions (one at the intake interview and one at the post-weatherization inspection) and attractive printed materials which are given to the client (Photo 3.3). In addition, more federal, State and local housing rehabilitation funding is now being used in conjunction with the weatherization funds.

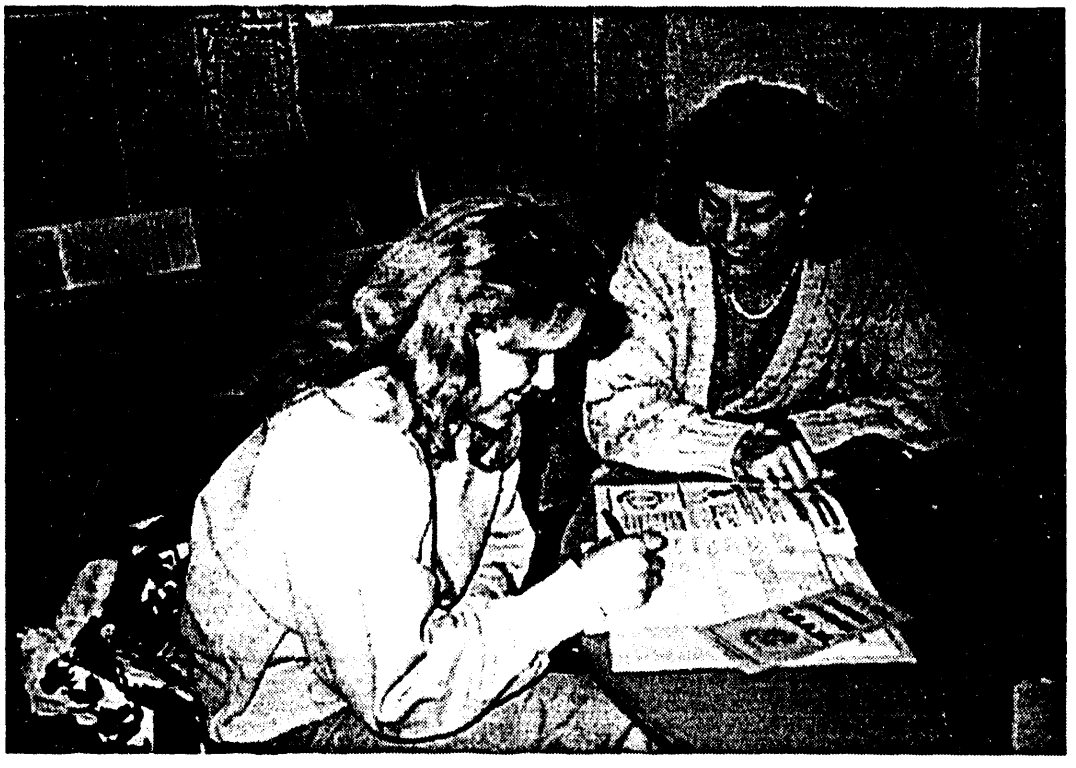

Photo 3.3 Client education is now an important part of weatherization services.

II. MODERATE CLIMATE REGION

II. MODERATE CLIMATE REGION

The five high performers in the moderate region significantly outperformed the sample of 49 agencies that represent the baseline for that region (Table II.1). The three high performers spent essentially the same per weatherization job ($1,473 vs $1,533), yet they reduced gas consumption by nearly twice as much (430 ccf/year, on average, for each weatherized dwelling compared to 222 ccf/year for the 49 agencies). These savings represent a 37% reduction in [illegible] heat (and a 26% reduction in total gas use) over pre-weatherization consumption le[illegible]erformers, and a 23% (and 16%) reduction in gas use for the 49 agencies region-wide. T[illegible]ffectiveness of the high-performing programs greatly exceeds that of the cross-section of 49 agencies, based on both the "program" and "societal" benefit/cost ratios.

Table II.1 Performance Indicators of the Moderate Climate Region

	5 High Performers	49 Agencies
Pre-weatherization Normalized Annual Consumption (in ccf/year)	1644	1392
Gross Gas Savings (in ccf/year)	385	177
Net Gas Savings (in ccf/year)	430	222
Net Gas Savings as a Percent of Gas Use for Space Heat	36.8%	22.5%
Net Gas Savings as a Perce of Total Gas Use	26.2%	15.9%
Installation Costs (in 1989 $s)	$973	$1,033
Total Costs (in 1989 $s)	$1,473	$1,533
Program Benefit/Cost Ratio	2.59	1.43
Societal Benefit/Cost Ratio	3.26	2.09

Table II.2 shows that the measure installation rates for dwellings weatherized by the five high performers in the moderate region differ from the installation rates of the sample of 49 agencies in the moderate region. In addition, the nature of these differences is generally consistent with the patterns described in the executive summary. The five high performers installed much more first-time attic insulation, wall insulation, furnace replacements, and hot water heater measures than is true of the regionwide sample of agencies. In contrast, the five high performers installed fewer storm windows. They also repaired more windows and conducted more air sealing with blower doors, which

are differences that were not true of the national sample of high performers. On the other hand, these "atypical" differences in the moderate region are not large.

Table II.2 Characteristics of Weatherized Dwellings, Occupants, and Measures Installed by Agencies in the Moderate Climate Region

Dwelling and Occupant Characteristics of Clients Served in Program Year 1989	5 High Performers	82 Agencies
Dwelling Type (percent):		
Single-Family Dwellings	71	68
Mobile Homes	6	12
Small Multifamily Dwellings	23	20
Age of Dwellings (years)	56	46
Area of Heated Space (square feet)	1,219	1,214
Central Heating Systems (percent)	94	88
Supplemental Heating Fuel (percent)	11	23
Occupants per Dwelling	2.7	2.9
Elderly Occupants (percent)	41	26
Household Income (in 1989 $s)	8,436	7,678
Owner-occupied Dwellings (percent)	63	54
Measures Installed (percent of dwellings that received measure)	**5 High Performers**	**82 Agencies**
Attic Insulation (first-time)	40	30
Attic Insulation (added to existing)	28	25
Wall Insulation (normal density)	51	30
Wall Insulation (high density)	0	2
Floor Insulation	6	13
Air Sealing with Blower Door	27	22
Furnace Cleaned and/or Tuned-up	34	35
Furnace Replacement	4	3
Hot Water Tank Insulation	61	51
Hot Water Pipe Insulation	82	37
Low-Flow Showerheads	8	6
Water Temperature Setback	50	19
Storm Windows	29	32
Window Repair	60	54

4. COMMUNITY ACTION AGENCY OF COLUMBIANA COUNTY LISBON, OHIO

by Dennis L. White

4.1 THE AGENCY AND ITS SERVICE AREA

4.1.1 The Agency

The Community Action Agency (CAA) of Columbiana County provides weatherization services, energy assistance, and other services for low-income families in an homogeneous rural county in northeastern Ohio near the Pennsylvania border, approximately one hour by automobile from Pittsburgh. The CAA operates a medium-sized weatherization program, having weatherized 209 housing units in PY 1989. DOE funding accounted for 58% of the 1989 PY budget, while the balance of $266,000 budget came from weatherization services in the U. S. Department of Health and Human Services (HHS).

4.1.2 Agency Goals

The CAA directs its efforts to the attainment of two major goals: (1) assist clients and (2) improve opportunities for economic development and create jobs. Weatherization is a mechanism by which the CAA can attain its two major goals. The weatherization program is one of six major programs administered by the CAA (Fig. 4.1), which cover a wide range of client needs including nutrition, health services, transportation, and employment.

All energy and housing related programs such as HEAP, Weatherization, Homeless and Home Repair are administered under one energy department with 15 employees. The programs work together by making a comprehensive assessment of needs and linkage between the programs. After needs are identified, information and referral are provided and self-help is encouraged. It is not uncommon for a person to prevent the disconnection of utility services by applying for emergency utility assistance under HEAP and stopping by the Weatherization office to request a long term solution to ease the financial burden of energy bills through weatherization. This one-stop approach not only provides for comprehensive services but also is appreciated by the clients.

If the estimator or crews discover repair work that needs to be done that is not within the scope of the Weatherization Program, a notation is made in the client file and the energy coordinator will make referrals and provide information on available resources, some of which are other programs operated by the energy department.

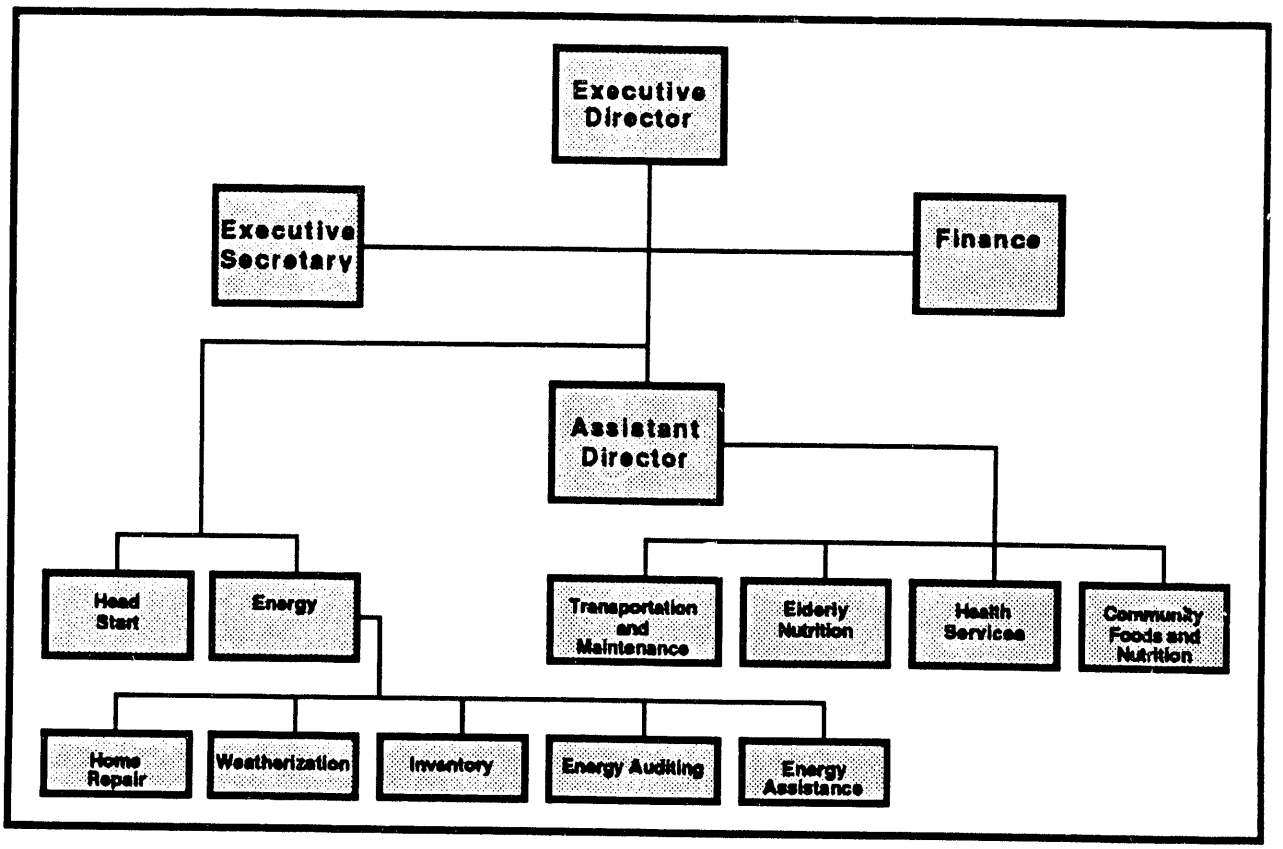

Fig. 4.1 Organization Chart of Columbiana County Community Action Agency

4.1.3 The Housing Stock

The housing stock in the CAA service territory has a higher savings potential than the type of housing most often weatherized in the moderate climate region (Fig. 4.2). Single-family detached housing units make up more than 90% of the gas-heated weatherization houses in Columbiana County compared to 68% in the climate region. In PY 1989, only 20% (one in five) of CAA weatherized houses used a supplemental heating fuel. Consequently, few participating households had the option of "taking back" some of the potential gas savings by relying less on supplemental heating fuels and more on natural gas. In contrast, one in four homes weatherized in the moderate climate region used a supplemental heating fuel. Finally, the homes weatherized by the CAA are relatively old, averaging 74 years, but they are also structurally sound compared with the low-income housing stock served by many other agencies.

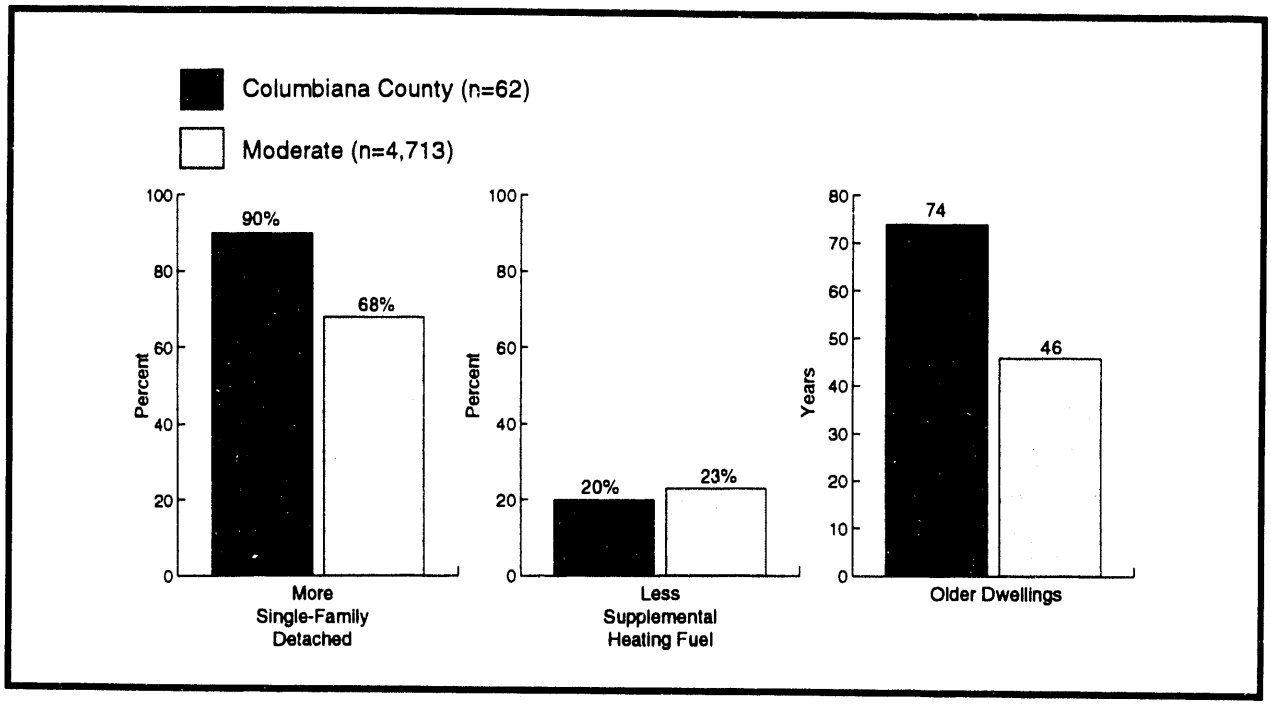

Fig. 4.2 Characteristics of the Housing Stock Weatherized by the CAA of Columbiana County

4.2 WEATHERIZATION STAFF AND TRAINING

4.2.1 Weatherization Staff

Except for furnace work, which is contracted, all weatherization work is done by in-house crews. The wage scale for crew members, both entry-level and veterans, compares favorably to local market scale, up to more than $9.00/hour for laborers and more than $12.00/hour for crew chiefs and estimators.[1] The CAA considers itself an employer as well as a service agency.

The current Energy Coordinator (i.e., weatherization program director) has served in the position for the last six years, having served in a number of capacities at the CAA for 16 years. There are two four-person crews, which consist of a crew chief and three technicians/laborers per crew. An estimator and inventory clerk complete the weatherization staff.

The use of contractors is limited to furnace work. Contractor selection and supervision have been systematic. The CAA advertises the program and then requests bids according to the State contract. When bids are received, certificates of insurance are reviewed, and a formal check on the contractor(s) is made with the Better Business Bureau. Once work has been completed, the estimator validates the work before the contractor is paid. The estimator verifies furnace work and conducts blower door tests. The contractor must guarantee its furnace work for 12 months.

[1] The CAA estimator has responsibilities and performs duties that are similar to another agency's auditor or inspector.

Just recently, the CAA has begun to interview applicants for furnace work, so that the CAA can use crews for all weatherization work. The CAA continues to centralize more of the weatherization work in order to maintain responsiveness and efficiency, and minimize costs. Furthermore, the CAA believes that more direct management of services (by using crews) enhances its ability to conduct quality assurance.

4.2.2 Training

The training of CAA weatherization staff is extensive. The Corporation for Ohio Appalachian Development (COAD), the State's central training facility in Athens, Ohio, has conducted all State sponsored training since 1991. (Previously, the Ohio Association of Community Action Agencies maintained a training center in Columbus, although the facility was not as sophisticated as the COAD facility in Athens.)

Each year, Ohio conducts a training needs survey. COAD develops a training calendar from the survey. Because the COAD training center is a leading edge facility, much of the training is conducted at COAD. Nonetheless, agencies like the CAA may request local and on-site training, which COAD usually obliges. There are also contingency plans for emergency situations and for training on new technologies, when waiting 12 months or more would adversely impact weatherization efforts. The heating unit replacement training is a good example of contingency training. The CAA technician was unable to attend the training at the COAD facility due to an illness in the family so COAD arranged to conduct training for the CAA in houses in Columbiana County.

The CAA requires additional training on the blower door and window replacements among other topics as necessary. CAA conducts monthly crew meetings. More training is being conducted at the job site, in order to minimize the negative impact on production. About 40% of the original blower door training conducted by COAD since 1986 has been done on-site.

The agency estimator receives training in heating unit repair. Since furnace work is done by contractors, the contractors must comply with the State model heating system contract established in 1985.

CAA crew members are highly experienced both as weatherization technicians in the CAA and as builders/laborers in structural repair in the residential sector. The CAA has been using blower doors since 1986--three years before Ohio required them--and the agency was one of the first to insulate ducts. Formal training on blower doors and duct insulation is now provided by COAD.

The wage scale for crew members, both entry-level and veterans, compares favorably to market scale, up to more than $9.00/hour for laborers and more than $12.00/hour for crew chiefs and estimators. The CAA considers itself an employer as well as a service agency.

The current Energy Coordinator (i.e., weatherization program director) has served in the position for the last six years, having served in a number of capacities for 16 years. Most of the crew

members have some construction background. The individual crew members and the crew teams are dedicated workers as evidenced by their low absenteeism and their high level of camaraderie. The crews balance their focus between productivity and quality.

4.3 CLIENT RECRUITMENT AND SELECTION PROCEDURES

The CAA recruits clients for the Weatherization Assistance Program through cooperative efforts with other county agencies including human services and the local office on aging, senior citizens networks, and newsprint articles. In addition, the Emergency Service Providers Coalition meets monthly and serves as an informal network for recruiting clients. Typically, there are approximately 100 to 150 clients on the waiting list for weatherization services at any one time, representing approximately four months of work. Most recently, the waiting list has doubled in length, with the extra clients living primarily in manufactured housing.

The CAA prioritizes the waiting list according to Ohio goals; public announcements and other publicity are conducted in ways that inform potential clients who are in the most need of energy and weatherization assistance. Priority is given to the elderly and persons with disabilities; the CAA stipulates that weatherization work will be completed in six months. The CAA also receives referrals from Columbia Gas's Warm Choice Program, which targets households who are on the utility's Percentage of Income Payment Plan and have high arrearages.

Of all the eligible applicants for weatherization services, only about one in 100 houses cannot be weatherized until extensive roof repairs are done. These households are referred to other programs or resources for the necessary repairs before weatherization can be performed. Generally, weatherization jobs are assigned on a first come, first served basis, except subsidized units are given lower priority. Dwelling units made of brick and units whose attics or sidewalls cannot be insulated are excluded. In other words, if the housing unit is already as energy efficient as it can reasonably expect to become, weatherization is not seen as a cost-effectiveness means to reduce energy use or utility bills.

The average age of the housing stock in the county is about 70 years. The great majority of the stock is two-story, single-family detached, with approximately 1,250 square feet of living space, most of which is heated and cooled.

Since 1989 and in the future, the CAA will modify its client selection procedures in order to take advantage of economies of scale. For instance, selection and outreach will focus on large dwellings, wherein retrofit work will benefit from gains in time dedicated to work rather than travel. The CAA will also target more of the multifamily audience. Also, high energy users will be assigned a higher priority for weatherization. The CAA will prioritize its weatherization jobs according to the priorities on HEAP and PIP lists and based upon referrals from Columbia Gas.

4.4 USE OF DIAGNOSTICS

The estimator's almost 30 years experience in construction and four years with the CAA enhances the use of diagnostic equipment such as the Bachrach furnace test, which has been used by the agency since 1983 and the blower door, which has been used since 1986.

The blower door is used during the audit to determine the level of air leakage. It is also used during the inspection to estimate the change in air leakage after weatherization.

4.5 INSTALLATION OF MEASURES

4.5.1 Selection of Weatherization Measures

The CAA is required to apply weatherization measures that are prioritized in order of cost-effectiveness for each standard housing type or according to Project Retrotech for other than standard housing. The CAA augments the audit (the Building Check and Job Order Sheet or BCJOS) with blower door tests. All dwelling units receive air leakage sealing.

The CAA operates its Weatherization Assistance Program in accordance with Ohio Program Standards, which have been enumerated in *Minimum Weatherization Program Standards*. The third edition of the standards applied to PY 89, the fourth edition was adopted in April 1991. Audit and retrofit guidelines are established in the State standards. The CAA does the vast majority of the weatherization work with in-house crews; the furnace work is done by a few experienced contractors. The CAA believes its inspections are strict.

Since 1989, the Ohio Program Standards have been revised one time. Selection procedures and weatherization have become more technical. In addition, the CAA has begun to concentrate on the nonenergy impacts of weatherization, e.g., comfort, health, and safety. As energy professionals are becoming increasingly concerned about indoor air quality (IAQ), COAD remains active in the energy and environmental community in order to maintain current knowledge about new technologies, especially those that help to identify and mitigate air quality problems. For instance, COAD and the West Virginia energy office co-sponsored a peer review conference, which included representatives and weatherization professionals from Ohio, West Virginia, Kentucky, and Pennsylvania.

4.5.2 Rates of Installation of Weatherization Measures

Weatherization jobs by CAA are thorough (Fig. 4.3). The CAA exceeded average installation rates in the moderate climate region on original attic insulation; added attic insulation; normal wall insulation; water tank insulation; and water pipe insulation. In more than one-third of the dwellings they serve, the agency adds insulation to attics that have inadequate existing insulation (Photo 4.1). Weatherization participants in the CAA area also reduced water heater thermostats after weatherization

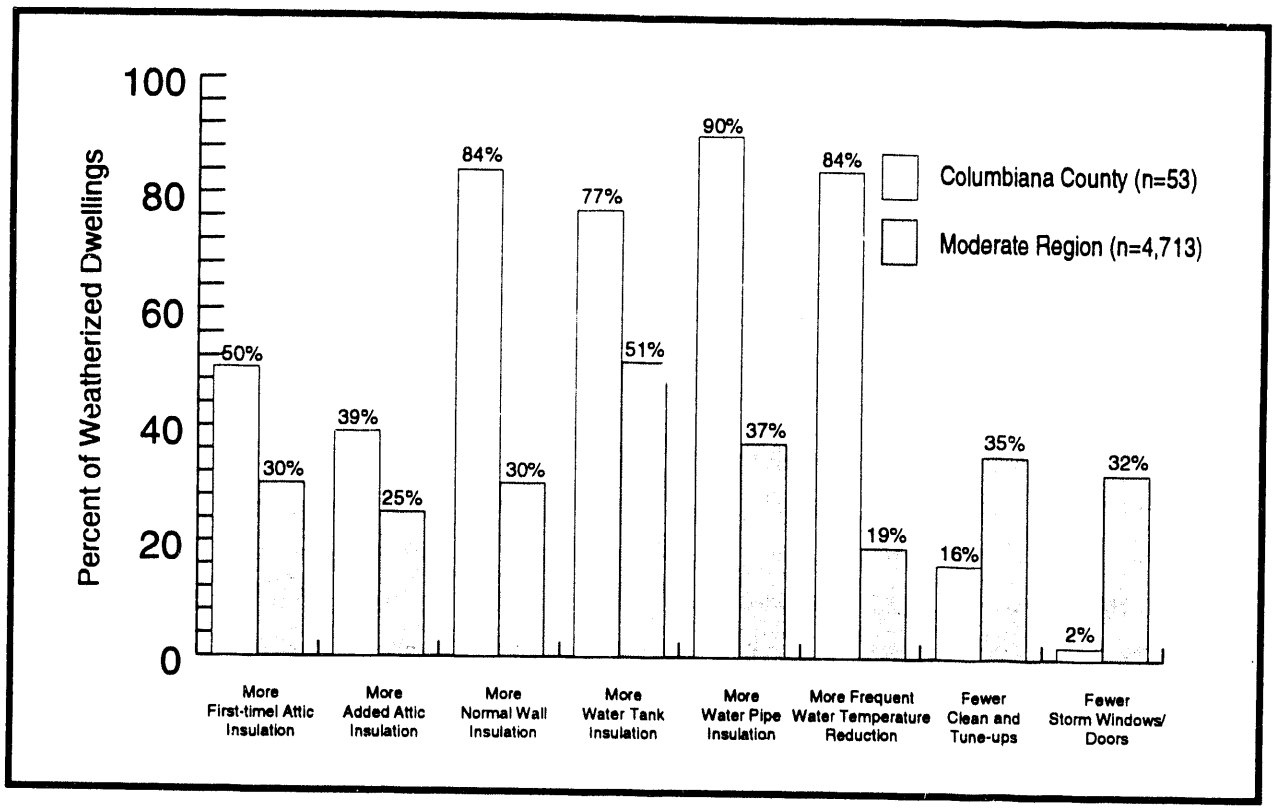

Fig. 4.3 Installation Rates for Selected Weatherization Measures Installed by the CAA of Columbiana County

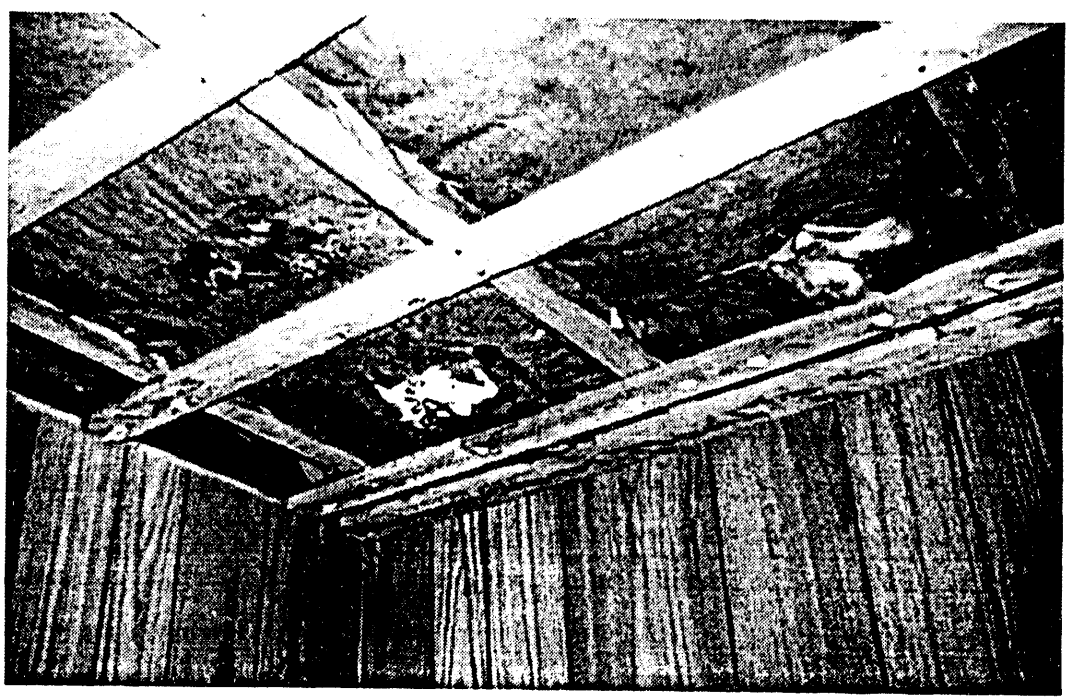

Photo 4.1 Pre-existing attic insulation is often inadequate.

at a rate almost five times the regional average. The CAA may have been one of the first local weatherization programs to seal and insulate ducts. In contrast, the CAA conducted furnace cleaning and tuning, and installed interior storm windows and storm doors at much lower rates than the regional average: 10% versus 35% for furnace cleaning and tuning and 2% versus 32% for storm windows and doors.

4.5.3 Client Education

The Weatherization Program has a formal client education component that involves on-site education by the estimator. (Copies of the client education forms the State provides are shown in Appendix G.) Applicants for weatherization are asked to fill out a questionnaire regarding their energy behavior habits. From this the estimator can suggest ways to increase energy savings that are low or no cost. Some examples are: changing furnace filters monthly; using cold water to wash clothes; and turning down the thermostat when away from home. The person then is asked to sign a partnership plan to carry out the suggestions that have been made. Follow-up contacts are made approximately six months after the weatherization work has been completed to see if they have followed the plan.

4.5.4 Materials Procurement

The CAA purchases most of its materials in large quantities at the beginning of the calendar year, based upon the previous year's activity. Approximately a three-month inventory of other materials is warehoused. The CAA has established contingency procedures for purchasing materials. The crews maintain "truck stock," weatherization material that is planned for use or anticipated for use under contingency plans and that is stored on the crew vehicles. During site work, the crews or contractors have sufficient autonomy to get the job done, which may include the purchase of additional weatherization materials, provided the deviation from the job plan actually promotes CAA objectives.

4.5.5 Quality Control

An emphasis on quality pervades all operations of the CAA. Explicit quality control procedures include inspecting all jobs, surveying client satisfaction (see Appendix G), random telephone checks on crews and contractors, and site visits by the Energy Coordinator.

The lack of bureaucratic hassles in the Weatherization Program at CAA makes it easier to get things done. The CAA has a very informal management structure which can respond to issues and problems quickly. Lines of command are clear and emphasis is placed on the importance of communication between staff members. Regular monthly meetings are held for all Home Weatherization Assistance Program staff persons to receive input and discuss problems and obstacles

to getting the job done. The CAA strives to convey that each staff person is part of the "team" and the part they play in the whole process is equally important to the end result. In addition, the agency's good wages attract professional people and help maintain staff morale.

Finally, clients are educated about the purpose of the program, before crews arrive, so that they don't have unrealistic expectations.

4.6 LEVERAGING AND COOPERATIVE EFFORTS

By operating the Weatherization Assistance Program, the CAA has the capacity to undertake other similar activities such as the Columbia Gas utility sponsored weatherization program called Warm Choice, the State Subsidy Home Repair Program for seniors over age 60 and Project P.R.I.D.E., a revolving loan program in conjunction with the Columbiana County Bankers Association which offers no interest loans to seniors for home repairs.

By generating other housing related dollars, the CAA can reduce the impact of budget cuts by the Weatherization Assistance Program. For example, equipment and vehicles owned by the Program but not currently in use due to funding cutbacks are used by these other programs who in turn reimburse the Program for their use.

4.7 COSTS AND SAVINGS

Weatherization costs in PY 1989 (excluding overhead and management costs) were similar to the climate region average, $1,000 versus $1,033 for the moderate climate region. This is despite the fact that the agency installs many more measures per dwelling than the typical cold climate program. Several cost-saving measures enable this extensive work.

Crew laborers report directly to the job site; they don't go to the office just as a formality. Crew chiefs take CAA vehicles home with them. Both of these actions reduce transportation costs and improve efficiency. Bulk purchases reduce the cost of materials. Finally, staff concentrate on reducing paperwork and take applications for weatherization and other CAA services by phone.

On average, CAA's participants consumed considerably more gas before weatherization than the weatherization participants of other agencies in the moderate climate region. They also saved more than twice as much gas after weatherization. Homes weatherized by the CAA reduced their gas consumption by 499 ccf or 30% of their pre-weatherization gas use (Table 4.1 and Figs. 4.4 and 4.5). The average participant household in the same climate region reduced its gas use by 177 ccf, or 13% of their pre-retrofit gas, after weatherization. These estimates represent gross savings. When the increased consumption of the control group is considered, the net savings for the moderate climate region increases to 222 ccf/year or 16%. A similar control group adjustment could also be made to estimate the CAC program's net savings, which would increase from 499 ccf (gross) to 544 ccf/year (net).

Table 4.1 PRISM Model Parameters for the CAA of Columbiana County

	Intercept (ccf/Day)	Heating Slope (ccf/^{o}F Day)	Temperature Dependent Use (ccf/Year)	R^2	Reference Temperature (^{o}F)
WEATHERIZED GROUP (N = 43)					
Pre-Weatherization	0.67 0.99	0.24 (0.03)	1505 (347)	.90	64.7 (7.41)
Post-Weatherization	0.77 0.92	0.20 (0.04)	962 (230)	.80	65.7 (18.23)

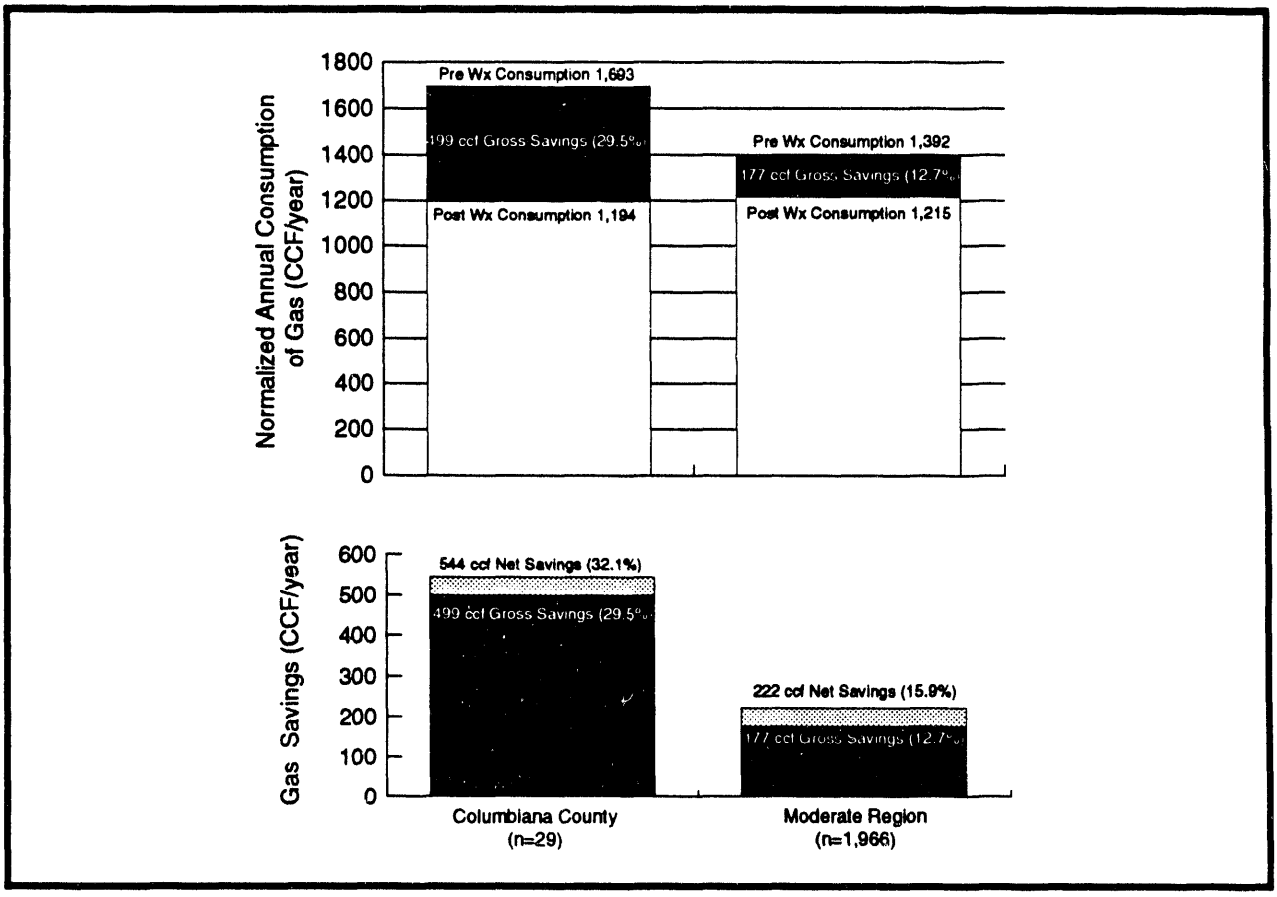

Fig. 4.4 Normalized Annual Consumption and Savings of Dwellings Weatherized by the CAA of Columbiana County

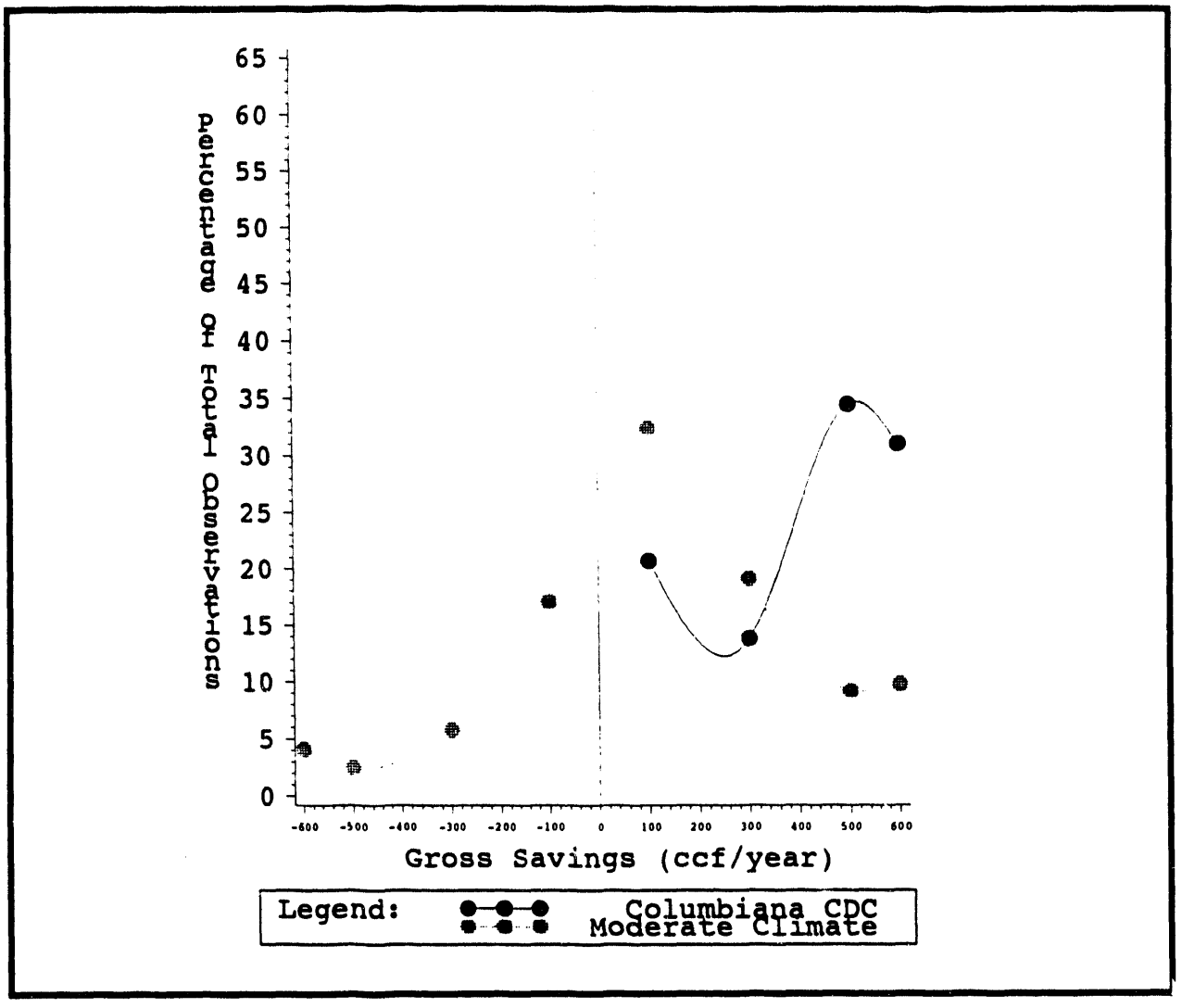

Fig. 4.5 Distribution of Savings of Dwellings Weatherized by the CAA of Columbiana County

The program benefit/cost ratio was 3.36 in the CAA program, an improvement of 135% over the program's benefit/cost ratio of 1.43 (Fig. 4.6) for other agencies in the moderate climate region. The societal benefit/cost ratio in the CAA program was also larger than the regional value, 4.02 versus 2.09.

4.8 MONITORING AND EVALUATION

All jobs are inspected. Bachrach testing is done on all furnace jobs. A second blower door is done within one month of weatherization. The CAA has not had the resources to evaluate its weatherization program, by analyzing pre- and post-weatherization energy use.

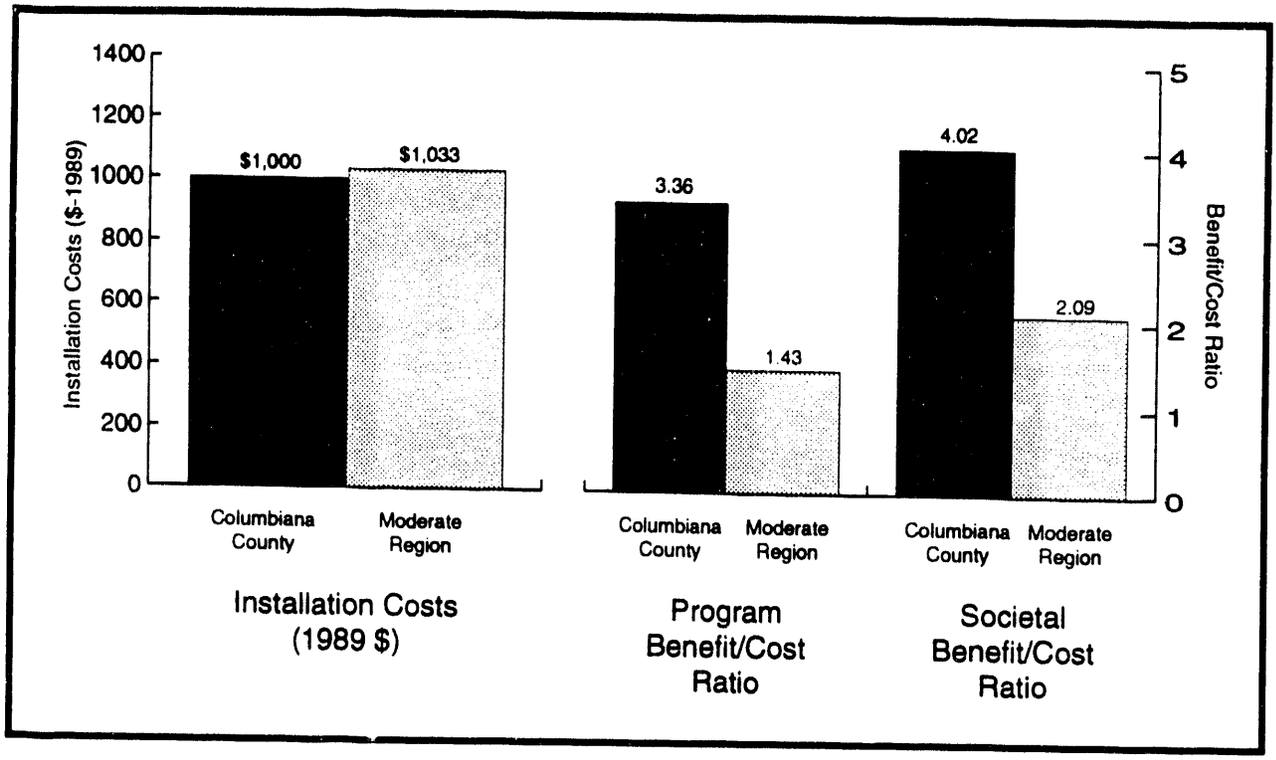

Fig. 4.6 Costs and Benefit/Cost Ratios for Dwellings Weatherized by the CAA of Columbiana County

4.9 REASONS FOR SUCCESS

The housing stock weatherized by the CAA has a high potential for cost-effective energy savings. In addition, the weatherization jobs tend to be comprehensive, involving much more insulation and water heater work than is typical of the moderate climate region. Extensive weatherization training may be another reason for the agency's successful performance. Finally, access to a variety of funding sources other than DOE allows the Weatherization Program's resources to have a greater impact on energy savings than would be possible otherwise.

5. ENERGY CONSERVATION ASSOCIATION DENVER, COLORADO

by James O. Kolb

5.1 THE AGENCY AND ITS SERVICE AREA

5.1.1 Agency History

The Energy Conservation Association (ECA) was founded in 1982 as a private, not-for-profit, community-based organization. ECA became the DOE Weatherization Assistance Program subgrantee for the City of Denver in 1986. It provides weatherization services to the low-income and disadvantaged population of the City and County of Denver.

In 1989, the ECA underwent a major reorganization as a result of organizational problems. Ms. Patricia Gallegos became the Executive Director at that time. A 50% turnover in the non-supervisory staff had occurred although all technical supervisory staff were intact from 1986. A revised salary structure plus many other improvements were initiated in 1989 to stabilize the non-supervisory staff. The current turnover period for non-supervisory staff is two years.

Because of the change in Executive Directors of ECA in 1989, many changes occurred in the operation of the agency at that time. Therefore, 1989 became a key period in the evolution of the ECA's procedures and management approach.

The current Executive Director, Patricia Gallegos, has an interesting background for her leadership role in a weatherization agency. She studied engineering for one year, but then graduated with a major in Education. Next, she was involved in electrical contracting for residential construction, and then worked for the City of Denver managing its minority electrical contractors before becoming ECA's Executive Director.

In 1989, the ECA weatherized 690 homes of which 16% were multifamily units. DOE Weatherization Assistance Program funding in 1989 was $1,195,000, while LIHEAP provided $245,000 for furnace measures. Thus, a significant portion of weatherization funding came from non-DOE sources.

5.1.2 Housing Stock

The housing stock of the ECA is typically old (averaging about 50 years of age), small (averaging about 1,300 sq. ft. of living area), and generally in poor condition. The poor condition of the housing stock leads to the potential for highly cost-effective conservation measures for occupants that use normal amounts of energy. Other attributes of ECA's housing stock that contribute to higher energy savings than for the moderate climate region, in which the ECA is located, are shown in

Fig. 5.1. Denver also has 6,283 heating degree days, indicating a relatively cold climate and high heating energy use.

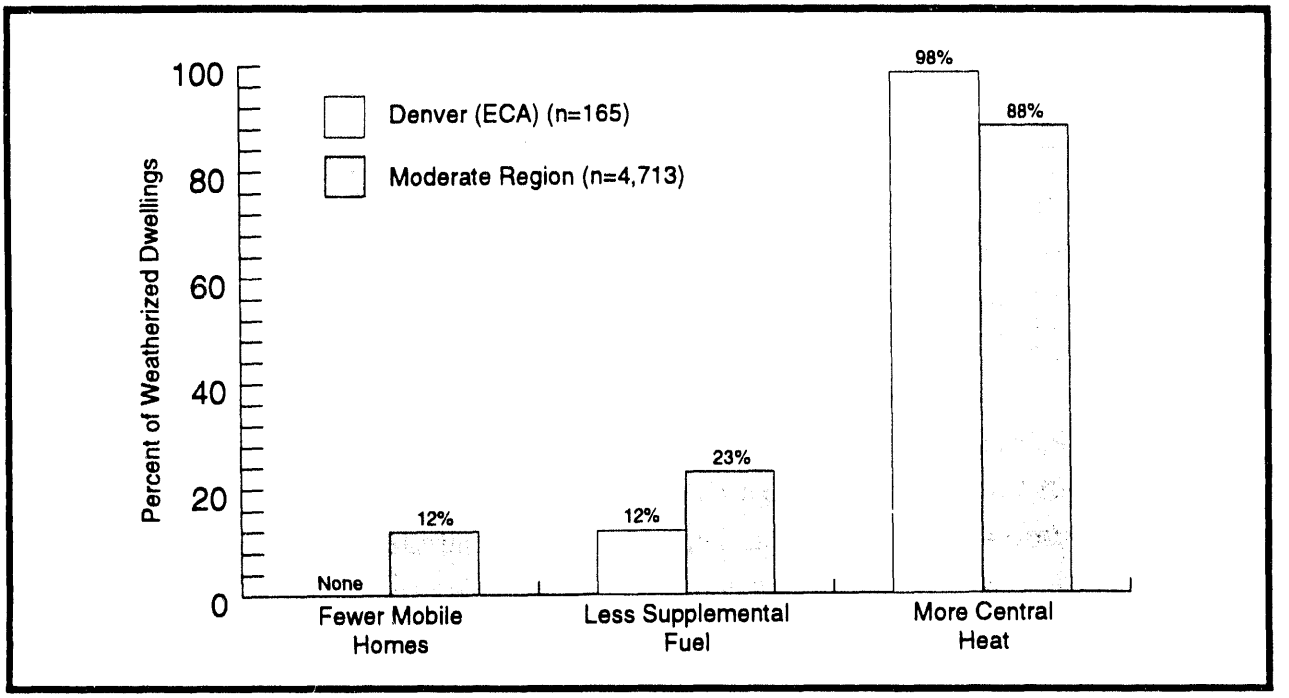

Fig. 5.1 Characteristics of Housing Stock Weatherized by the Denver ECA

5.2 WEATHERIZATION STAFF AND TRAINING

5.2.1 Management Philosophy and Approach

The management philosophy of ECA's Executive Director is pro-active for employee concerns in health and safety issues and professional advancement. The following employment policies for non-supervisory employees indicate this management approach.

1. New employees will receive training in applicable Occupational Safety and Health Administration and National Institute for Occupational Safety and Health safety standards.

2. After demonstrating adequate abilities, training in all weatherization areas - air sealing, auditing, envelope measure installation, inspection, and heating system diagnosis - will be provided to enhance employee's skills and value to the ECA.

3. Reward good performance with attendance at Affordable Comfort Conference (usually four crew members annually) or state or regional Weatherization Assistance Program training opportunities.

4. Select employees that are sympathetic to the needs of low-income clients, and can provide feedback to the ECA on client's needs and effectiveness of the ECA's services.

5. Involve employees in decision making on such issues as vehicle maintenance, safety, recycling, and outstanding employee awards.

In addition, the ECA places a high priority on producing substantial energy and cost savings for its clients. As a result, in 1989 the ECA established a goal of achieving energy savings averaging 20% for its clients. An evaluation procedure was initiated to test the effectiveness of ECA's Weatherization Assistance Program services.

5.2.2 Weatherization Staff

As a non-profit organization, the ECA is responsible to a Board of Directors through the Executive Director. The ECA is organized to provide weatherization services only, so the organizational structure is based on that function. Fig. 5.2 shows the organizational structure which divides the personnel into two primary functions, production and quality improvement. Altogether, the ECA had 27 employees in 1989 and a total budget of $1,454,000.

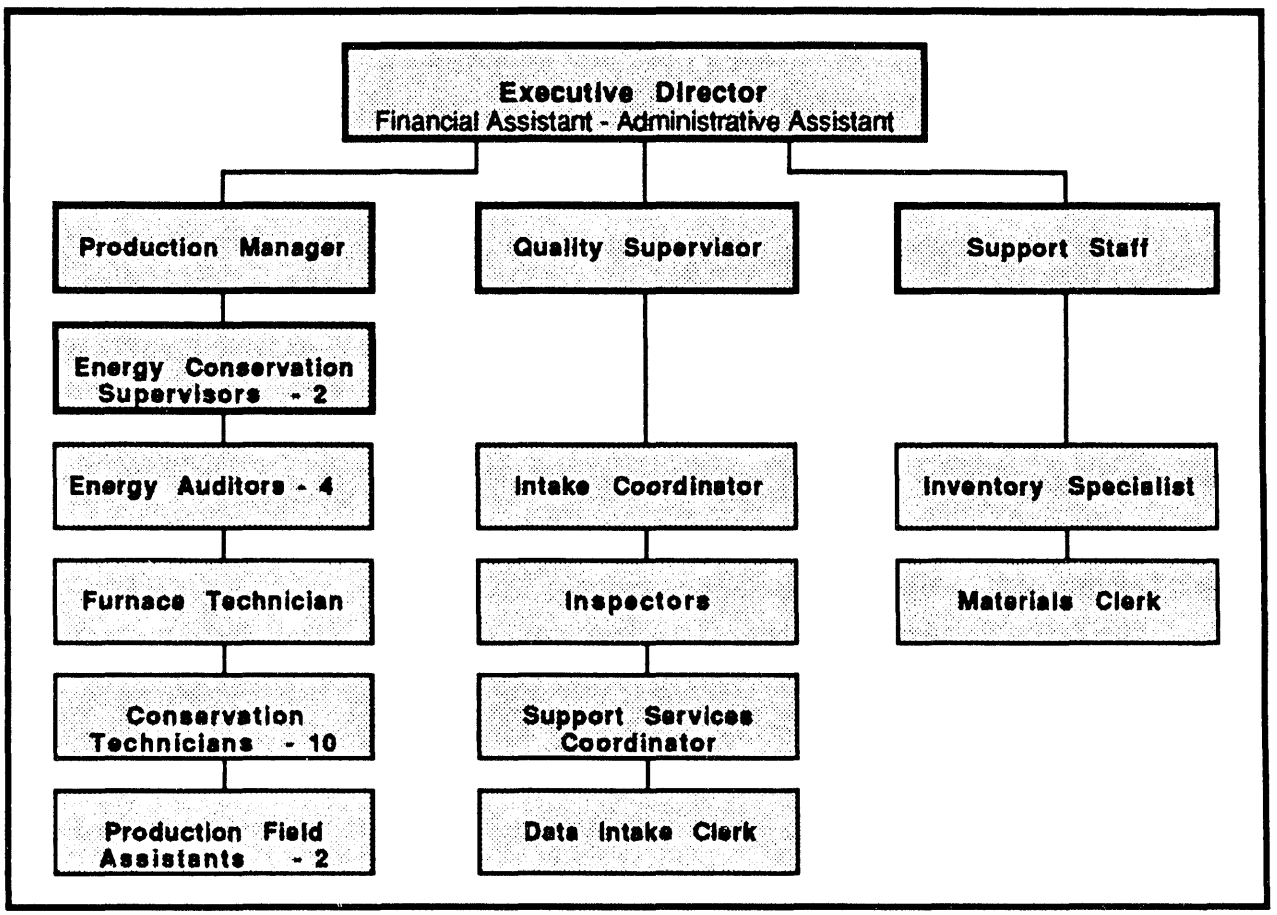

Fig. 5.2 Organization of the Energy Conservation Association in 1992

The ECA's main criteria in hiring weatherization crew members are 1) being able and willing to learn, 2) motivated to work for low-income residents, 3) motivated to use energy conservation technologies, and 4) can relate well to low-income residents.

As a result of these criteria, many crew members have not had extensive experience in building construction. However, the emphasis on the ability to learn has been very important because of the many new diagnostic techniques that are available and used by the ECA in its Weatherization Assistance Program.

Crews have been relatively stable since 1991-1992 with an average tenure of two years. The new Executive Director implemented several new incentives in 1989 to improve employee morale and reduce staff turn-over.

The ECA selects subcontractors annually for HVAC, electrical, and plumbing work based on being licensed and insured, relevant experience, cost competitiveness, and references - which are verified. The ECA believes that it has been able to obtain reliable and competent subcontractors through its selection procedure, which is an RFP that includes a cost proposal for a typical furnace replacement. Selected subcontractors are assigned to furnace replacements on a rotational basis.

5.2.3 Training

In 1989, the state provided state-wide training on blower door testing and furnace repairs (from Sunpower Associates). Additional training has been received from the state on client education. Training information also is received from attending the Affordable Comfort national meetings annually since 1986.

Weatherization crews have been trained locally by the Production Manager and Energy Conservation Supervisors. In addition to blower door testing, local training has been conducted on furnace safety (asbestos handling and CO monitoring of gas- and oil-fueled appliances), duct sealing, power tool use, health and safety, and client education.

The Executive Director emphasized the importance of training, especially at the local level. New staff members are trained by teaming experienced and new members in field situations. Using attendance at the Affordable Comfort Conference as an incentive for good staff performance is also effective for both motivation and improved technical competence. As more new diagnostic procedures are developed, training needs will increase. Therefore, training will need to be emphasized continually in the future.

5.3 CLIENT RECRUITMENT AND SELECTION

5.3.1 Client Recruitment

In early 1989, there was no waiting list for weatherization services, and over 90% of applicants were served. Clients were obtained primarily from income-qualified persons on the LIHEAP list. A marketing program was initiated in 1989 through newspaper articles, phone banks, and door-to-door contacts. A small waiting list was developed as a result of these activities.

By 1992, a waiting list of over 300 clients had developed, which is about a six month waiting period. Recruiting activities have been reduced because of the waiting list, but appearances continue to be made at public meetings. Also, the ECA has purchased new vehicles with magnetic signs on the doors, which has improved the visibility of the agency and increased the demand for weatherization assistance.

5.3.2 Client Selection

In early 1989, client selection was based entirely on house or occupant characteristics — low-income and either elderly, or handicapped. During 1989, the ECA began using utility bills of applicants as a consideration for selecting clients. By 1991, all applicant's bills were screened; the utility bill for electricity and gas had to exceed $300 for a three month period during the winter. Therefore by 1991, the selection criteria had changed to a combination of energy consumption and house or occupant characteristics. The reason for increasing the emphasis on energy consumption was to increase the potential for reducing utility costs from the weatherization measures.

Large multifamily buildings (> 5 units) have been included in the ECA's client base because a large number of moderate-sized, 2-3 story buildings with 10-20 units per building exist in Denver with adequate energy savings potential for weatherization services. The buildings recruited have individually heated gas furnaces and gas water heaters, and the occupant pays the gas utility bill. In 1989, 16% of ECA's clients lived in this type of building, and by 1991, the multifamily clients had increased to 25%. The ECA intends to keep the participation of this type of multifamily building client at the 20% level.

There are several reasons for selecting this type of multifamily building rather than larger high-rise type of building with a central heating system. First, the smaller buildings with 10-20 units require less staff time to gain the required approval of two-thirds of the occupants before approaching the building owner with a request for co-funding. Secondly, the ECA has gas furnace technicians to service small, individual unit furnaces. A large, central boiler type heating system would require the ECA to subcontract the heating retrofits out and thereby lose some control of the work.

The mobile home building sector is not represented in ECA's client base because there are few mobile homes in the city of Denver.

5.3.3 Client Feedback

Client feedback is obtained verbally from each client after completing the weatherization activities. In addition, clients are educated about the measures installed and their performance, and maintenance procedures are discussed for the measures installed. Energy conservation actions for the entire house are also discussed, and an energy conservation booklet is reviewed with the client and left for future reference. Information from the client evaluations are reviewed and kept with the client's file.

5.3.4 Agency Referrals

Approximately 15% of 1989 applications for weatherization were referred to other public assistance programs in Denver. The most frequent referrals were to the Emergency Home Repair Program and to the Crisis Intervention Program funded by the City of Denver. These same referrals are also part of the current program.

5.4 INSTALLATION OF MEASURES

5.4.1 Selection of Weatherization Measures

Energy audits are performed by the Energy Auditors of the Production staff. In 1989, a state-approved, ordered priority list was used that was evolved from the Project Retrotec audit procedure. The advantages of this procedure were that it was simple to use yet somewhat flexible in application. The auditor would select measures as the audit was performed, beginning with air sealing measures based on blower door testing. The disadvantages of this procedure were that the measures were prioritized based on state averaged costs for materials and labor which did not reflect local costs with reductions from volume purchases.

Another disadvantage of the state-mandated measure selection procedure in 1989 resulted from the fact that the priority list had essentially no input from local weatherization agencies. Instead a Technical Advisory Committee, with no representatives from weatherization agencies, had input to the state measure selection procedure.

By 1992, measure selection had been modified to an audit approach based on energy savings per dollar invested requiring a benefit-to-cost ratio greater than 2.0 for each measure. Instead of a set order for considering measures on the state-approved list, the auditor selects both envelope and HVAC measures on the basis of estimated cost effectiveness of each measure, using ECA's material and labor costs. This approach allows a more cost-effective selection of measures for a specific house and client.

The reason for changing the measure selection procedure between 1989 and 1992 was the desire of the ECA to make the measure selection procedure more technically correct by using local costs.

Another significant change in the audit procedure between 1989 and 1992 was in the procedure for performing air sealing using blower door testing. In 1989, only the auditor performed blower door tests to quantify the amount of leakage and identify the most prominent leakage locations, which were then sealed by crew members with no blower door test to observe the effectiveness of their efforts. A blower door test was performed by an inspector to verify that the air sealing performed was adequate. By 1992, the auditor still performed a blower door test but the weatherization crews also used blower doors to monitor air sealing progress using an economic criterion requiring a reduction of at least 50 CFM_{50} per hour. A final blower door test is still performed by the inspector.

In 1989, the level of non-overhead, weatherization expense allocated to a specific client was based on meeting a running average cost of $1,400/unit for DOE-funded, non-furnace repair measures. Furnace repairs from LIHEAP funds were allocated an average of $200/unit plus an additional $25 for furnace replacements.

By 1991, the level of DOE weatherization expenses was still based on an average cost per unit that was approved by the state Weatherization Assistance Program. However, the state approval was changed to a "state-wide average expense" approach.

5.4.2 Rates of Installation of Weatherization Measures

The ECA employs four crews to install all weatherization measures except measures requiring licensed personnel - i. e., furnace replacement. This approach has been selected by the ECA for several reasons. First, employee-based crews can be more accountable and more readily trained than subcontractors, leading to better quality control of measure installations. Secondly, weatherization can be performed more economically with ECA employees than with subcontractors.

Crew-Installed Measures. The most frequent measures used in 1989 were:

1) air sealing and infiltration reduction including attic by-passes as shown on Photo 5.1;
2) adding water heater wraps;
3) repairing doors and windows; and
4) adding attic insulation.

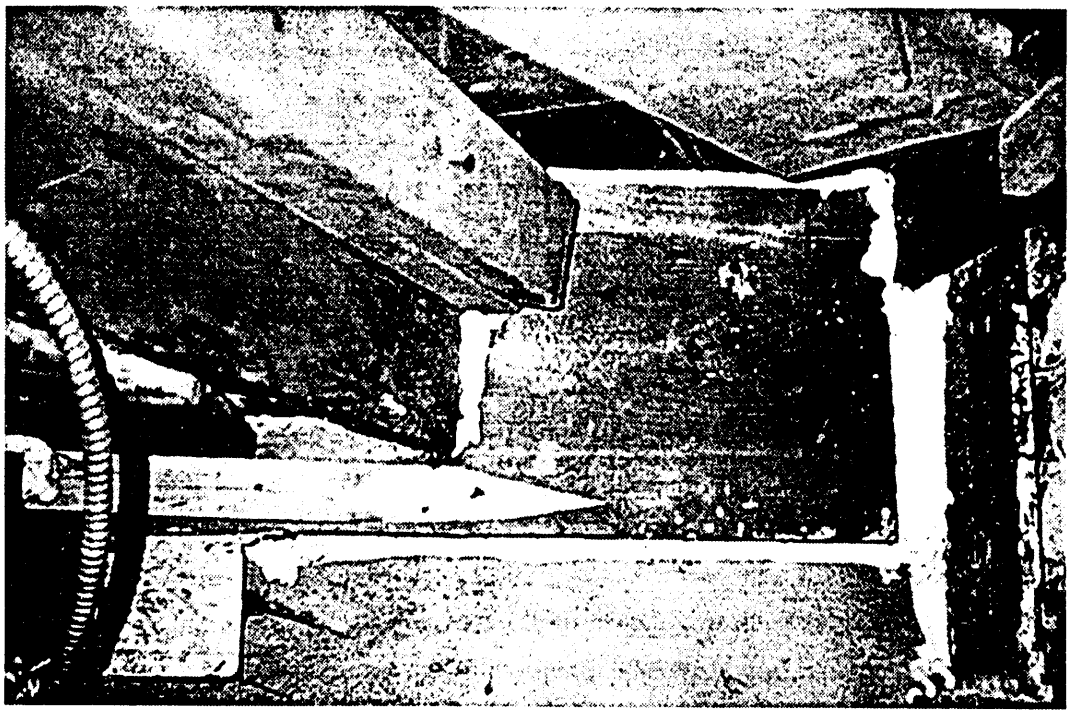

Photo 5.1 Infiltration Reduction Includes Attic By-Passes.

Other measures considered in 1989 were: wall insulation (normal density), low-flow showerheads, furnace tune-up, sealing duct leaks with aluminum tape, window and door replacement, and general repairs to the building envelope. Fig. 5.3 shows that the ECA performed furnace measures at a significantly higher rate than for weatherization agencies in the moderate climate region. Photo 5.2 shows a furnace that had a tune-up and had ducts repaired.

Interestingly, no storm windows or doors were used in this relatively cold climate because they were not as cost effective as other measures.

In 1989, air sealing was performed based on a blower door test by the auditor. As noted earlier, the use of blower door-guided air sealing by the weatherization crews was implemented between 1989 and 1992.

The measures that were added or modified between 1989 and 1992 are: high-density sidewall insulation, duct sealing with mastic and "fabglass" (the latest materials for duct sealing), zonal testing and pressure balancing, attic insulation to R-38 level, and cost-effective air sealing.

Material lists are reviewed by the crew supervisor before a crew receives a client assignment. Each crew has a truck that is stocked with all standard materials. When an unusual material need arises, only the crew supervisor has the authority to have the materials clerk order such materials. Therefore, crews have limited freedom in selecting materials for installing measures.

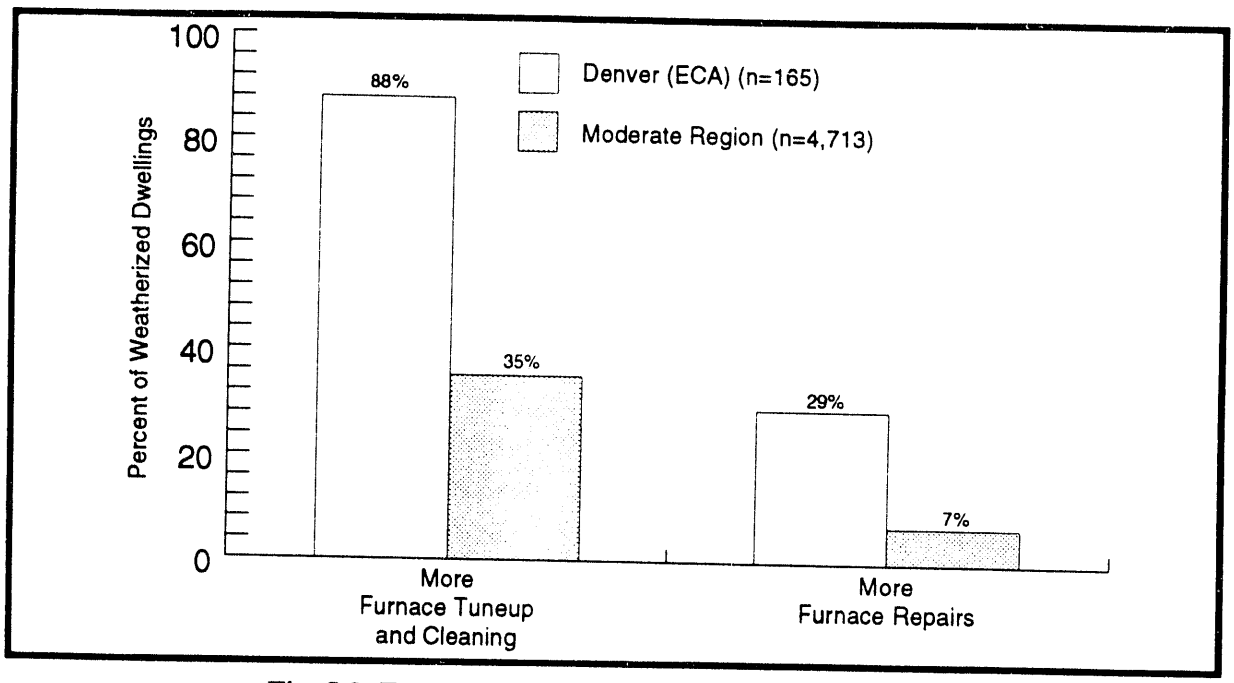

Fig. 5.3 Furnace Measures Performed by the Denver ECA

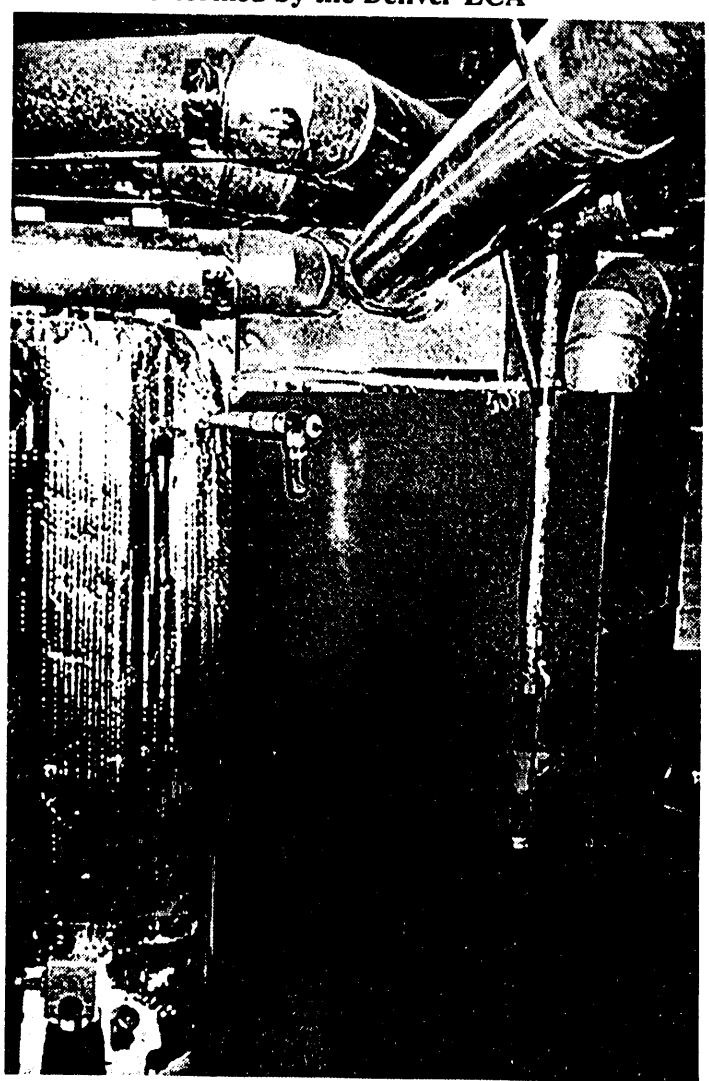

Photo 5.3 Furnace with Tune-up and Duct Repairs.

After finishing work at each client's house, the crews conduct an in-person discussion with the client, aimed at educating the client about ways to operate their home and appliances efficiently. The client is also told about the weatherization measures installed. Client education is repeated by each crew member that visits the client (three to four visits per client).

Subcontractor-Installed Measures. Subcontractor-installed measures are limited primarily to furnace replacements. Subcontractors are used to replace furnaces because the local code requires licensed personnel for furnace installations.

5.4.3 Inspection and Quality Assurance

In 1989, inspections were performed on all envelope measures and 30% of all furnace repairs, per state Program requirements. Envelope inspections included a blower door test to check for adequate total infiltration, and infra-red camera inspection and core sampling in "problem" areas of 25% of sidewall installations to check for adequate insulation coverage. Inspection of furnace repairs included CO monitoring to check for combustion safety problems, but no flue gas analyses were performed.

In 1989, the inspectors also performed energy audits of prospective clients. However, by 1992, inspectors no longer were involved in energy audits so they could be totally independent of the weatherization activities and objectively evaluate the weatherization work.

Additional feedback on Quality Assurance is obtained by inspectors from client's evaluations after the weatherization work is completed.

5.5 LEVERAGING AND COOPERATIVE EFFORTS

5.5.1 Leveraging with LIHEAP, Local Rehabilitation, and Utilities

DOE Weatherization Assistance Program funds, which provided 82% of total 1989 weatherization funds of $1,441,000, were leveraged primarily with LIHEAP weatherization funds, which were used in 100% of Weatherization Program clients for furnace repairs and replacements. In 1989, the ECA received a small amount of funds from the Public Service Company of Colorado for a pilot residential program that involved lighting retrofits.

The primary advantage of the use of leveraged funds is that additional problems found in a client's house could be addressed by the same agency.

5.5.2 Cooperative Efforts

The ECA is expecting to receive funds for FY 1993 from the Public Service Company of Colorado for a low-income, pilot weatherization program.

5.6 AGENCY COSTS

For the Program Year 1989-90, the ECA's weatherization program costs totaled $1,292,650 for 690 weatherization clients and an additional 79 clients who received only furnace work for an average expenditure of $1,681 per client. Of the total cost, 92% or $1,725 per client was spent on weatherization materials and labor with the 8% balance spent on program management costs.

The ECA has reduced its agency costs in several different ways: 1) material costs are reduced by purchasing materials in bulk orders; 2) annual bids from subcontractors lock in material costs at current prices; 3) material wastage and tool replacement have been reduced by a material and tool inventory system the savings of which are added to employee benefits; 4) insurance rates have been reduced by membership in national, non-profit associations; and 5) cross-training personnel utilizes staff time more efficiently.

5.7 ENERGY SAVINGS AND COST EFFECTIVENESS

Annual energy savings per weatherized unit for the ECA are shown in Fig. 5.4 on a comparative basis with results from a sample of agencies located in the moderate climate region. For

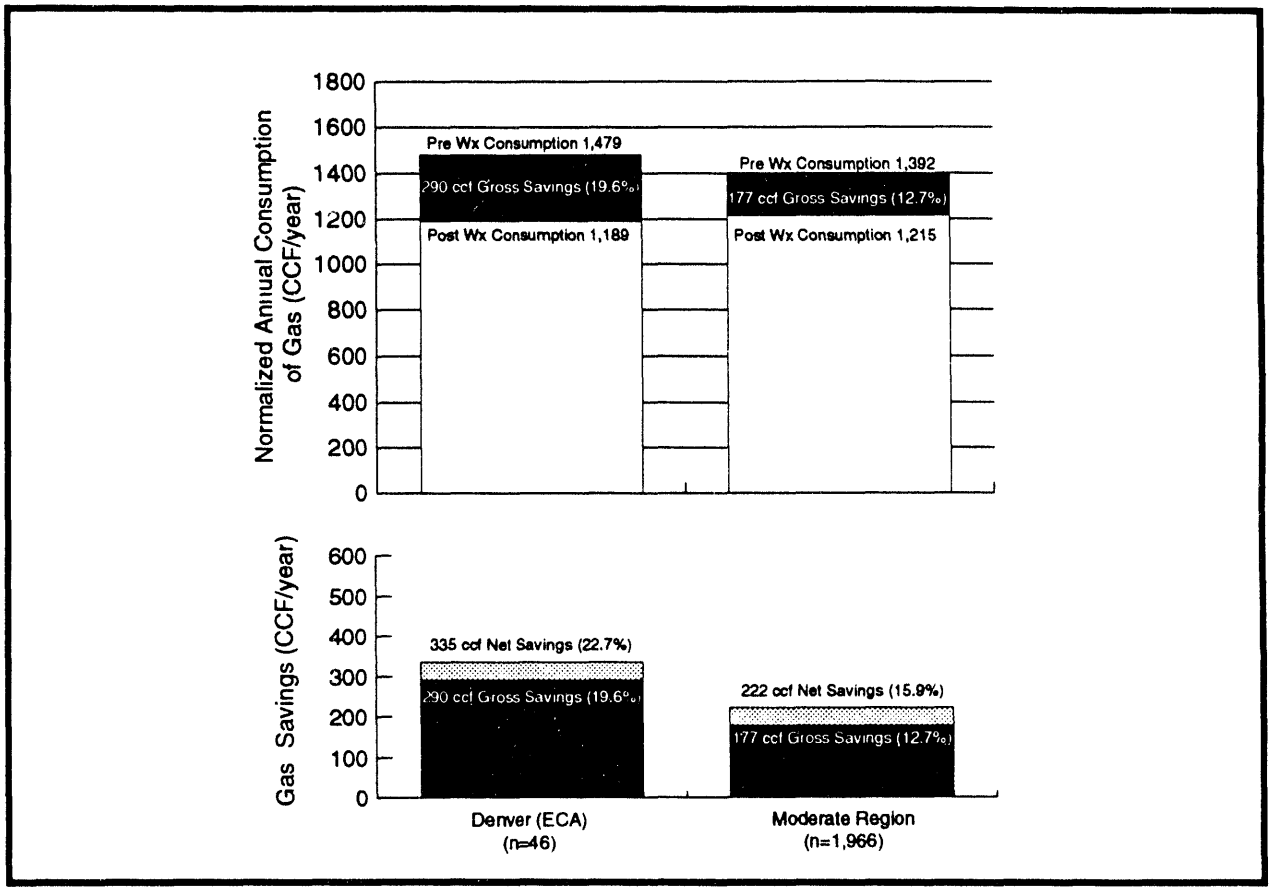

Fig. 5.4 Normalized Annual Consumption and Savings of a Dwelling Weatherized by the Denver ECA

the ECA, annual gross gas savings averaged 290 ccf/year, which reduced the average energy use by 19.6%. The moderate region's annual gross savings averaged 177 ccf/year for a reduction of 12.7% of total pre-weatherization gas use. Net gas savings are 335 ccf/year for ECA and 222 ccf/year for the region. Thus, the ECA average net gas savings were 50% more than the average for the moderate region (Fig. 5.4). Table 5.1 and Fig. 5.5 provide more information about the estimation of gas savings.

Table 5.1 PRISM Model Parameters for the Denver Energy Conservation Association

	Intercept (ccf/Day)	Heating Slope (ccf/^{o}F Day)	Temperature Dependent Use (ccf/Year)	R^2	Reference Temperature (^{o}F)
WEATHERIZED GROUP (N = 46)					
Pre-Weatherization	1.14 (0.47)	0.20 (0.03)	1106 (153)	.92	63.03 (4.63)
Post-Weatherization	0.94 (0.28)	0.18 (0.02)	843 (63)	.93	62.02 (3.69)

Installation costs for the ECA sample averaged $918 per weatherized unit in 1989 which is 11% less than the comparable installation cost of $1,033 for other agencies in the moderate region, as shown in Fig. 5.6. Thus, the ECA achieved both higher energy savings and lower installation costs than the average achieved in the moderate region. The energy savings and installation costs achieved by the ECA result in higher benefit-to-cost ratios for the ECA than the moderate region, also shown in Fig. 5.6.

5.8 AGENCY EVALUATION

5.8.1 Goal Setting

The Executive Director of ECA has set the following goals for the agency's weatherization program:

1. the ECA's weatherization program should continue to emphasize energy and cost savings, and client comfort and safety in providing weatherization services to low-income, elderly, and handicapped or disabled clients;

2. installed weatherization measures should produce on average 20% savings in energy and utility costs;

3. increase flexibility and autonomy of local weatherization agencies by having a participatory vs. regulatory relationship with state and federal government entities;

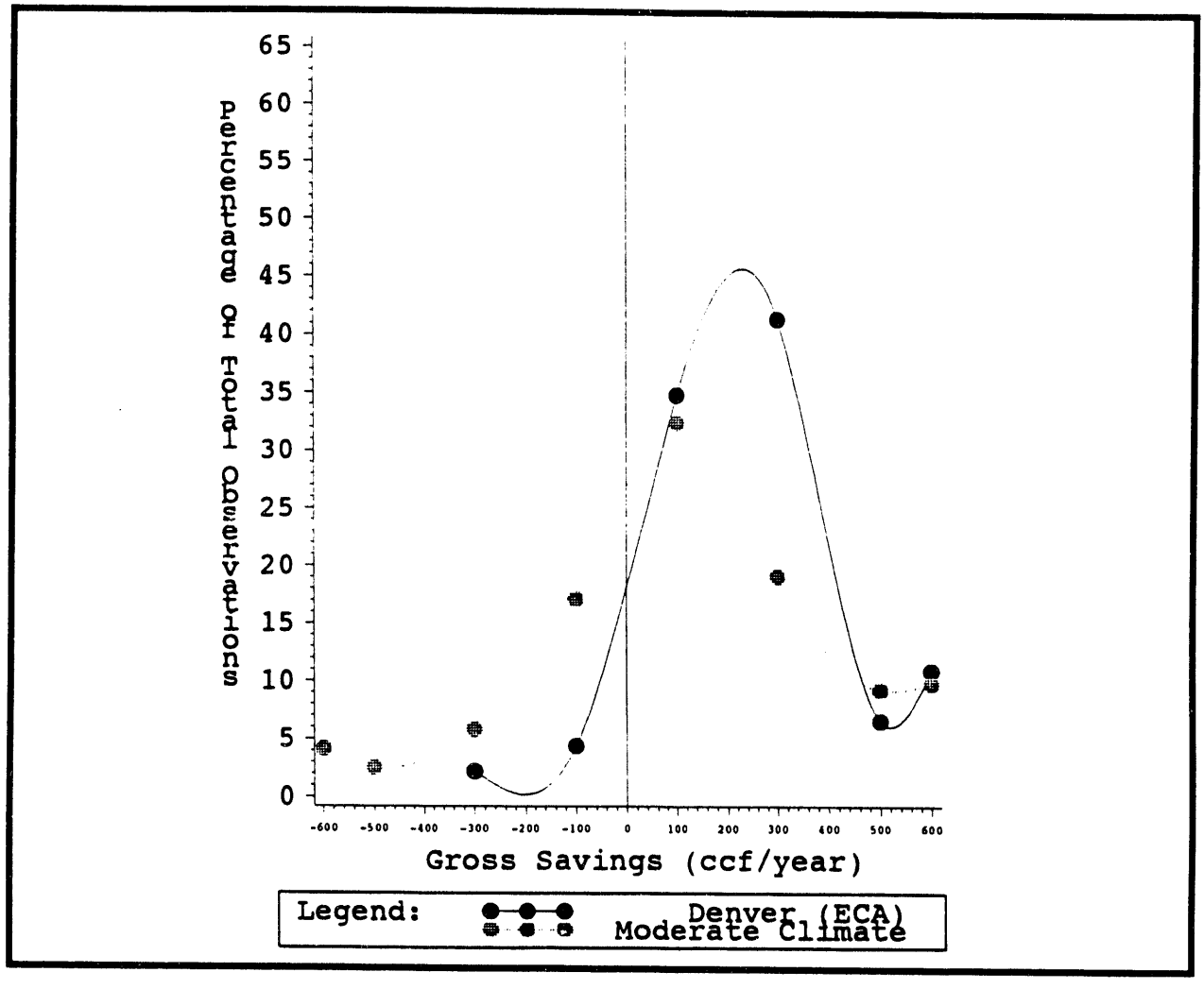

Fig. 5.5 Distribution of Gross Savings of Dwellings Weatherized by the Denver ECA

4. improve procedure for capital equipment purchases by removing mandatory, "low-bid" selection of sellers, and raising the limit on "low-bids" for non-profits from $500 to $5,000; and

5. consider implementing a computerized audit procedure.

5.8.2 Internal Evaluation Procedures

The ECA implemented the following internal evaluation procedures in 1989. First, energy savings are analyzed for a random sample of 25% of ECA's clients annually with the PRISM procedure. The latest results for 1991 show an average savings of 20%, which meets the ECA's energy savings goal. Secondly, surveys of all ECA's clients are obtained and analyzed for needed improvements and satisfaction of the clients.

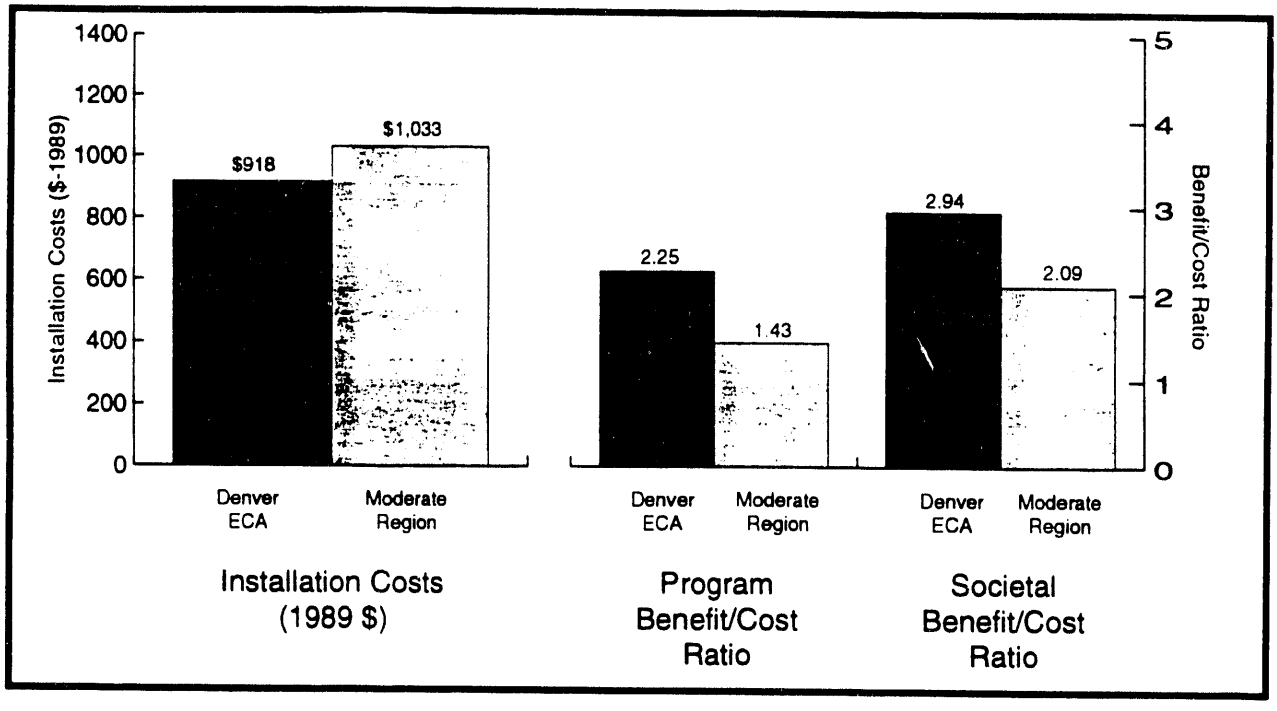

Fig. 5.6 Costs and Benefit/Cost Ratios for Dwellings Weatherized by the Denver ECA

In addition, weatherization crews and inspectors are trained to obtain feedback from clients when making visits, and this information is recorded for management review.

5.9 REASONS FOR SUCCESS

5.9.1 Perspective of the Housing Department Head

The Executive Director offered the following reasons for the exemplary performance of the ECA's weatherization program:

1. management uses a "risk-taking" approach to implement new innovations for program improvements - the addition of furnace repairs as a weatherization measure is a good example of a program improvement;
2. staff motivation is emphasized by soliciting input into daily activities to improve productivity and reduce staff turnover;
3. the importance of client intake and feedback are recognized so that decisions on the weatherization program will emphasize client services; and
4. the importance of client and employee health and safety plays a key role in creating a positive work environment.

5.9.2 Evaluator's Perspective

This evaluator observed several attributes during the on-site interview which may explain the exemplary performance of the ECA's weatherization program:

1. the talented management staff in the ECA weatherization program is highly motivated to provide the best services in their respective roles;
2. the quality of workmanship in a sample of measures installed is very high; and
3. the ECA emphasizes the use of the latest diagnostic techniques in determining measures selected and post-repair inspection.

Finally, this evaluator was particularly impressed with the leadership qualities of the Executive Director. It is this individual who is ultimately responsible for both the management organization and effectiveness. In my brief period of time at the ECA, it was very evident that the Executive Director has effectively blended the roles of setting challenging goals for the agency and also supporting the staff on a day-to-day basis.

6. GOLDENROD HILLS COMMUNITY ACTION COUNCIL WISNER, NEBRASKA

by Dennis L. White

6.1 THE AGENCY AND ITS SERVICE AREA

6.1.1 The Agency

The Goldenrod Hills Community Action Council (CAC)[1] provides weatherization services, energy assistance, and other services for low-income families in a homogeneous area of 14 rural counties in Northeast Nebraska (excluding Omaha). The CAC operates a medium-sized weatherization program. During PY 1989, the CAC weatherized 364 houses at a cost of $524,000. The U. S. DOE accounted for approximately 45% of the CAC's PY 1989 funding; the U. S. Department of Health and Human Services (HHS) accounted for another 31% and petroleum violation escrow (PVE) funding accounted for the remaining 24%.

6.1.2 Agency Goals

The CAC intends to accomplish multiple objectives through its weatherization program. Objectives include: reduce home heating expenses; reduce home energy use; improve or maintain housing conditions; provide comprehensive services to clients; and contribute to the economic health of its service territory.

The weatherization program is one of nine major activities administered by the CAC (Fig. 6.1). Other programs include nutrition and food programs, Head Start, and drug abuse prevention.

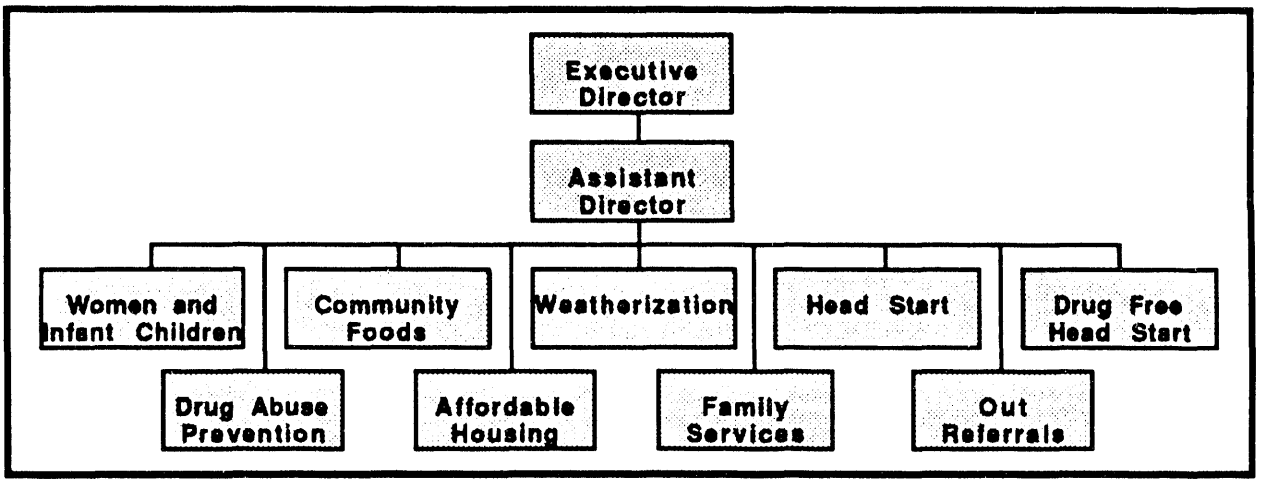

Fig. 6.1 Organization Chart of Goldenrod Hills CAC

[1] The CAC has been reorganized as Community Services.

6.1.3 The Housing Stock

The housing stock in the CAC service territory has a higher savings potential than the type of housing most often weatherized in the moderate climate region (Fig. 6.2). Single-family detached housing units make up more than 92% of the gas-heated weatherized houses in Northeast Nebraska compared to 68% in the moderate climate region. Mobile homes comprise 35% of all dwellings weatherized by the CAC in PY 1989. However, most of these are heated with fuel oil, liquid propane gas, or kerosene and are therefore not included in the analysis of energy savings (Photo 6.1). The high percentage of mobile homes accounts for the relatively young age of the housing stock weatherized by the CAC. In PY 1989, only 11% of the CAC weatherized houses included in the analyses used a supplemental heating fuel; consequently, participating households had fewer options to maintain comfort levels before and after weatherization than the climate region households in general, where nearly one in four households used a supplemental heating fuel.

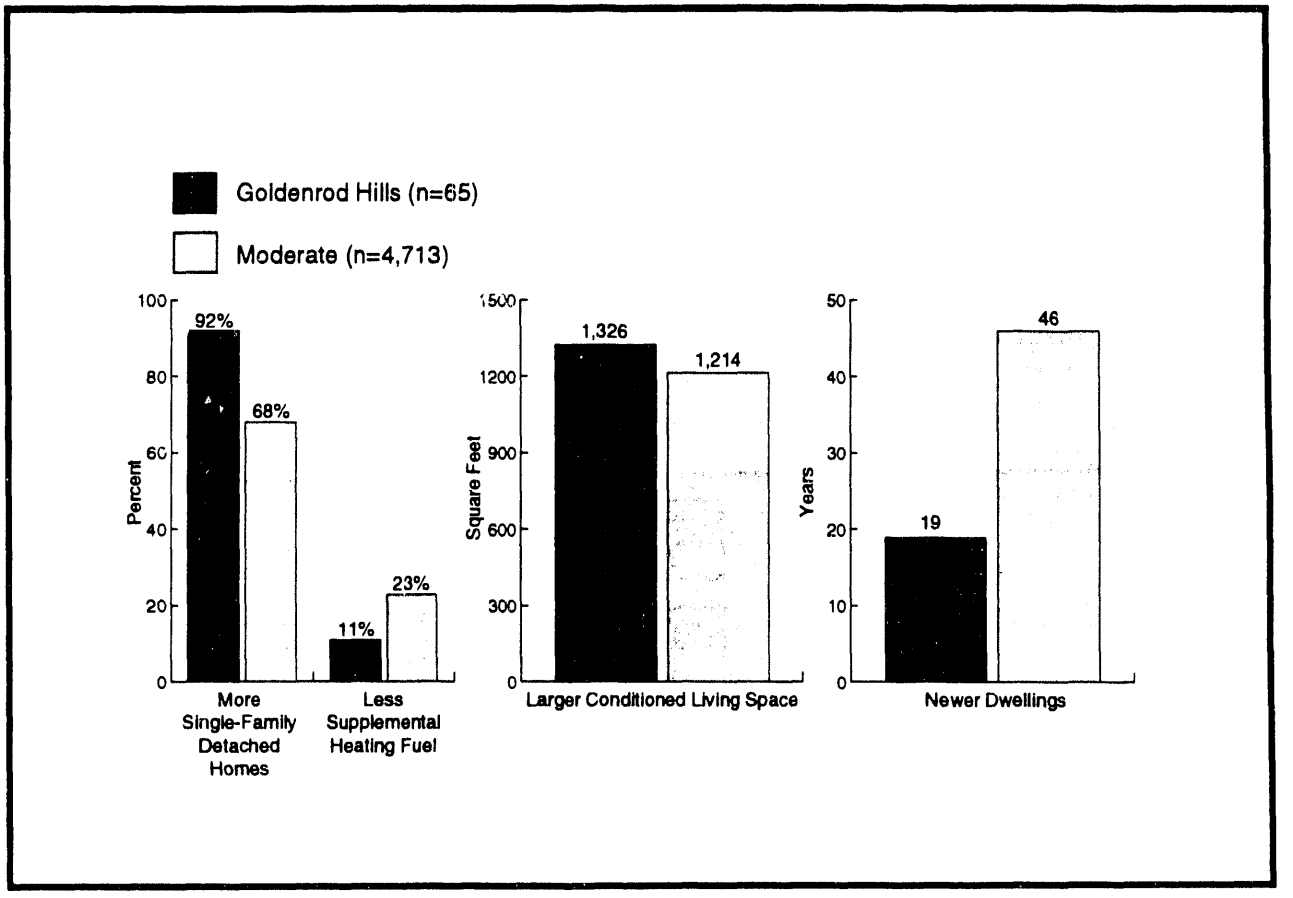

Fig. 6.2 Characteristics of the Housing Stock Weatherized by the Goldenrod Hills CAC

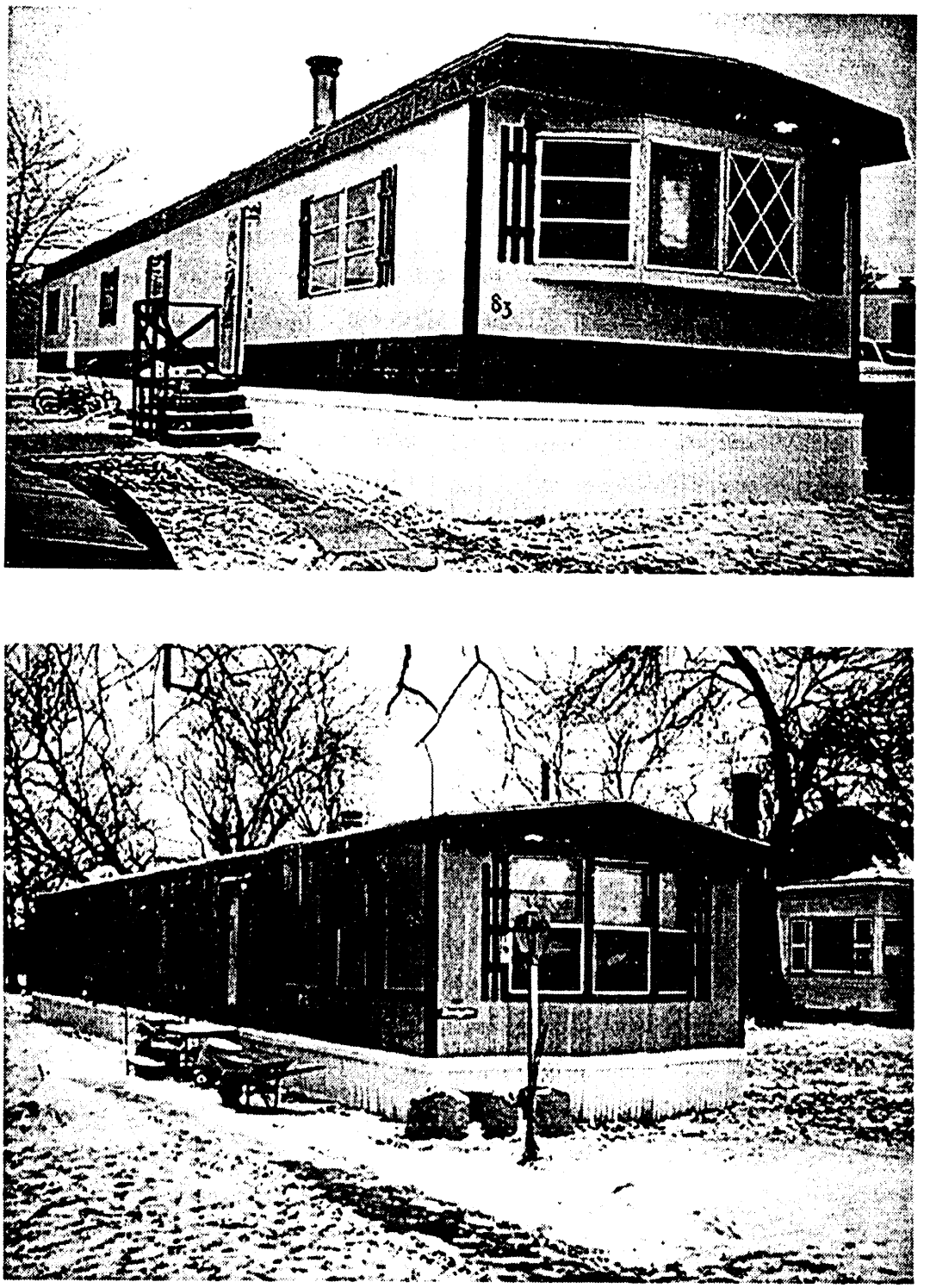

Photo 6.1 Many of the customers not yet served by Goldenrod Hills CAA reside in manufactured housing.

6.2 WEATHERIZATION STAFF AND TRAINING

6.2.1 Weatherization Staff

Since 1983, Goldenrod CAC has relied entirely upon contractors to install weatherization measures. Due to the vastness of the service area and related travel costs, the CAC does not use crews. Additionally, the CAC avoids costs associated with maintaining inventory, space, and equipment. Besides the Weatherization Director, the program's in-house staff is comprised of an estimator/auditor.

Contractors submit bids for program work at the beginning of the program year. Furnace work is also contracted, regardless of the complexity. There are two or three contractors in each county of the CAC service area, and each furnace job is bid.

6.2.2 Training

Nebraska developed a subgrantee training manual with its State Plan. Nebraska Energy Office staff, local community colleges, and private contractors conduct training.

In-house staff and contractors have not received training in the use of duct sealing, but they received training on the use of insulation. Training on heating systems and retrofits has been conducted on the job. Virtually all crew members and contractors have extensive construction experience. As a matter of fact, the basis for Nebraska's priority list of weatherization measures is the state's collective "experience and research in weatherizing several thousand frame, masonry, modular and mobile dwellings".

6.3 CLIENT RECRUITMENT AND SELECTION PROCEDURES

The first to apply are the first to be weatherized. Elderly and disabled persons are given priority. There is no other ranking of applicants on a three to four month waiting list. The year after an especially long winter, a greater number of eligible households apply for weatherization. The primary marketing strategy is person-to-person, in order to control the number of applicants. Unmanageably large numbers would apply if mass marketing were conducted. Dwelling units that are not sanitary are excluded.

Housing in need of repair or rehabilitation is referred to FMHA or the Nebraska Department of Social Services; the Nebraska State Energy Office (SEO) offers low-interest loans for energy projects in which energy-saving materials must be used. Once repairs have been completed, up to a maximum of $300, the CAC completes weatherization. Although no more than 5% of the housing weatherized under the Weatherization Assistance Program has been repaired or rehabilitated under another program, the Weatherization Administrator believes weatherization costs and program effectiveness have been enhanced by this partnership.

6.4 USE OF DIAGNOSTICS

The blower door was not used until PY 1990, when Nebraska made it mandatory. Blower doors are now used by estimators/auditors, both before and after weatherization. The CAC uses smoke candles to detect furnace leaks. Back draft and codes tests are conducted on furnaces before and after retrofit or replacement.

The Project Retrotech audit was used by the CAC in 1989. Today the program is using the National Energy Audit, a PC-based integrated audit.

6.5 INSTALLATION OF MEASURES

6.5.1 Selection of Weatherization Measures

Generally, the CAC follows State guidelines. Weatherization measures are omitted if (1) the measure has been previously implemented, (2) the measure has a benefit/cost ratio of less than one as documented by Project Retrotech, or (3) undertaking the weatherization measure would subject workers to unreasonable health or safety hazards. In addition, in PY 1989, the CAC emphasized amenities and safety measures like sash locks. Moreover, the CAC focused on protective and comfort measures; a lot of air sealing was done above and beyond what was necessary for energy efficiency alone. The CAC tries to respond to common client criticisms, like "my windows are shot."

6.5.2 Rates of Installation of Weatherization Measures

The CAC weatherization strategy emphasizes the whole house. Compared to the moderate climate region, the CAC installed 13% more original attic insulation; 128% more additional attic insulation; 100% more normal wall insulation; 35% more water tank insulation; and 138% more water pipe insulation (Fig. 6.3). The list of eligible measures is shown in Appendix E.

6.5.3 Client Education

Client energy education services can be best described as integrated with other CAC programs and services. During intake procedures into any CAC program, client consent is obtained so that client information, for example, on the application for weatherization services can be shared with other CAC programs. The CAC also distributes a two-page flyer that explains each agency service (Appendix E). The Weatherization Administrator, estimators, contractors, and state monitors reinforce energy conservation behaviors during their visits. During the last quality control inspection, the client receives a post-weatherization brochure that explains dollar and energy savings opportunities.

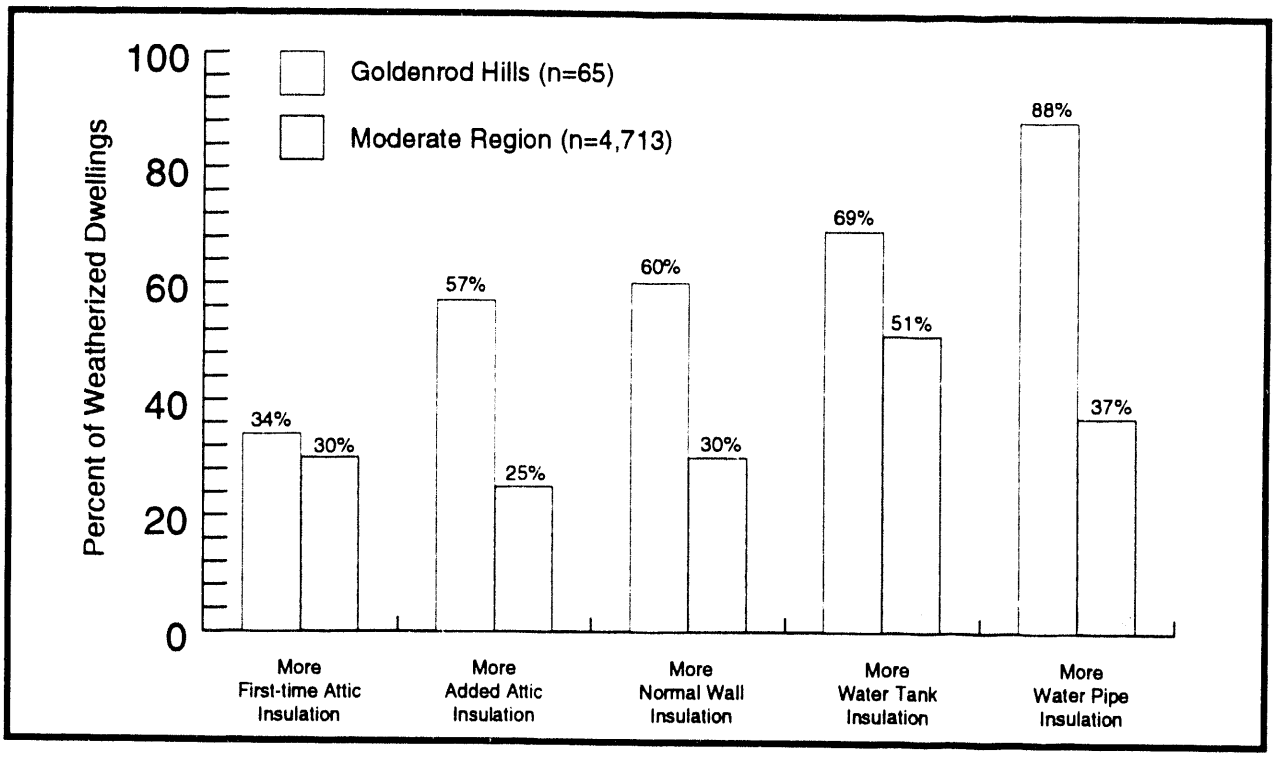

Fig. 6.3 Installation Rates for Selected Weatherization Measures Installed by the Goldenrod Hills CAC

6.5.4 Quality Control

The CAC operates its weatherization assistance program in accordance with Nebraska standards, which have been enumerated in the Subgrantee Training Manual and the Weatherization Priority Measures and Work Standards in the State Plan. Audit and retrofit guidelines are established in these State standards. Every three months, the weatherization coordinator conducts a comprehensive assessment of the contractors' work. These assessment activities reflect the high emphasis the CAC places on quality. The CAC inspects all completed work, including furnace replacements. And because each individual job is put out for bid to experienced and proven contractors, the assessment process contributes to a highly functional, although seemingly arduous, contractor selection procedure. The furnace work is done by experienced contractors. These practices explain the low incidence of rework--only one furnace rework every two years.

The state monitor conducts site visits once a month for two to three days at a time. About 30% of all completed weatherization jobs are inspected by the State monitor.

6.6 LEVERAGING AND COOPERATIVE EFFORTS

The CAC is an organization formed for the purpose of cooperatively providing services. Weatherization and related programs and services probably could not be satisfactorily delivered in

this 14-county region of Nebraska by any other mechanism because of the high cost of transportation to clients in a sparsely populated but vast service area.

There is no Public Utility Commission in Nebraska. Municipal governments regulate themselves and the public power that they make available for consumers.

6.7 COSTS AND SAVINGS

Average weatherization costs for the CAC in PY 1989 were higher per house at $1,141, or 11% above the average for climate region (Fig. 6.4). To reduce DOE costs, the CAC shares the costs of furnace work with the landlords of rented housing. The CAC will pay the first $250.00 of the work and the landlord pays the balance.

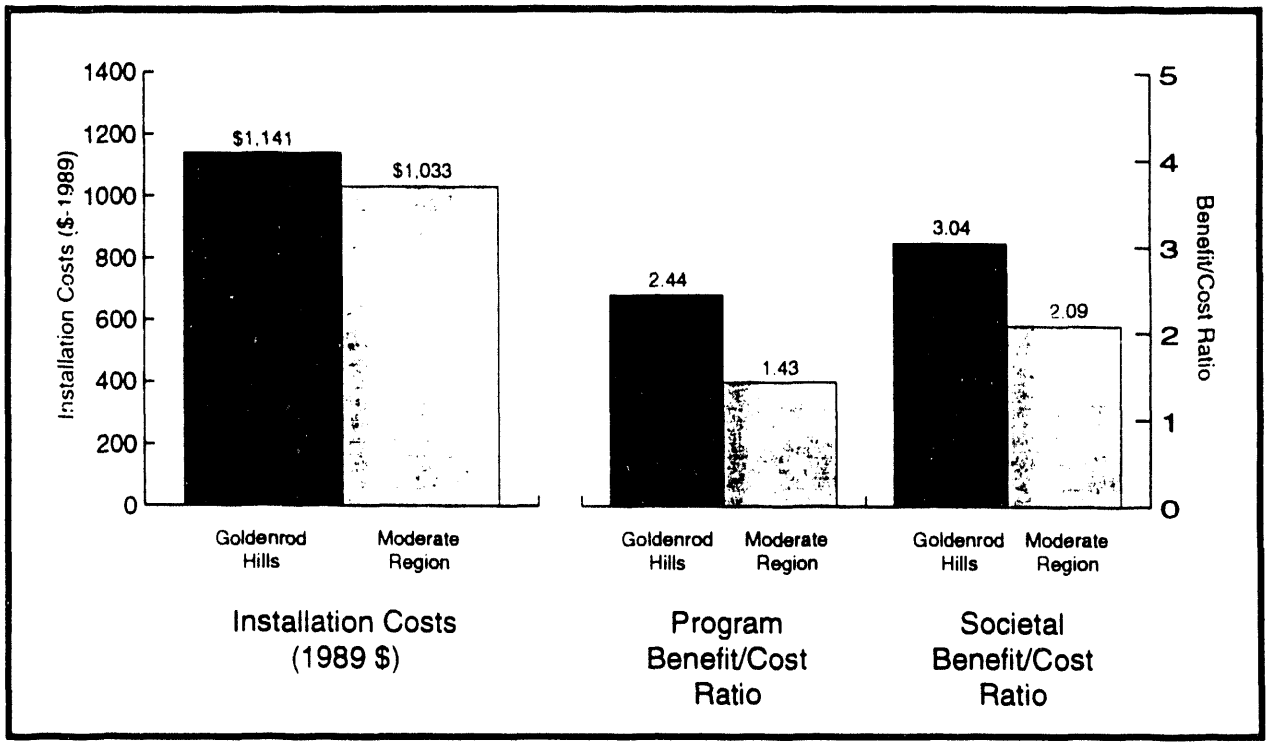

Fig. 6.4 Costs and Benefit/Cost Ratios for Dwellings Weatherized by the Goldenrod Hills CAC

Although CAC weatherization participants consumed virtually the same amount of natural gas before weatherization as other participants in the moderate climate region, the CAC participants saved 26% of their pre-weatherization gas use (Table 6.1 and Figs. 6.5 and 6.6). The CAC average gross savings of 387 ccf/year was more than twice the gross gas savings achieved by other agencies in the same climate region, which averaged 222 ccf/year. When the increased consumption of the control group is considered, the CAC program's net savings increases to 432 ccf/year or 29%, and the net savings for agencies in the moderate climate region increases to 182 ccf/year or 12%.

The program benefit/cost ratio (2.44) for CAC greatly exceeds that for the climate region (1.43). Additionally, the societal benefit/cost ratio was also considerably higher, 3.04 versus 2.09.

Table 6.1 PRISM Model Parameters for the Goldenrod Hills CAC

	Intercept (ccf/Day)	Heating Slope (ccf/°F Day)	Temperature Dependent Use (ccf/Year)	R^2	Reference Temperature (°F)
WEATHERIZED GROUP (N = 40)					
Pre-Weatherization	0.76 (0.35)	0.18 (0.02)	1256 (115)	.91	61.24 (4.66)
Post-Weatherization	0.71 (0.41)	0.11 (0.02)	872 (94)	.89	63.28 (6.93)

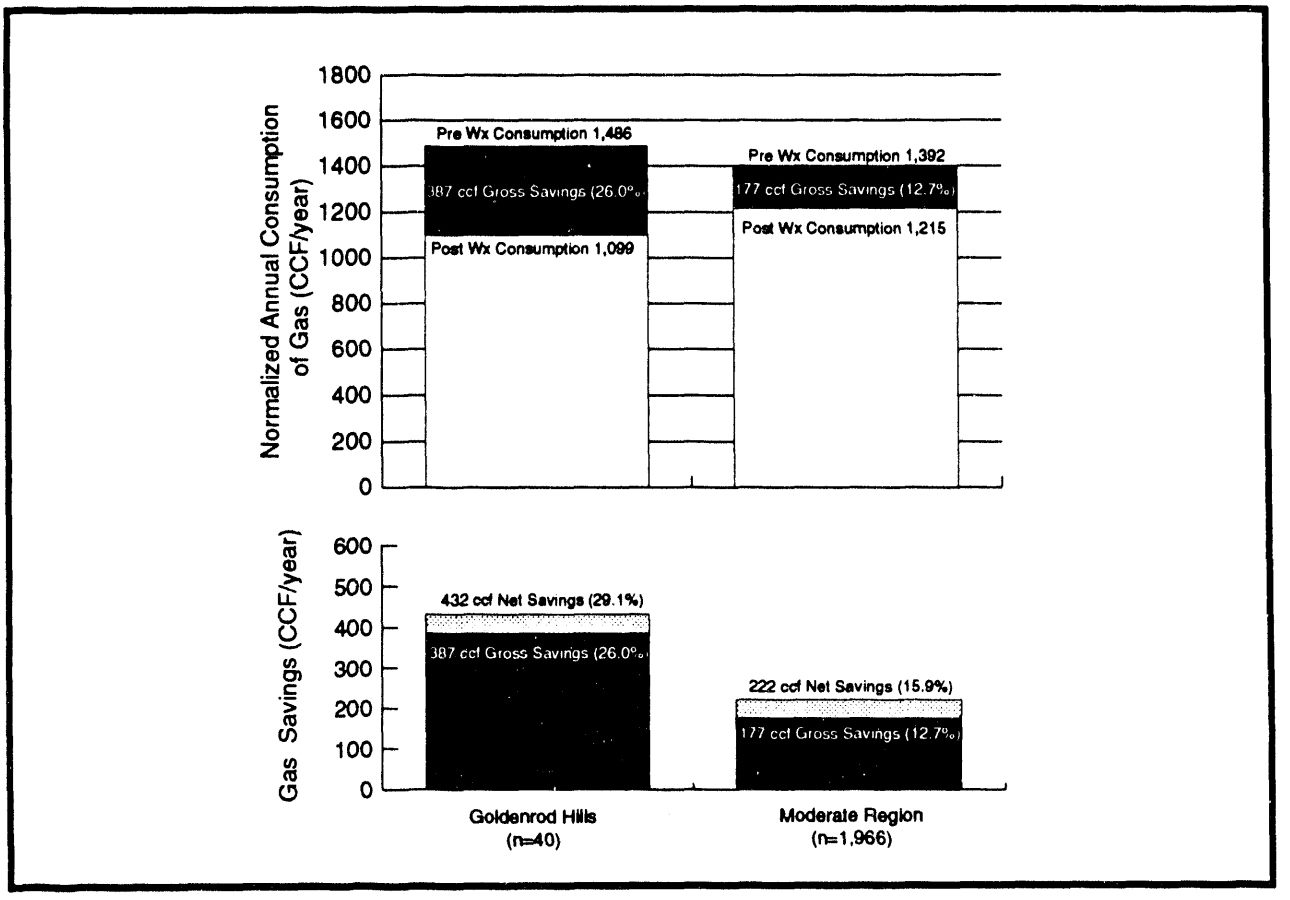

Fig. 6.5 Normalized Annual Consumption and Savings of Dwellings Weatherized by the Goldenrod Hills CAC

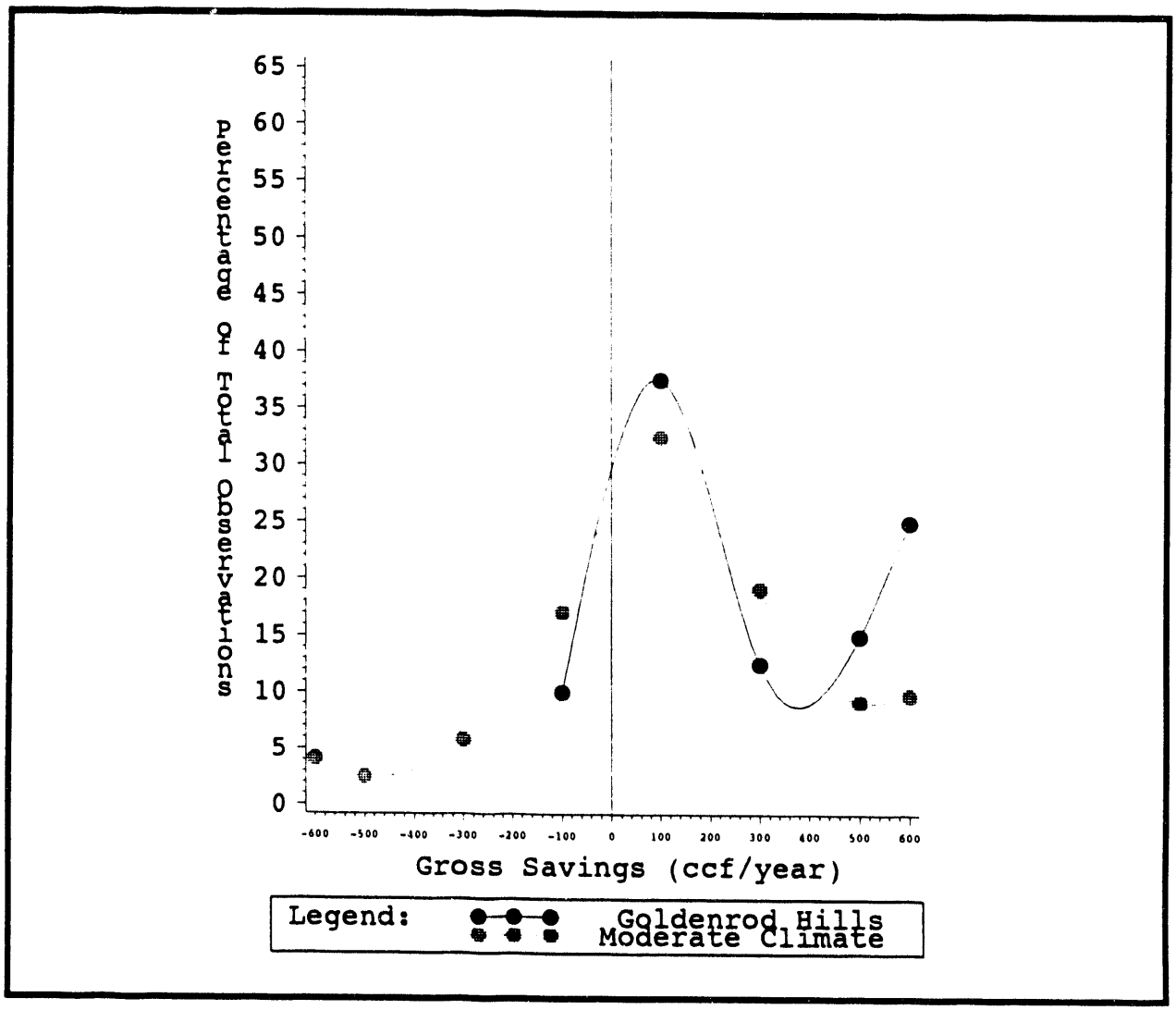

Fig. 6.6 Distribution of Savings of Dwellings Weatherized by the Goldenrod Hills CAC

6.8 MONITORING AND EVALUATION

The Executive Director of the CAC is an involved administrator. The Weatherization Administrator formally evaluates each contractor every three months. CAC estimators inspect all completed jobs. The estimators emphasize quality of installation in their inspections. When common or systematic problems are encountered, the Administrator and estimators conduct situational inspections.

The CAC conducts open bidding for weatherization every 12 months. That means that prices are fixed for 12 months. Formerly, furnace work was also opened to bidding for 12-month periods. Because mileage is not reimbursable through the Weatherization Assistance Program, bids tended to

approach the high side, so that transportation expenses could be absorbed. On the other hand, the CAC's current practice of bidding each furnace job tends to keep prices down.

The CAC has always felt that it was doing a good job for its clients. There have been no formal evaluations of its weatherization program. However, State review and formal programmatic monitoring contribute to success. Additionally, the CAC requests proposals and funds private audits of the entire agency. Moreover, the CAC canvasses client needs and conducts periodic surveys of a sample of clients (Appendix E).

6.9 REASONS FOR SUCCESS

Success can be attributed to a combination of factors, including a housing stock that has high savings potential, a comprehensive and individualized weatherization strategy and implementation plan, competent staff, and high productivity among the contractors. Perhaps just as significant, themes related to energy conservation and efficiency are reinforced on a regular basis in Nebraska because all the electricity in the State is public power.

7. NORTH BUFFALO COMMUNITY DEVELOPMENT CORPORATION BUFFALO, NEW YORK

by Dennis L. White

7.1 THE AGENCY AND ITS SERVICE AREA

7.1.1 The Agency

The North Buffalo Community Development Corporation (CDC) provided weatherization services, energy assistance, and other services for low-income families in the very heterogeneous city of North Buffalo[1] . The CDC operated a medium-sized weatherization program, having weatherized 218 housing units in PY 1989 at a total cost of $386,000. DOE funding accounted for about 34% of the PY 1989 budget; petroleum violation escrow funds accounted for approximately 42%; about 21% of the budget was funded by the U. S. Department of Health and Human Services (HHS); the balance of the budget (3%) was contributed by other sources.

7.1.2 Agency Goals

The success of the CDC was fostered by the agency's family assistance strategy. The CDC manages nine major activities, including weatherization (Fig. 7.1 — the current Clarkson Center organizational structure resembles the CDC structure when the CDC was the local weatherization agency). The CDC offered comprehensive family assistance, with special emphasis placed on senior and handicapped services and housing rehabilitation, and then on weatherization. Auditors were trained to "read between the lines." That is, auditors and other weatherization staff were trained to identify client needs in addition to conserving energy and reducing energy expenses.

7.1.3 The Housing Stock

The housing stock served by CDC is clearly atypical of the participants in the moderate climate region (Fig. 7.2). In PY 1989, more than 74% of the CDC participating households resided in small multifamily buildings (compared to 20% for the region). Their housing units were smaller than the regional average by about one full room and were occupied by one less person on average. Finally, average household income, while still low, exceeded the average income for the moderate climate region by 18%, $9,100 annually versus $7,680. These differences in housing stock and household characteristics are also not typical of high performing local agencies. Nationwide, energy savings are greatest in the largest dwellings and in single-family detached houses.

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[1] **Historical note**: Clarkson Center for Human Services, Inc., became the local Weatherization Assistance Program administering agency on October 1, 1992. Previously, the North Buffalo Community Development Corporation operated the Weatherization Assistance Program. For the approximately 18 months prior to October 1, 1992, there was no institutionalized weatherization assistance program in North Buffalo.

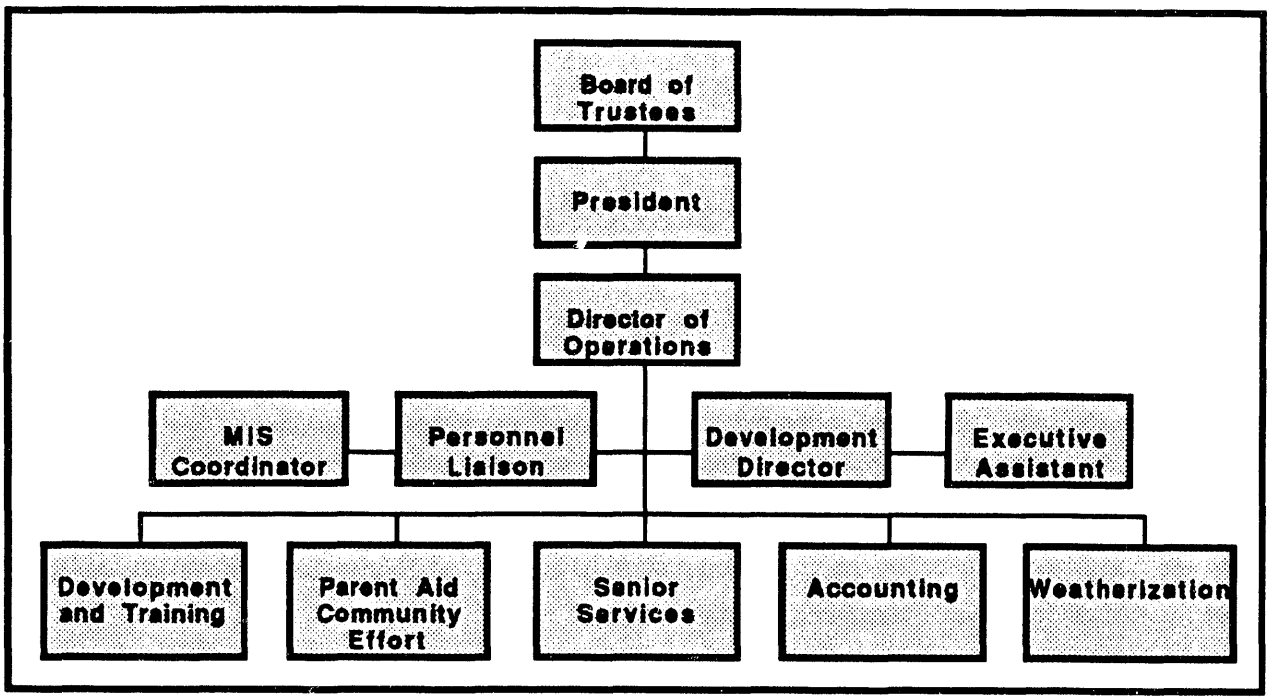


Fig. 7.1 Organization Chart of Clarkson Center for Human Services

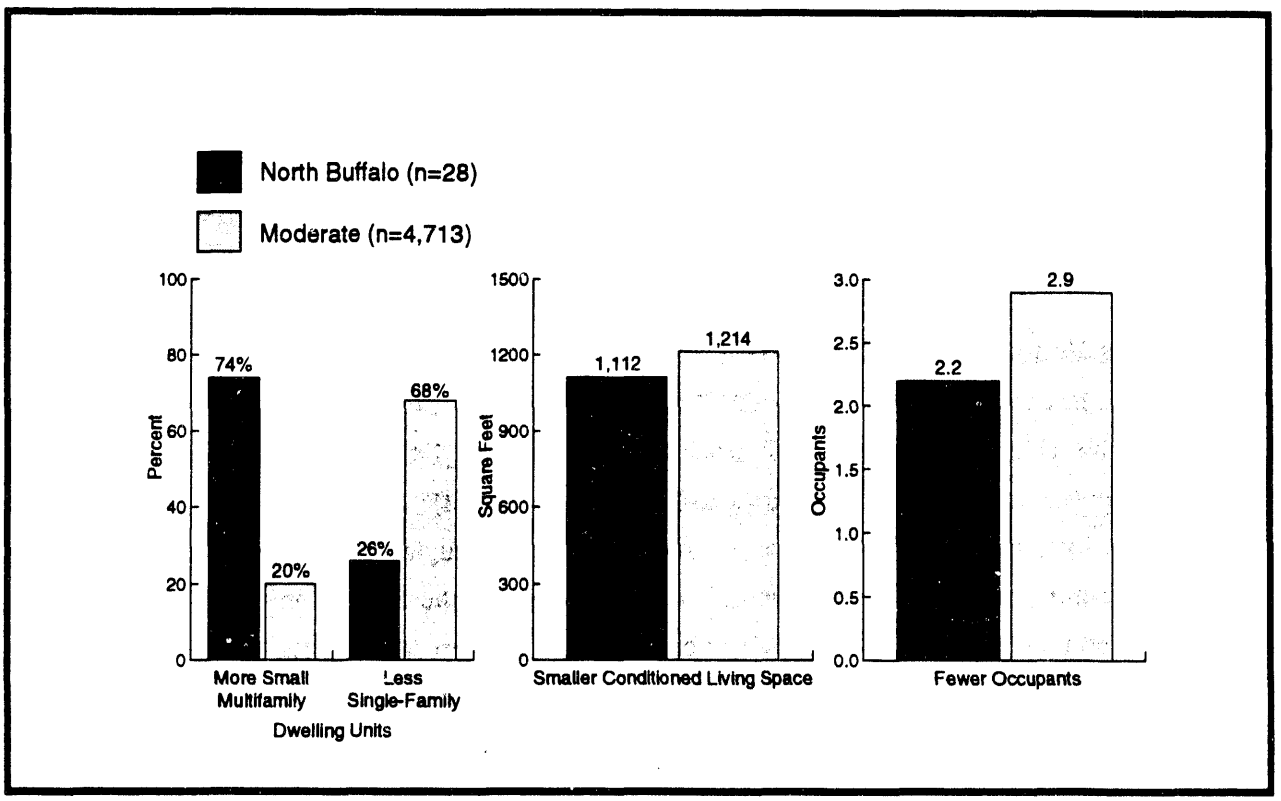


Fig. 7.2 Characteristics of the Housing Stock Weatherized by the North Buffalo CDC

7.2 WEATHERIZATION STAFF AND TRAINING

7.2.1 Weatherization Staff

Until 1987, all work was done by in-house crews, which maximized the amount of control that the CDC could exercise on quality. Between 1987 and 1991, the CDC began using more contractors, primarily because demand for weatherization and related services in the service territory increased, and in-house crews could not handle all of the jobs. The Clarkson Center is now returning to crews in order to improve program efficiency and maintain greater management of quality. The furnace work, however, continues to be done by experienced contractors.

7.2.2 Training

New York does not have a State training facility, but the CDC participated in State supported training and in training provided by utilities, energy services companies and other organizations. Crews received training in duct insulation but not duct air sealing. Crews also received training from the New York State Training Department in high density blowing of insulation and air sealing using the blower door to identify air leaks.

The Crew Manager was a CDC employee since 1979, and was responsible for day-to-day operations, the warehouse, and purchasing. A warehouse clerk and field supervisor assisted the Crew Manager. The CDC operated two crews; each crew was staffed by three installers and a crew chief.

7.3 CLIENT RECRUITMENT AND SELECTION PROCEDURES

The CDC did not advertise. All outreach was conducted through established community groups for seniors and disabled persons and through National Fuel Gas, which does not target high users or arrears. Work was scheduled on a first-come, first-served basis.

Housing with basement sewage problems was not weatherized until the conditions were resolved. Plank siding was considered extremely difficult to weatherize and does not receive wall insulation.

7.4 USE OF DIAGNOSTICS

The CDC used the Bachrach furnace test and conducted inspections on all furnace retrofits and replacements. Setback thermostats were required on all replaced furnaces.

An 80% efficiency rating was required for all newly installed furnaces. A heat load calculation was done to determine the size (in Btu's) of the furnace to be installed. Duct work and ventilation where needed were also completed. Many retrofits and replacements required a new gas connection. The contractor was instructed to inform the agency of any problems not identified by the inspector before replacing a heating system. An inspector was immediately sent to the job site

when a problem occurred or a repair was questioned by the contractor. All systems were checked by the inspector after installation.

Blower door testing was initiated in 1991 in conjunction with the adoption of the Targeted Investment Protocol System (see insert).

7.5 INSTALLATION OF MEASURES

7.5.1 Selection of Weatherization Measures

Housing units with health risks (e.g., filth or rodents) and housing units that could not be practically weatherized (e.g., houses with 100 windows and metal frames) were not selected for weatherization.

The CDC followed the state guidelines. Generally, the CDC concentrated on furnace work, then insulation, then infiltration. Since 1990, weatherization measures have been selected based upon the energy savings likely to be cost effective, following the Targeted Investment Protocol System (TIPS). The result is expected to be "more cost-effective weatherization across all jobs, better quality for all clients, and a more responsible investment of public dollars earmarked for energy conservation."

Targeted Investment Protocol System (TIPS)

. . . analyzes the energy consumption data of a building with from one to four dwelling units; characterizes the building in terms of its comparative energy efficiency; derives an investment in the building based on its potential for energy savings; targets a workscope that includes cost-effective weatherization measures and allows the local weatherization agency to obtain post-weatherization consumption data for comparison and analysis.

When using TIPS it is important that the workscope decisions be postponed until all the information from the building can be processed. This information includes heating and baseload analysis; instrumented audit; site inspection; client behavior information; health and safety examination; and indoor air quality test.

Under TIPS, blower door tests are conducted on all dwelling units, before and after weatherization, and infiltration work is blower-door assisted.

TIPS includes specific weatherization protocols that require initial analyses of fuel bills, cold air infiltration rate, and heating system efficiency. These protocols and analyses help to characterize a building in terms of its potential energy savings and, ultimately, the required investment.

The CDC began testing furnaces in 1987, and conducted furnace retrofits beginning in 1989. Furnace replacements required preliminary approval from the state monitor.

All furnaces and boilers were tested for combustion efficiency and carbon monoxide. A system check of the filter, draft, expansion tanks, thermostat, cold air returns, ducts, chimney and gas lines was completed. A work order was issued for cleaning and tuning all heating systems that tested below 75% efficiency, and for minor repairs. The contractor notified the agency of any repairs needed other than those identified by the inspector on the work order. For systems that tested 75% or better, the CDC could schedule a clean and tune or minor repair work.

7.5.2 Rates of Installation of Weatherization Measures

The CDC weatherization program was thorough and complete. The dual focus of the program in PY 1989 was house tightening and client education. Air sealing was applied to 100% of participating houses. Thermostats were reset downward in 100% of all houses. These two actions exceeded regional averages of 39% and 20%, respectively. Original attic insulation was installed in 46% of the CDC houses compared to 30% for the region (Fig. 7.3). Normal wall insulation was installed in 79% of the CDC houses compared to an installation rate of 30% for the region. Water tanks were insulated in 93% of the CDC houses compared to 51% in the moderate climate region. Water pipes were insulated at a rate more than double the regional average, 86% to 37%.

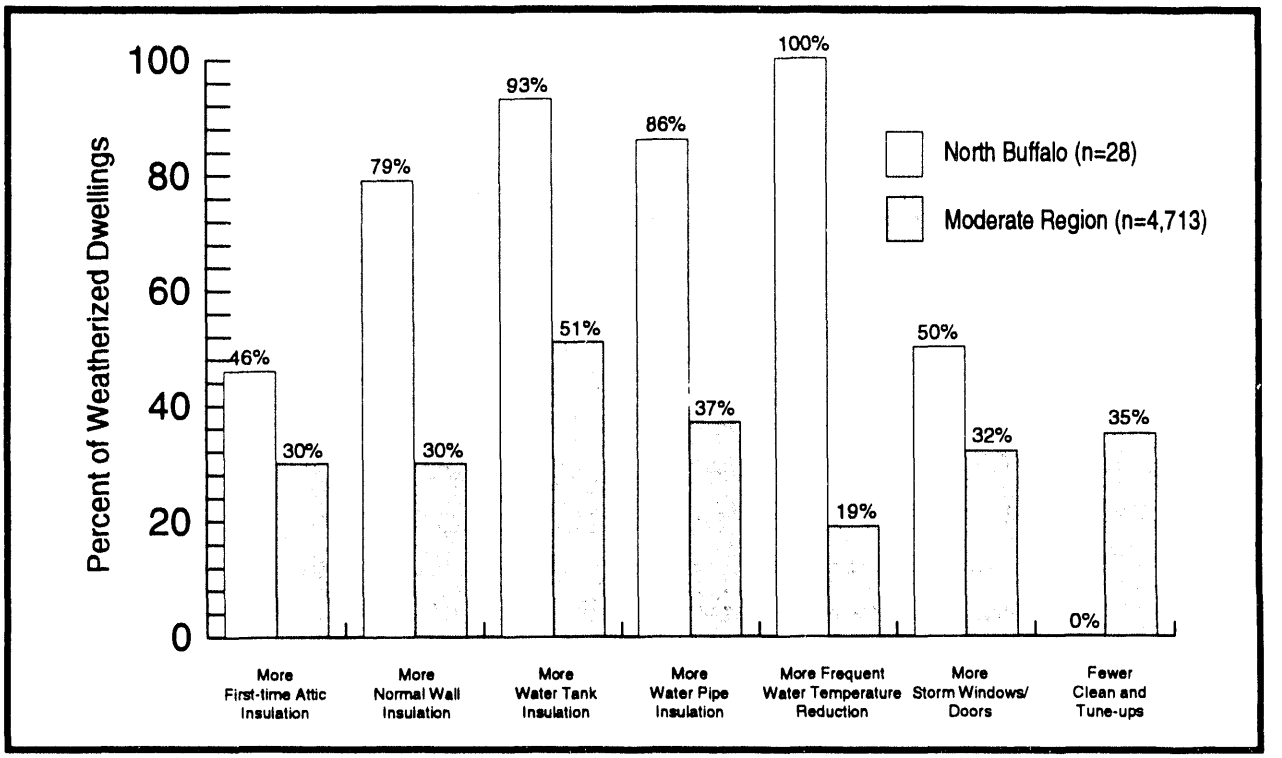


Fig. 7.3 Installation Rates for Selected Weatherization Measures Installed by the North Buffalo CDC

The CDC operated its weatherization assistance program in accordance with New York standards, which have been enumerated in the *Technical Assistance Notebook for New York Weatherization Program* (the Notebook). Audit and retrofit guidelines were established in the State standards.

7.5.3 Client Education

Client education begins during intake, during the initial telephone call or walk-in to the office. The weatherization program is explained and the program's goals. The client is also told

about ways to lower the heating bill. The CDC describes the types of materials that will be installed or used for retrofit, and why they are important. An information package is given to the client.

When the inspector audits the house, the inspector walks through the house with the client and explains the weatherization work that will be done and **how the client can save energy both before and after the work is completed.** The inspector goes over a list of questions with the client; this "interview" helps the inspector to assess the client's lifestyle. Upon completion of the audit, the inspector sets a date for the weatherization work to begin. When the work has been completed, new equipment is demonstrated for the client. The weatherization work is explained and why it was necessary.

7.5.4 Quality Control Procedures

Although the CDC did not publish a quality assurance manual, the CDC did emphasize — like Clarkson Center emphasizes — continual improvement, the key feature of total quality management programs. Moreover, the CDC specified for its contractors the procedures and materials that were acceptable and the procedures and materials that were not acceptable. Consequently, contractors could concentrate more of their efforts on the quality of the installation.

CDC always met State standards. It focused on improving on those standards by conducting real-time verification of work. All units were inspected while the work was in progress to assure the proper materials were being used, and to make sure that the contractor or crew was not having a problem on the job that could cause a delay. These inspections of work in progress also assisted with work changes that were needed to complete a job. A post inspection was performed while the contractor or crew was still at the work site. The inspector also talked with the client about the work habits of the laborers, making sure the area was clean, and that the client could operate the windows, doors, thermostat, or heating system, after the work had been completed.

7.6 COSTS AND SAVINGS

In 1989, there were no middlemen; the CDC and its contractors purchased supplies and materials directly from the manufacturers. Neither the CDC nor its contractors used subcontractors. The CDC executed work-change orders with contractors because some work could take as much as five or six months to complete and conditions could change in that length of time. Moreover, New York encouraged performance-based contracting. The Weatherization Director explained that performance-based contracting was a problem for the very low-income and the elderly: energy savings was not the primary objective.

Gross gas savings among participants in PY 1989 were more than three times the average housing unit savings in the moderate climate region (Fig. 7.4, Table 7.1 and Fig. 7.5). CDC weatherization participants saved 558 ccf or 32% of pre-weatherization gas use while the average

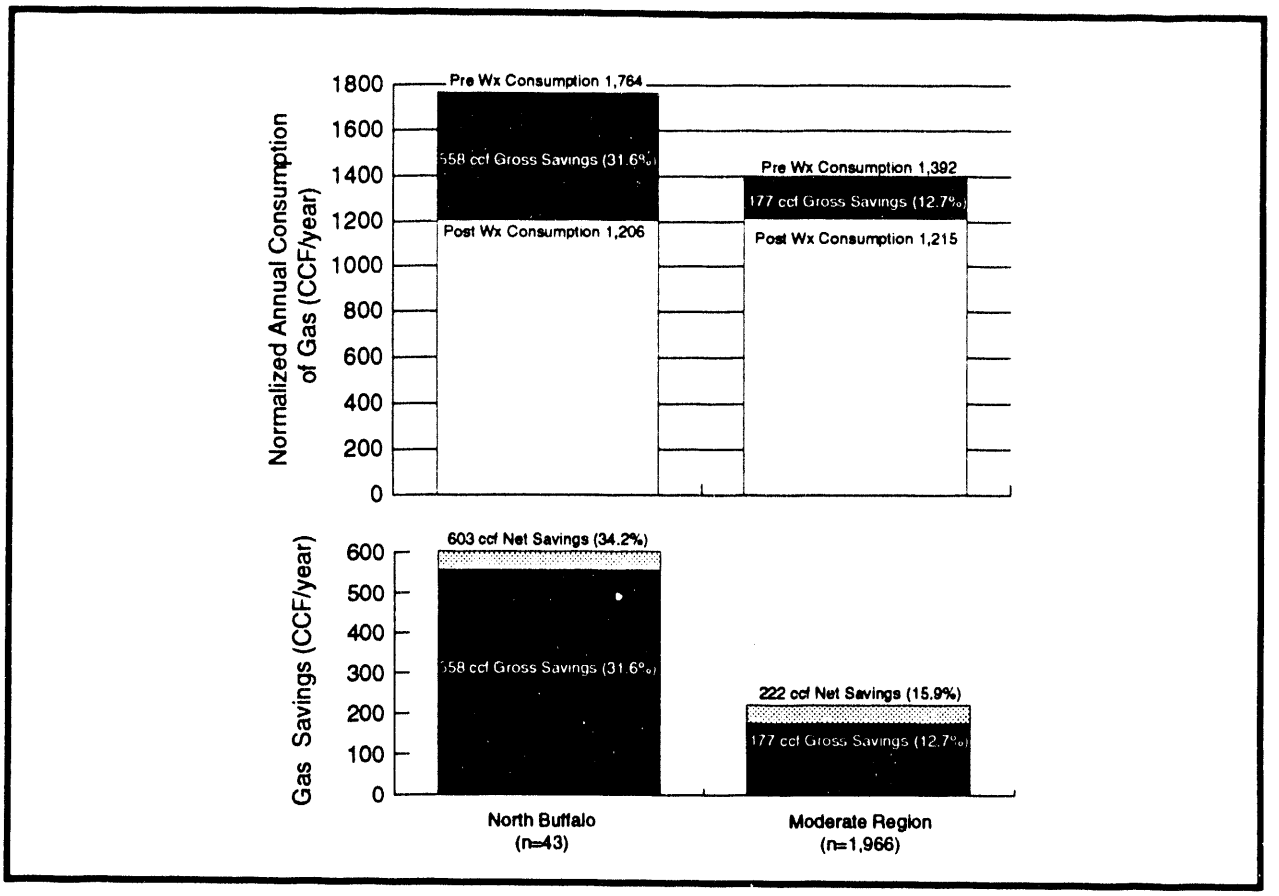


Fig. 7.4 Normalized Annual Consumption and Savings of Dwellings Weatherized by the North Buffalo CDC

Table 7.1 PRISM Model Parameters for the North Buffalo CDC

	Intercept (ccf/Day)	Heating Slope (ccf/^{o}F Day)	Temperature Dependent Use (ccf/Year)	R^2	Reference Temperature (^{o}F)
WEATHERIZED GROUP (N = 43)					
Pre-Weatherization	1.04 (0.63)	0.24 (0.04)	1440 (219)	.88	62.42 (5.93)
Post-Weatherization	0.98 (0.89)	0.12 (0.03)	905 (149)	.90	64.67 (14.32)

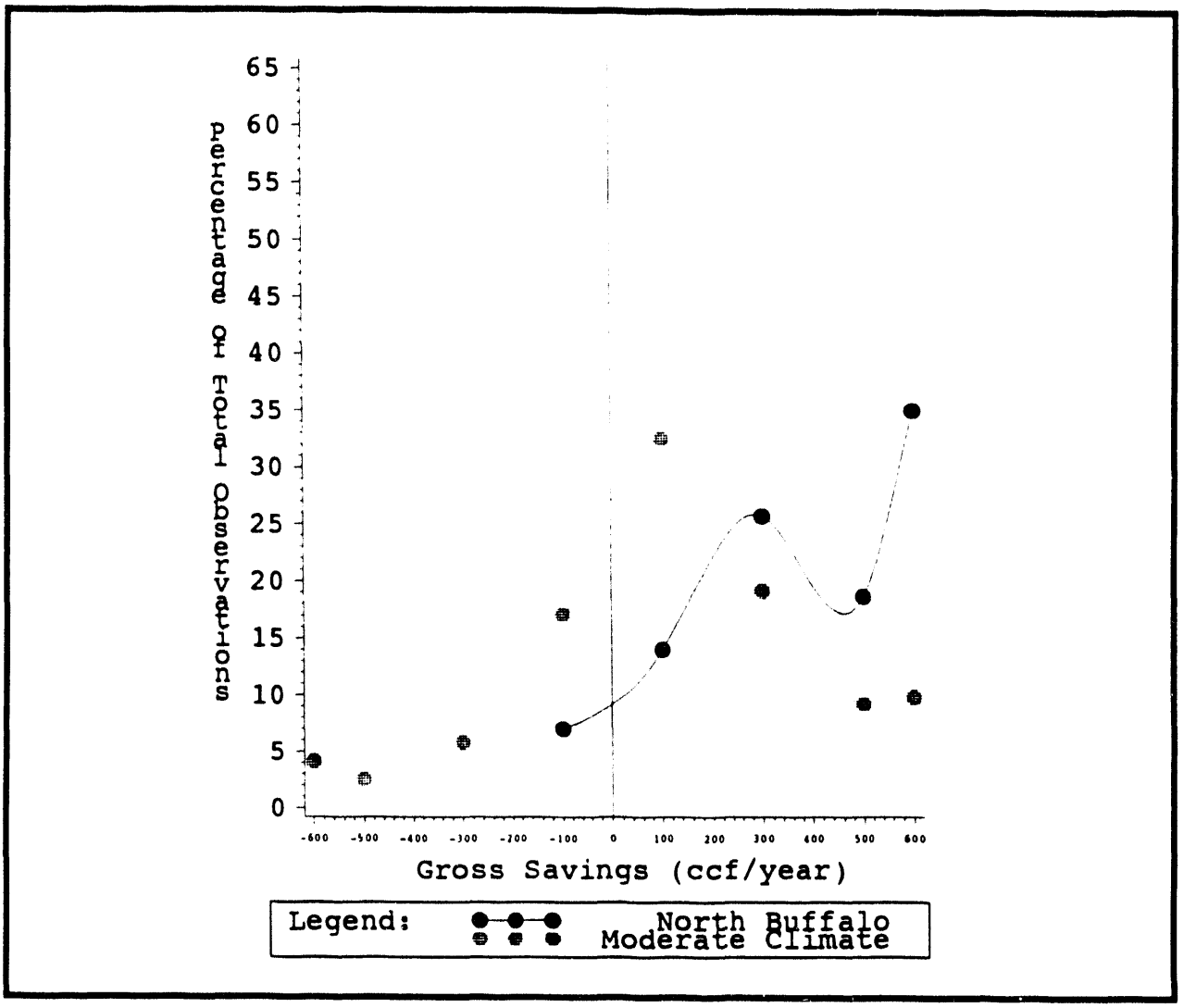


Fig. 7.5 Distribution of Savings of Dwellings Weatherized by the North Buffalo CDC

gross savings for agencies in the region was 177 ccf or about 13% of pre-retrofit gas consumption. When the increased consumption of the control group is considered, the net savings for the moderate climate region increases to 222 ccf/year or 16% of total gas consumption. A similar control group adjustment results in an estimate of the CDC program's net savings of 603 ccf/year. Although North Buffalo participants used 27% more gas before weatherization than did their counterparts in the region, the CDC weatherization participants used essentially the same amounts of gas after weatherization.

Weatherization costs at the CDC and for the region in PY 1989 were virtually identical. Average house-level weatherization costs at the CDC were only $74 (7%) higher than the regional average of $1,033.

In general, the CDC weatherization program in PY 1989 was highly cost effective. The program benefit/cost ratio exceeded the average for the region by more than 140% — 3.48 to 1.43. The societal benefit/cost ratio for the CDC was more than twice the average for agencies in the region — 4.09 to 1.79 (Fig. 7.6).

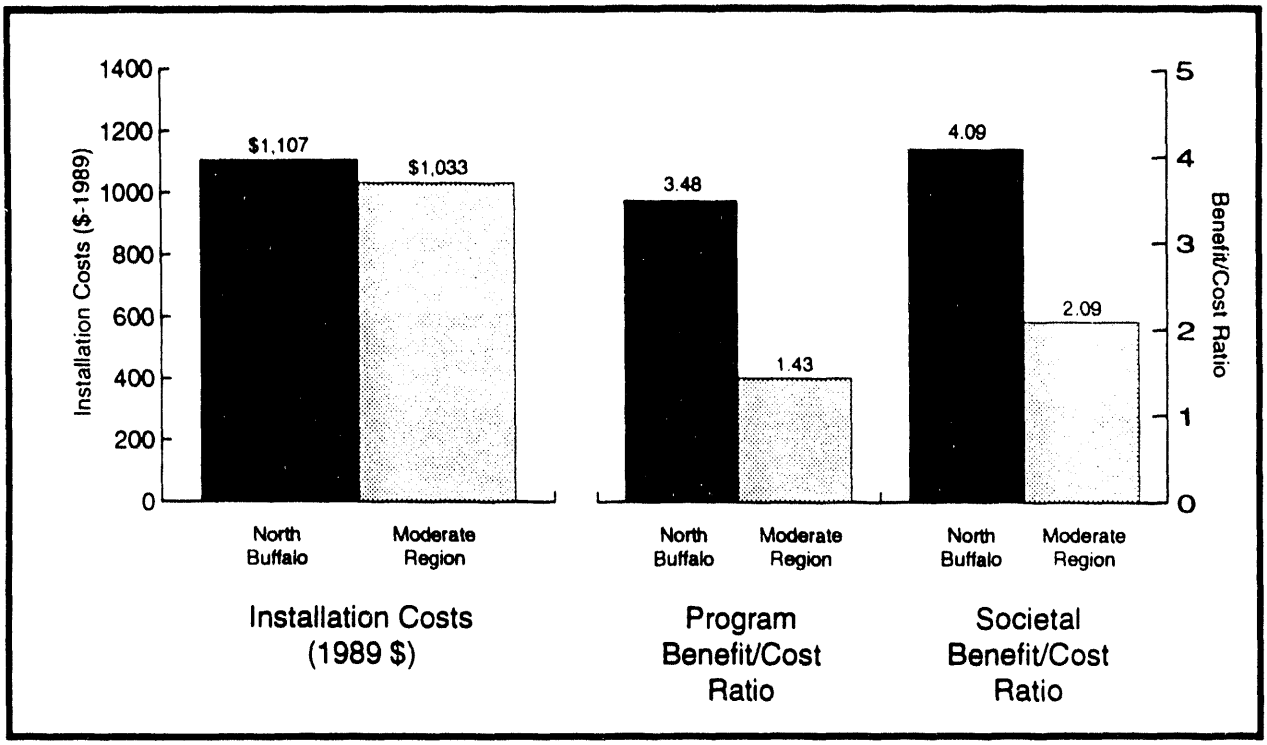


Fig. 7.6 Costs and Benefit/Cost Ratios for Dwellings Weatherized by the North Buffalo CDC

7.7 LEVERAGING AND COOPERATIVE EFFORTS

The former CDC Weatherization Director has suggested that leveraging funding might actually reduce the value of a particular service to the client. This is because co-funders may have conflicting objectives. However, in-kind assistance with recruiting like that provided by National Fuel Gas (NFG) benefited the CDC and its clients.

7.8 MONITORING AND EVALUATION

NFG conducts regular evaluations of residential energy conservation programs in its service territory. Some of the CDC's client housing units are included. The NFG evaluations are designed to identify tendencies or test marketing strategies, rather than to quantify the energy and non-energy impacts of its programs. When the CDC conducts its own follow-up about six months after weatherization, the tenant often has already moved out.

7.9 REASONS FOR SUCCESS

The Weatherization Director explained that the condition of the housing stock was probably the best predictor of energy savings. In North Buffalo the housing is old but well built. (Photo 7.1 shows the type of asbestos that is sometimes encountered in older structures. Photo 7.2 shows a well-built old home.) The housing can therefore be weatherized more easily and less expensively. Since the cost of energy was considerably lower at the time of construction, weatherization has a greater impact on energy use in a well-built but energy-inefficient house.

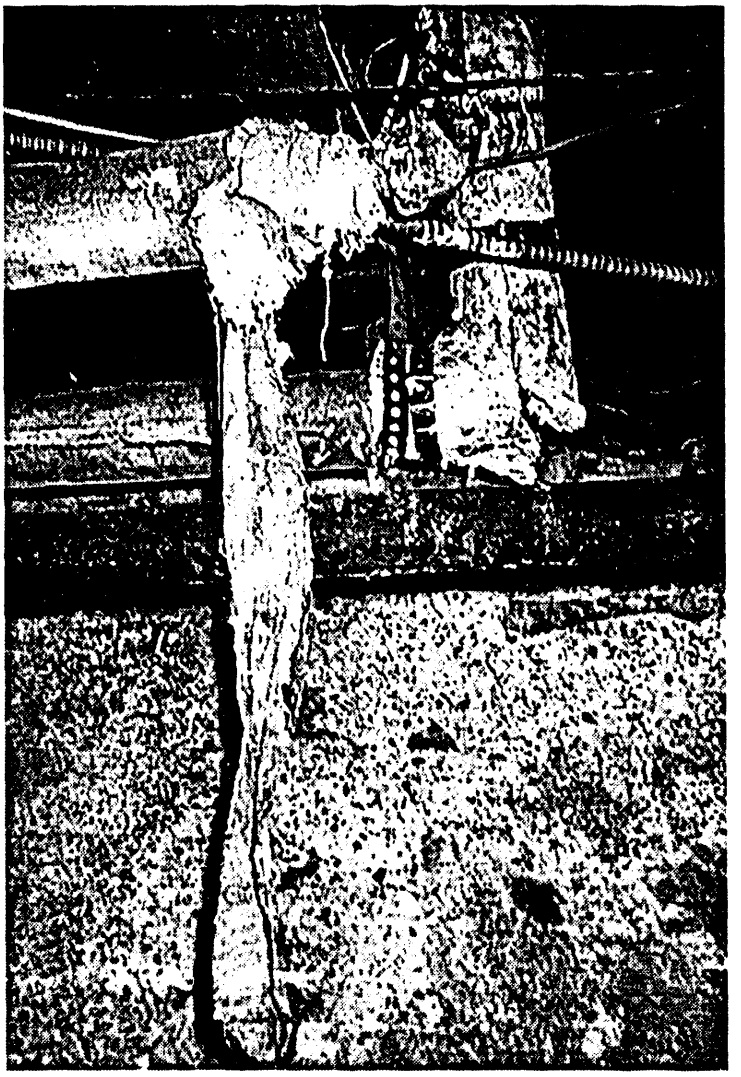


Photo 7.1 Many low-income dwellings in Buffalo have asbestos.

Photo 7.2 This large dwelling was weatherized by the North Buffalo CDC.

8. SCRANTON/LACKAWANNA HUMAN DEVELOPMENT AGENCY SCRANTON, PENNSYLVANIA

by Marilyn A. Brown

8.1 THE AGENCY AND ITS SERVICE AREA

Since 1976, the Scranton/Lackawanna Human Development Agency (SLHDA) has operated a large weatherization program in Northeastern Pennsylvania. The territory served by the agency includes Scranton and the surrounding towns and rural areas that comprise Lackawanna County. Scranton was founded in the 1800's around the Scranton brothers' iron furnaces located by the Lackawanna River. At that time, Northeastern Pennsylvania supplied 80% of the nation's coal, and was a major industrial center where anthracite mining, iron and steel, rails, textiles, and manufacturing combined to support a strong economic system. By the late 1890's, Scranton was among the 50 largest cities in the United States. With the replacement of anthracite by electricity, oil, and gas for home heating and industy, the region suffered a major economic downturn during the first half of the 1900's, losing more than 250,000 of its most employable workers. In the 1950's some of the county's leaders developed a community-action fund committed to revitalizing the economic base of the county. Its success is reflected by a drop in unemployment from a 1950's high of 20% to 9% in 1990. The outcome is an ethnically diversified population with a strong work ethic and a slightly older-than-average population.

8.1.1 The Agency

The Scranton/Lackawanna Human Development Agency has played an integral role in the recovery of the county. Its primary goal is to generate jobs. It operates approximately 20 programs including Head Start, Fuel Crisis Assistance, a job training program, and an older worker employment services program ("CHORES"). Of its total budget of approximately $6 million in 1992 (down from $11 million in the early 1980s), approximately $1 million supported weatherization.

Consistent with the focus of SLHDA, when asked about the goals of the weatherization program, the program manager, Bill Firjone, noted that after "saving energy," "creating jobs" was the next most important goal. Also noted were the objectives of housing rehabilitation, comfort, and safeguarding the health of clients.

8.1.2 The Housing Stock

The housing stock in Lackawanna County is much older than the average low-income dwelling in other parts of the United States. Many homes were built in the late 1800's and early 1900's. They tend to be both large and structurally sound, but leaky and with old and inefficient heating equipment. Indeed, between 5 and 10% of the dwellings weatherized by the agency during

PY 1989 still used coal as their main heating fuel — a remnant of the region's reliance on coal earlier this century. The vast majority of the county's low-income homes are either single-family or small multifamily. Only 9% of the dwellings weatherized in PY 1989 were mobile homes (Fig. 8.1). Thus, the housing rehabilitation requirements in Lackawanna County may not be as great as they are in other parts of the country.

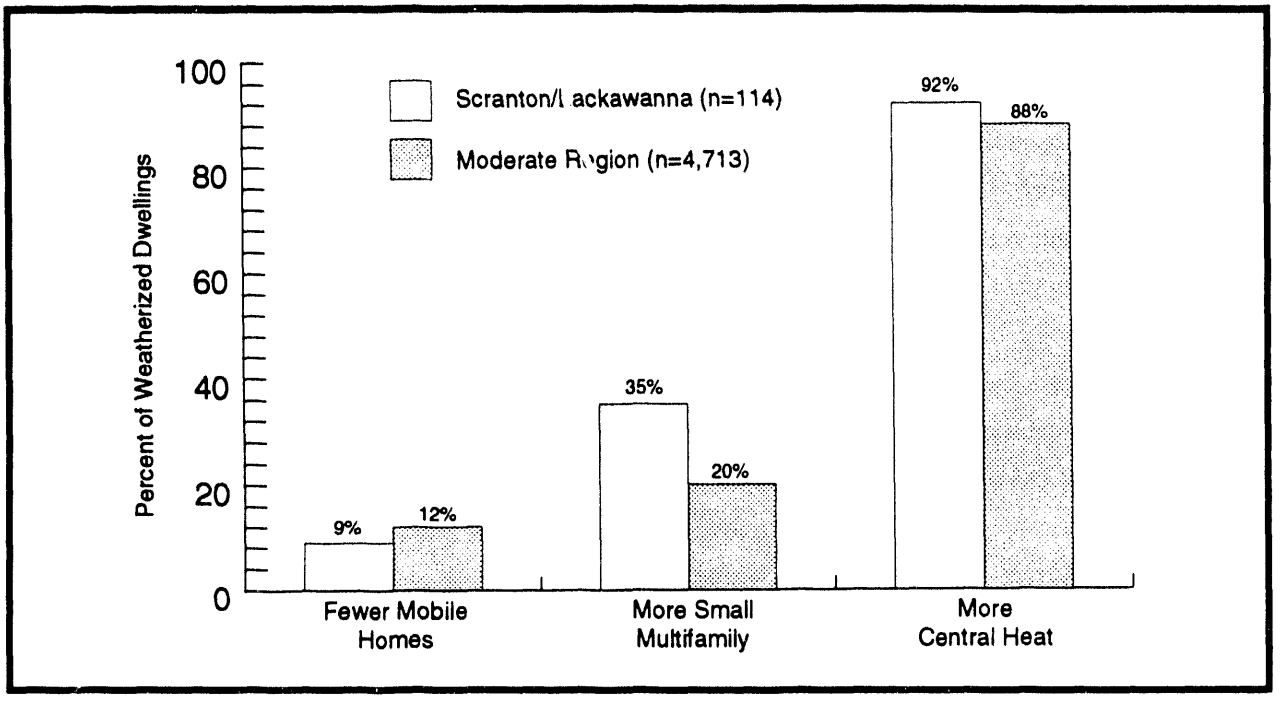


Fig. 8.1 Characteristics of the Housing Stock Weatherized by the Scranton/Lackawanna Human Development Agency

Just as the housing stock tends to be older than average, so are the low-income clients served by SLHDA. Almost half (48%) of the dwellings weatherized in PY 1989 had one or more elderly occupants, compared to an average of 26% in the moderate region as a whole. This results in special attention being given to health and safety issues by the SLHDA crews. The severity of Lackawanna County's winter weather (averaging 6,330 HDD per year) means that weatherization can prevent life-threatening situations.

8.2 WEATHERIZATION STAFF AND TRAINING

8.2.1 Weatherization Staff

Bill Firjone is the Weatherization Program Manager for the SLHDA. He has a Bachelor's degree in accounting, and prior to taking charge of the weatherization program in 1989, he was the accountant for several other programs in the agency.

The weatherization program currently has 13 full-time equivalent (FTE) employees. This is down from a total of 17 FTEs in PY 1989, when the budget for the program was significantly larger and three crews operated each day rather than two, which is the case today. The current duties of these 13 FTEs are outlined in Fig. 8.2.

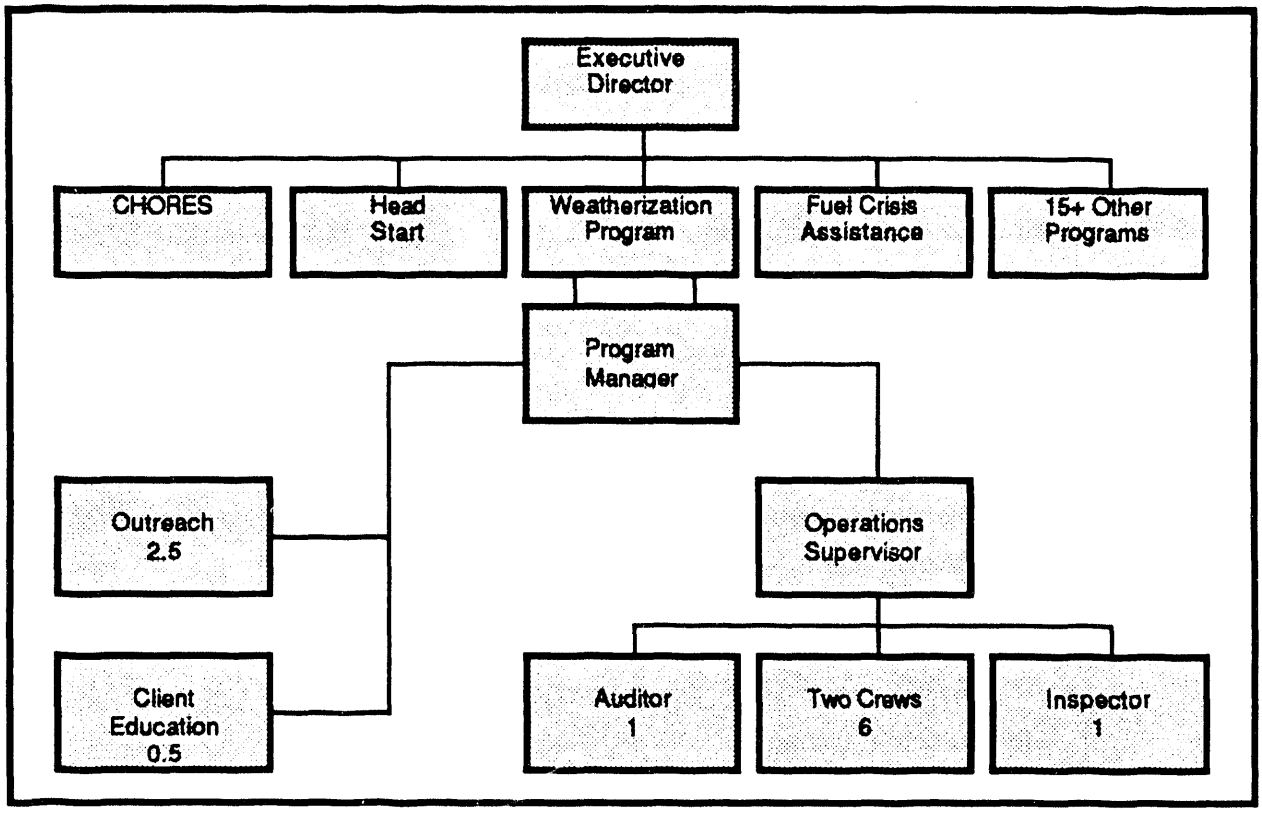


Fig. 8.2 Organizational Chart of the Scranton/Lackawanna Human Development Agency's Weatherization Program

Nine of the 13 employees are involved with the field work. They include the operations supervisor, an auditor, two crew chiefs, four crew members each, and an inspector. Each of the two 3-person crews has a certified furnace/boiler technician and two envelope specialists. The envelope specialists conduct the blower door testing, seal air leaks, and install storm windows and insulation.

The remaining four employees are primarily office staff. In addition to the weatherization program manager, they include 2-1/2 FTE's dedicated to outreach, and 1/2 FTE involved in client education. Additional duties of the office staff include the implementation of a computerized client tracking system, which was developed by one of the program's employees to track the progress of each job, from application, to certification of eligibility, estimation of the job requirements, and weatherization and inspection.

The two crew chiefs and three of the four crew members have a great deal of experience: each has had ten or more years of work in either weatherization or a related building trade. The operations supervisor, Joe Haddock, has also had years of experience in construction and weatherization. In the early 1970's, he had his own construction company. Then in 1976 he went to work for the SLHDA weatherization program — during its first year of operation. He began as a fiberglass installer. He was then promoted to crew chief in charge of a three-man crew. Next he became an estimator (a position that is now called "auditor"). He then became the crews supervisor, in charge of four crews and several inspectors. Most recently he was promoted to operations supervisor, which puts him in charge of the warehouse, coordinating jobs, and assisting with field work when the need arises.

Partly as a result of the national economic downturn, the weatherization program has had limited job turnover. Because of their seniority and experience, the crew's pay is fairly competitive — averaging approximately $10/hour.

8.2.2 Training

The agency relies on the Pennsylvania Weatherization Training Center located at Williamsport for its weatherization training needs. The Center's current courses include:

- Weatherization Tactics I & II
- Mobile Home Weatherization
- Home Energy Auditing
- Diagnostic Approaches to Weatherization (House Doctoring)
- Introduction to Residential Central Heat Systems
- Combustion Analysis and Retrofit
- In-Field Training

The crew chief was particularly pleased with the course on House Doctoring, which provided in-depth training on blower door usage. Because of the seniority of the agency's crews, however, the agency has not had an ongoing need to send each of its staff to the Williamsport Center on a frequent basis.

The SLHDA has supplemented the training offered by the Williamsport Center by taking advantage of additional opportunities. For instance, the two furnace and boiler crew members have regularly attended seminars offered by the Pennsylvania Petrolem Association on such topics as electrical wiring, burners, and chimneys. As a result, both of these HVAC staff are now Certified Master Technicians.

SLHDA does not use any contractors in its weatherization program. This is consistent with the agency's emphasis on the creation of jobs for Lackawanna County residents. It is also consistent with the experience of one local utility weatherization program, which found that SLHDA crews could install weatherization measures at a lower cost than private-sector contractors.

8.3 CLIENT RECRUITMENT AND SELECTION

Clients apply for weatherization assistance to SLHDA primarily as the result of referrals from other development programs operated by SLHDA, particularly the fuel crisis assistance program. In return, the weatherization program sometimes refers its clients to the other programs operated by SLHDA. This is one of the many benefits of operating a weatherization program within the infrastructure of a large, multi-program community action agency.

The weatherization program typically has a two- to three-month waiting list, but it is always much larger in the fall and winter than in the spring and summer. By promoting year-round demand for weatherization, the program hopes to manage more efficiently the agency's client in-take process.

Clients are selected mostly on a first-come, first-served basis. Emergency situations receive immediate attention, and an effort is made to meet the State of Pennsylvania's target for elderly persons and families with disabled members or young children. However, clients are not prioritized by level of energy consumption or utility payment arrears. All income-qualified applicants receive some amount of weatherization. These services may be limited by the dilapidated condition of a structure, as when attic insulation is not installed in homes that have an unsafe roof. But some weatherization measures will be installed nonetheless.

8.4 USE OF DIAGNOSTICS

The use of diagnostic equipment has grown steadily over the years. Blower door testing was initiated in 1987; by 1989 approximately one-quarter of the agency's weatherization jobs involved blower door testing; today the majority of homes benefit from blower door diagnostics. The blower door is used to assess the leakiness of a house before weatherization work begins. While the dwelling is depressurized, the crews locate the leaks. Smoke sticks are not used. The bare hand is believed to be sufficient. In particularly complicated situations, infrared testing may be conducted.

Other diagnostics are used in conjunction with furnace and boiler work. These include the use of gas leak detectors, carbon monoxide testers, and furnace efficiency testers. At present, the following types of equipment are used:

- Minneapolis blower door
- Infrared scanner

- Tiff 8800 (combustion gas detector)
- Sensit Leak Seek (heat exchanger leak detector)
- Bachrach 300 (furnace efficiency tester)

8.5 INSTALLATION OF MEASURES

8.5.1 Selection of Weatherization Measures

The SLHDA employs the Pennsylvania State Weatherization Program's prescribed list of weatherization measures to guide the selection of measures to be installed in individual homes. This priority list has been carefully developed and tested at the State level. Nevertheless, crews are encouraged by the SLHDA to be flexible and to use good judgment in deciding what is needed on a house-by-house basis. Each house is treated individually, and different amounts are spent on different homes.

Pennsylvania's priority list currently excludes storm doors, mobile home skirting, and cool seals on mobile home roofs. Furnace work was first allowed in 1985. By 1989 approximately half of the dwellings weatherized by SLHDA received a heating system tune-up or a heating system component retrofit. Common heating system retrofits include the addition of vent dampers, the replacement of clogged nozzles, and the installation of flame retention head oil burners.

8.5.2 Rates of Installation of Weatherization Measures

The broad coverage of both envelope and heating equipment measures distinguishes the SLHDA weatherization program from many others (Fig. 8.3). During PY 1989, the SLHDA program installed a variety of envelope measures, including: attic, floor, hot water pipe, and rim/band joint insulation; air sealing and general caulking and weatherstripping; and storm windows. Furnace and boiler work included clean and tunes, burner replacements, and the installation of vent dampers. In addition, the program promotes energy education through discussions with clients at the time of the weatherization and by leaving literature with the clients (e.g., *Energy Use: 50 Ways to be a Saver*).

Perhaps more distinctive than this breadth, however, is the program's emphasis on storm windows. In PY 1989, 90% of the weatherized dwellings received storm windows. Typically, storm windows were placed on every window in a dwelling's heated space that only had a single pane of glass. This emphasis contradicts the State Weatherization Program's recommendation that storm windows not be installed. However, the State allows the installation of storm windows (unlike storm doors, which are disallowed), and the SLHDA weatherization crews are convinced that their storm windows are cost-effective. The storm windows are placed on the outside of the primary windows,

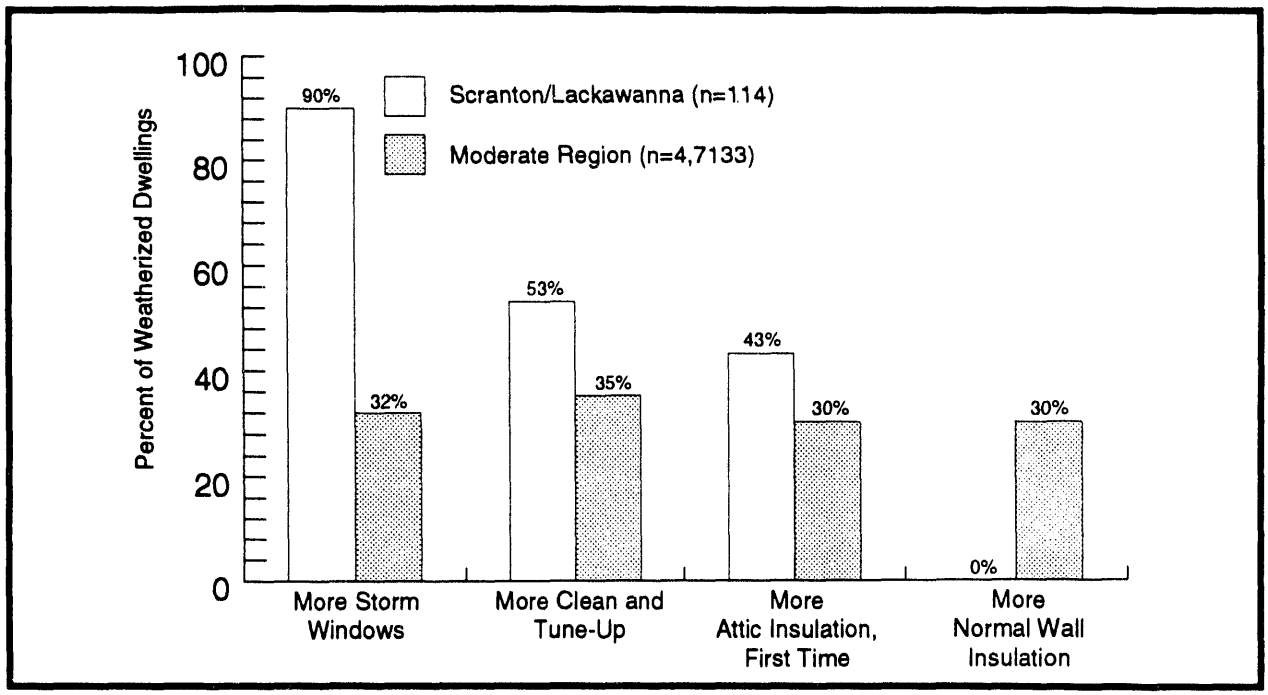


Fig. 8.3 Installation Rates for Selected Weatherization Measures Installed by the Scranton/Lackawanna Human Development Agency

reducing air infiltration and draftiness, postponing or preventing the need for replacement windows. The clients tend to be more pleased with the storm windows than any other feature of the weatherization job. Storm and replacement windows, in addition to reducing air infiltration, can significantly improve the appearance and longevity of low-income housing (Photo 8.1).

Attic insulation was added for the first time to 43% of the dwellings weatherized in PY1989, and other homes had cellulose insulation blown into attics which had some pre-existing insulation. The addition of attic vents is a common component of this work. Photo 8.2 illustrates the degree of moisture damage that occurred when one owner added attic insulation, and before the SLHDA arrested the problem with the addition of vents.

The SLHDA weatherization program has elected not to install certain measures, even though they are allowed by the State. No wall insulation, for instance, was installed in PY 1989, and it is not a part of the current program, either. Some clients have double-boarded walls, which make blown-in insulation difficult. In other instances, the program director believes that drilling and plugging holes may create aesthetic problems. Nevertheless, wall insulation continues to be considered as a possible addition sometime in the future.

Photo 8.1 This home received storm and replacement windows.

The SLHDA weatherization program also does not install water heater blankets. At a 1988 meeting with representatives of the Pennsylvania Gas and Water Company the utility indicated that it did not want gas-fired water heaters in its service area to be wrapped. They were concerned that the blankets could slip down and create a fire hazard. Electric water heaters, on the other hand, are wrapped by the agency, but they are much less common than gas water heaters.

Finally, the program does not generally install either electronic ignition systems or setback thermostats. Electronic ignition systems have proven in the past to be too undependable, and when they malfunction the client must pay more than $100 for a technician to fix them. In addition, the crews believe that pilot lights can extend the lifetime of a burner by preventing rust when the burner is not being used. Setback thermostats are a low priority because the program has found that clients do not know how to use them effectively, particularly elderly residents.

If a gas furnace or boiler needs to be replaced, the client is referred to PG&W's furnace program.

Photo 8.2 Substantial moisture damage occurred in this attic as the result of owner-installed insulation. SLHDA arrested this problem by adding attic vents, at the same time that they blew in additional cellulose insulation.

8.5.3 Warehousing and Materials Procurement

The warehousing and materials procurement system employed by SLHDA contributes significantly to the success of its weath zation program. SLHDA rents a 6,500 square foot warehouse that stores a considerable stock o weatherization supplies and equipment. Much of the warehouse area is dedicated to storing a wide ariety of storm windows, so that most of the needs of its crews can be met without having to custom-order and wait for a particular size and type of window. The large stock of supplies also allows the program to install materials that blend with the structure's existing color scheme and building materials — for instance, wood can be stained to match the weatherstipping and window casings on a home.

Some weatherization materials are custom-made, and the warehouse has the carpentry and other equipment necessary to allow the crews to perform most of this work. For instance, attic domes are fabricated to fit the dimensions of individual attic hatched, and plywood and insulation panels are created to fill specific holes and thermal bypasses.

At least once a year the agency solicits bids for $10,000+ purchases of materials. This has resulted in material costs that are often 20% lower than local wholesale prices and substantially lower than retail prices. For instance, standard storm windows are purchased through competitive procurements for as little as $35 each. The program director believes that this has been one of the keys to the success of the program's emphasis on storm windows.

8.5.4 Quality Control

Quality control is maintained by having every job inspected and signed off by the agency's own inspector/auditor. As each job nears completion, the inspector is dispatched to the job site. If there are problems, the corrections typically are made on the spot without requiring a return trip. If any special materials must be purchased to complete the job, or if any window repair is required, the inspector will deliver these before the end of the day.

Blower door testing is conducted in approximately 25% of these inspections. Heating system diagnostics are completed as part of virtually every inspection.

The agency provides the client with a verbal, one-year warranty on its work. At any point during this one-year period, the client simply needs to call the agency and it will dispatch a technician to correct the problem or to redo any faulty work. Over the past year, callbacks have occurred in less than 1% of the weatherized dwellings.

8.6 LEVERAGING AND COOPERATIVE EFFORTS

The SLHDA weatherization program described above is funded by a combination of DOE Weatherization Assistance Program and PVE resources. In PY 1989, approximately $350,000 was received from DOE and $683,000 of PVE funding was received from the State. (The level of PVE funding has decreased markedly since 1989, resulting in a total budget of only $750,000, or approximately 25% less than in 1989.) The State elected to operate the PVE weatherization program under HHS/LIHEAP weatherization rules, which allow a maximum of $1800 per home, and up to 70% can be spent on labor, thus giving greater flexibility than the DOE Program. In essence, however, the two programs operate in an identical fashion.

The DOE funding cycle lasts about seven months, and the PVE funding cycle covers the remaining five months. During the last few months of each of these two funding cycles, the weatherization program manager, Bill Firjone, assesses how much money can be spent in order to stay

within the DOE and PVE guidelines. He then directs work accordingly. Clients may have to be delayed until the next funding cycle so that the necessary weatherization measures can be installed.

SLHDA also operates two weatherization programs for local utilities. Both utility programs were initiated as the result of a Pennsylvania Utility Commission mandate requiring utilities to launch demand-side management programs for low-income customers.

Both of these utility programs operate independently of DOE's Weatherization Assistance Program. They are separate private ventures of the SLHDA, with no co-mingling of DOE and utility funds. The crew members for the DOE program also staff the utility programs by performing the utility work during late afternoon and weekend hours. They are paid straight time (not time and a half), which helps contain the utility program's costs. At the same time, the additional income improves the job satisfaction of SLHDA crew members by allowing them to increase their earnings, if they choose to do so.

The Pennsylvania Power & Light (PP&L) weatherization program began in 1985. At that time SLHDA was one of five contractors conducting weatherization for PP&L. Within a year the agency became the only contractor because it proved to be most cost competitive. The program is limited to low-income customers with electric heat, and the utility provides the list of customers for SLHDA to contact. In addition to serving Lackawanna County residents, SLHDA also serves Monroe County residents as part of the PP&L program. The diagnostics and weatherization measures use in the PP&L program are the same as those used in the DOE Program, except that storm doors are an allowable expenditure.

The Pennsylvania Gas and Water (PGW) weatherization program began in 1987. As with the PP&L program, the utility provides the list of customers for SLHDA to contact. The PGW list includes low-income customers with gas heat, high levels of gas consumption, and significant arrears. SLHDA serves only Lackawanna County residents, in the PGW program (as in the DOE Program). The diagnostics and weatherization measures used in the PGW program are the same as those used in the DOE Program, except that furnace and boiler replacements are an allowable expenditure. The utility programs have no 60/40 requirement for labor, and their spending limits per dwelling tend to be higher than for the DOE Program, but the weatherization work nevertheless tends to be similar.

8.7 PROGRAM SAVINGS, COSTS, AND COST EFFECTIVENESS

Pre- and post-weatherization consumption data were available for a random sample of 54 gas-heated dwellings weatherized by SLHDA with DOE Program or PVE funds during PY 1989. These billing histories were weather-normalized using PRISM, in order to estimate the normalized annual consumption of these homes before and after weatherzation (Table 8.1 and Fig. 8.4). The results indicate that Lackawanna County's weatherization clients consumed more home heating fuel (1,800 ccf/year of natural gas) prior to weatherization than clients in the moderate region at large (with only

Table 8.1 PRISM Model Parameters for the Scranton/Lackawanna Human Development Agency

	Intercept (ccf/Day)	Heating Slope (ccf/°F Day)	Temperature Dependent Use (ccf/Year)	R^2	Reference Temperature (°F)
WEATHERIZED GROUP (N = 54)					
Pre-Weatherization	0.86 (0.73)	0.29 (0.03)	1539 (181)	.93	63.50 (4.74)
Post-Weatherization	0.77 (0.49)	0.24 (0.03)	1376 (106)	.92	63.70 (4.31)

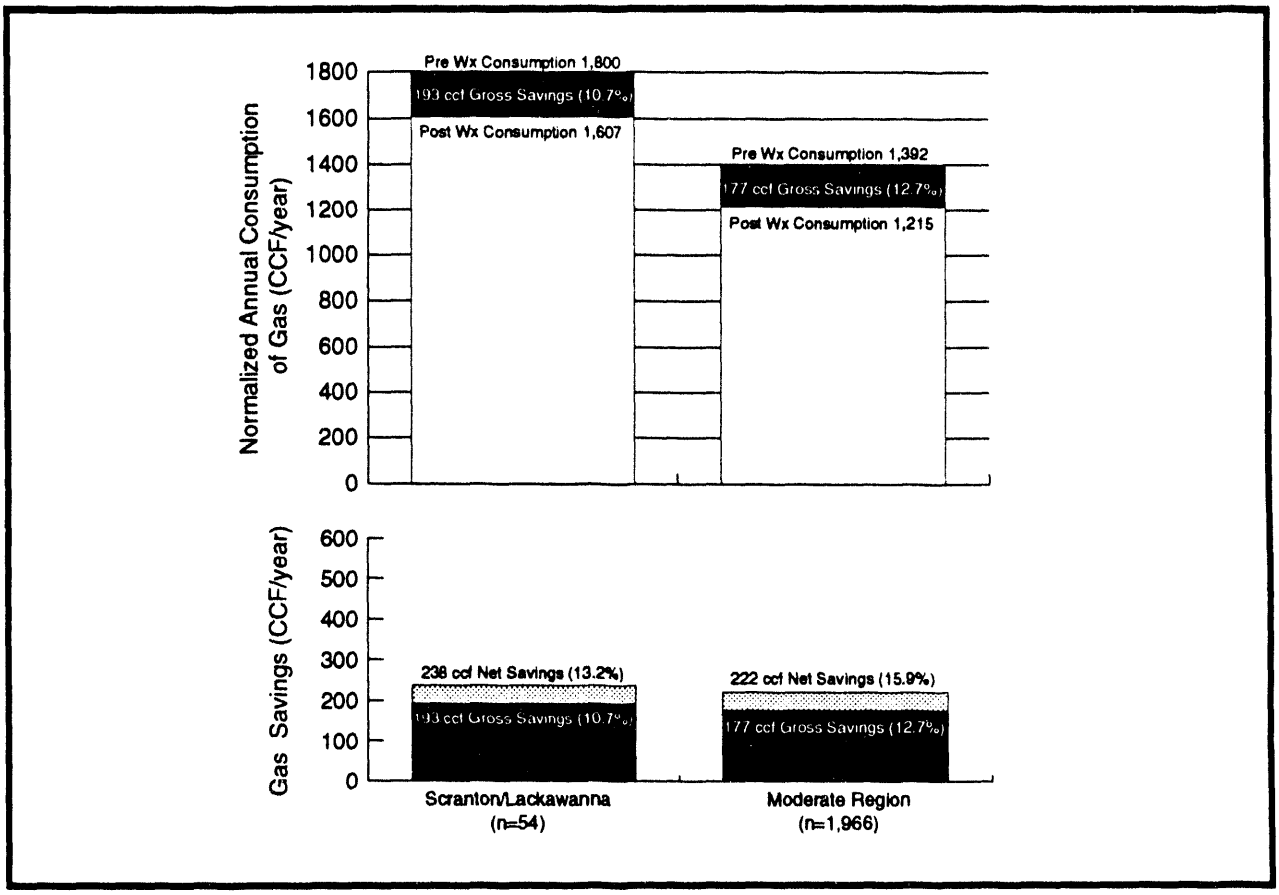


Fig. 8.4 Normalized Annual Consumption and Savings of Dwellings Weatherized by the Scranton/Lackawanna Human Development Agency

1,392 ccf/year). The intensity of Lackawanna County's energy use reflects the severity of its weather relative to the rest of the moderate region (6,300 HDD's for Lackawanna County vs. 5,600 HDD's for the moderate region).

On average, gas-heated dwellings weatherized by SLHDA reduced their gas consumption by 193 ccf/year, or 10.7% of their pre-weatherization gas consumption. This is 9% more than occurred in the rest of the moderate region, which reduced consumption by 177 ccf/year (or 12.7% of pre-weatherization consumption). These estimates represent gross savings. When the increased consumption of the control group is considered, the net savings for the moderate region increases to 222 ccf/year (or 15.9%). A similar control group adjustment also can be made to estimate the SLHDA program's total energy impact. The result is an estimated net savings of 238 ccf/year (or 13.2% of pre-weatherization consumption). This percentage is lower than the region-wide average because of the high level of gas consumption that typified Scranton's participants prior to weatherization. As Fig. 8.5 illustrates, very few of the dwellings weatherized by SLHDA consumed more gas after weatherization than before.

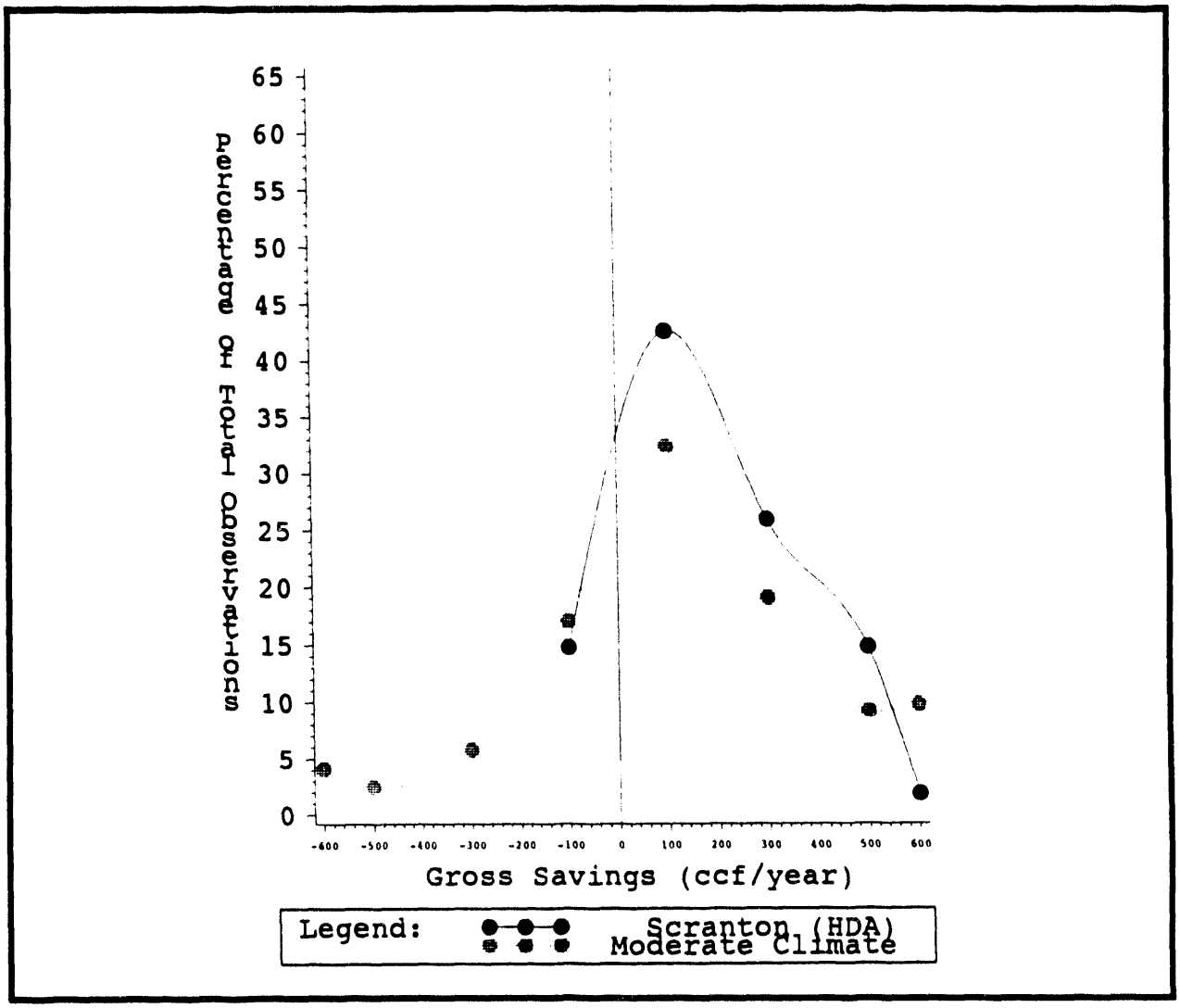


Fig. 8.5 Distribution of Gross Savings of Dwellings Weatherized by the Scranton/Lackawanna Human Development Agency

The Weatherization Program Manager, Bill Firjone, believes that the savings documented for his program would be greater if it were not for several "takeback effects." The utility programs pay the SLHDA to conduct remedial energy education visits with households that do not reduce their energy consumption after weatherization. These visits have indicated at least three reasons for the lack of savings: (1) weatherization participants often reduce their use of kerosene and other space heaters after weatherization; (2) they often maintain warmer indoor temperatures during winter, after weatherization; and (3) they open up rooms that were previously closed off and left unheated during winter. Mr. Firjone feels strongly that these are important nonenergy benefits that warrant consideration when evaluating his agency's activities.

In addition to its higher-than-average gas savings. SLHDA also had lower-than-average weatherization program costs. On average, $700 in materials and labor costs were spent on each dwelling weatherized during PY 1989. This compares to an average cost of $1,033 for agencies in the moderate region (Fig. 8.6). It is estimated that an additional $500 is spent on installation-related overhead and management costs, per dwelling, for both the SLHDA program and the moderate region as a whole.

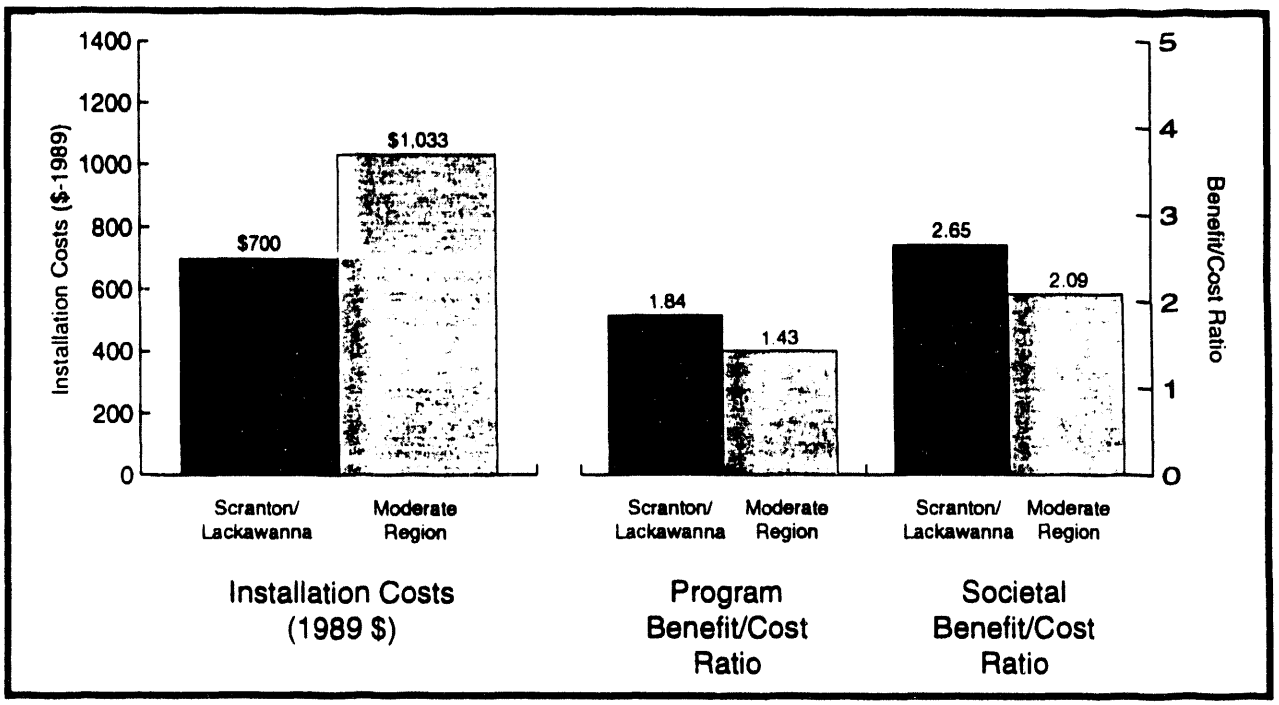


Fig. 8.6 Costs and Benefit/Cost Ratios for Dwellings Weatherized by the Scranton/Lackawanna Human Development Agency

These lower costs in combination with higher energy savings result in a benefit/cost ratio of 1.84 for the SLHDA weatherization program compared to a benefit/cost ratio of 1.43 for the moderate region. These benefit/cost ratios are a "worst case" estimate because they reflect only the

benefit of reduced gas consumption but include all costs (i.e., both the material and labor costs associated with the weatherization and the additional $500 spent on installation-related overhead and management costs). This is defined in Brown et al. (1993) as the "program perspective." If the estimated $976 of nonenergy benefits such as employment and reduced environmental damages are also included (i.e., the "societal perspective"), the benefit/cost ratio increases to 2.65 for the SLHDA program and 2.09 for the moderate region. Thus, the cost effectiveness of the SLHDA weatherization program far exceeds that of the moderate region (Fig. 8.6).

8.8 REASONS FOR SUCCESS

The success of the SLHDA's weatherization program can be attributed to a combination of factors, including the housing stock that has high savings potential, a comprehensive and individualized weatherization strategy, well trained and experienced staff that includes both envelope specialists and furnace and boiler technicians, and a materials procurement and warehousing system that leads to considerable cost savings.

III. HOT CLIMATE REGION

III. HOT CLIMATE REGION

The two high performers in the hot region significantly outperformed the sample of 16 agencies that represent the baseline for that region (Table III.1). The two high performers spent less per weatherization job ($1,284 vs $1,416), and they reduced gas consumption by more than twice as much (102 ccf/year, on average, for each weatherized dwelling compared to 39 ccf/year). These savings represent a 20% reduction in gas use for space heat (and a 15% reduction in total gas use) over pre-weatherization consumption levels for the high performers, and an 8% (and 6%) reduction in gas use for the 16 agencies region-wide. Accordingly, the cost effectiveness of the high-performing programs greatly exceeds that of the cross-section of 16 agencies, based on both the "program" and "societal" benefit/cost ratios.

Table III.1 Performance Indicators of the Hot Climate Region

	2 High Performers	16 Agencies
Pre-weatherization Normalized Annual Consumption (in ccf/year)	704	714
Gross Gas Savings (in ccf/year)	114	51
Net Gas Savings (in ccf/year)	102	39
Net Gas Savings as a Percent of Gas Use for Space Heat	20.4%	7.7%
Net Gas Savings as a Percent of Total Gas Use	14.5%	5.5%
Installation Costs (in 1989 $s)	$784	$916
Total Costs (in 1989 $s)	$1,284	$1,416
Program Benefit/Cost Ratio	0.82	0.23
Societal Benefit/Cost Ratio	1.58	0.96

The analysis of high performers in the hot climate region is based on less data than the analysis of high performers in either of the other two regions. Perhaps because of this, the pattern of differences shown in Table III.2 does not conform closely to the pattern of differences identified in the other two regions. The two high performers installed more first-time attic insulation, furnace clean and tune-ups, and furnace replacements, but they did not install more wall insulation or hot water heater measures than did the 16 agencies regionwide. Further, they installed more storm windows, not fewer (as was the case nationwide). The high rate of installing storm windows is due to

one of the region's high performers, Clayton County Community Services Authority, which installed storm windows in 77% of the dwellings it weatherized in 1989.

Table III.2 Characteristics of Gas-Heated Weatherized Dwellings, Occupants, and Measures Installed by Agencies in the Hot Climate Region

Dwelling and Occupant Characteristics of Clients Served in Program Year 1989	2 High Performers	35 Agencies
Dwelling Type (percent):		
Single-Family Dwellings	85	83
Mobile Homes	11	12
Small Multifamily Dwellings	4	5
Age of Dwellings (years)	34	36
Area of Heated Space (square feet)	1,088	1,016
Central Heating Systems (percent)	65	36
Supplemental Heating Fuel (percent)	40	36
Occupants per Dwelling	2	3
Elderly Occupants (percent)	71	53
Household Income (in 1989 $s)	7,123	7,043
Owner-occupied Dwellings (percent)	88	78
Measures Installed (percent of dwellings that received measure)	**2 High Performers**	**35 Agencies**
Attic Insulation (first-time)	32	30
Attic Insulation (added to existing)	7	11
Wall Insulation (normal density)	0	1
Wall Insulation (high density)	0	0
Floor Insulation	9	1
Air Sealing with Blower Door	6	4
Furnace Cleaned and/or Tuned-up	30	3
Furnace Replacement	5	0
Hot Water Tank Insulation	24	28
Hot Water Pipe Insulation	23	20
Low-Flow Showerheads	6	15
Water Temperature Setback	0	6
Storm Windows	52	37
Window Repair	54	57

9. CLAYTON COUNTY COMMUNITY SERVICE AUTHORITY FOREST PARK, GEORGIA

by Linda Berry

9.1 THE AGENCY AND ITS SERVICE AREA

9.1.1 The Agency

The Clayton County Community Service Authority (CSA) is located just south of Atlanta in suburban Forest Park, Georgia. It serves a three county area (Clayton, Fayette and Henry) in a mixed suburban/rural setting. The Clayton County CSA operates several social service programs, including child development (day care and Head Start), assistance with utility bills (LIHEAP), transportation, food distribution, and homeless programs.

The Clayton County CSA also operates a small weatherization program that weatherized 89 houses in the 1989 Program Year (PY 1989), with a total budget of $74,000, which consisted entirely of DOE funds. The weatherization program has been operating continuously since 1976.

9.1.2 The Housing Stock

Fifty-nine percent of the homes weatherized by the Clayton County CSA in PY 1989 had central heating systems, compared to 36% for the hot region (Fig. 9.1). Further, none of the homes

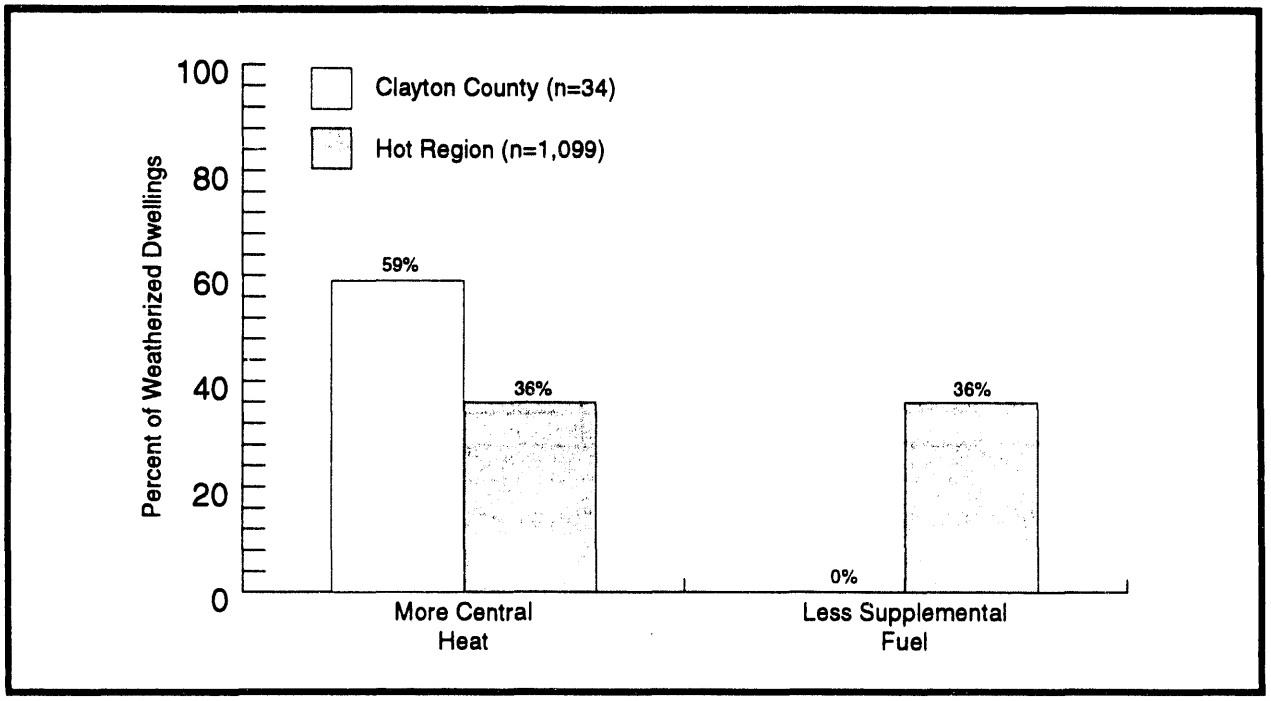


Fig. 9.1 Characteristics of the Housing Stock Served by the Clayton County CSA

in the agency sample used supplemental heating fuels, although about 39% of the homes weatherized by agencies in the hot region did in 1989. The prevalence of central heating and the absence of supplemental heating fuels indicates that the housing stock weatherized by the Clayton County CSA has greater potential for saving gas relative to other agencies in the same region. The dwellings served by this agency were about the same average size (963 square feet) and age (33 years) as was typical for the region.

Many of the Program-eligible houses in this agency's service area are in very poor condition. Uneven settling in the dwellings produces large gaps between non-loadbearing walls and ceilings, and around doors and windows, that allow extremely high levels of air infiltration. Many of the dwellings have broken windows and doors, are extremely drafty, and have no insulation before they are weatherized. Program spending limits often permit installation of only a few of the measures that would be needed to completely tighten and weatherize a house.

9.2 WEATHERIZATION STAFF AND TRAINING

In PY 1989 all field work was done by an in-house crew of two workers. At that time, the weatherization agency employed four people, with about two full-time equivalent employees involved in management, administration, outreach, and support functions; and two working as crew members. The same two crew members are still installing all weatherization measures today. Both crew members have extensive experience. One has worked for the weatherization program for seven years and one for nine years. The current director joined the agency in 1991, while the materials specifier has worked at the agency since 1989. The current director is highly qualified for his position. He is a former manager for Eastern airlines and he has extensive experience in home construction and the building trades.

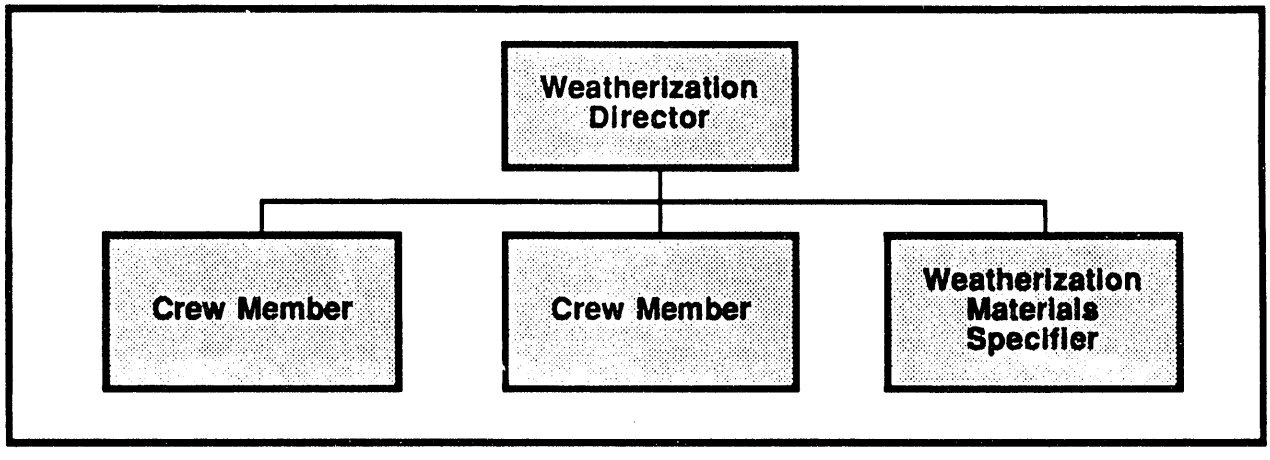


Fig. 9.2 Organizational Chart of the Clayton County CSA Weatherization Program

This agency's staff (managers and crew) generally participates in two to three training activities per year. Each year they attend DOE's National Weatherization Conference and one or two training programs offered by the State. The staff generally adopts the recommendations of the training sessions. For example, in response to a training session that included a notebook detailing specifications for materials, they changed their ordering procedures and some of their suppliers to conform with these specifications. They also purchased a blower door in July of 1992 and are beginning to use it. A training session on wall insulation did not lead to adoption, however, because the installation procedure seemed excessively time consuming and ineffective to the staff.

9.3 CLIENT RECRUITMENT AND SELECTION

Client recruitment was largely by word-of-mouth in PY 1989. Little advertising was necessary. Sometimes managers of mobile home parks were contacted in Fayette County to recruit a sufficient number of participants. In Clayton and Henry Counties this has not been necessary, because there is usually a waiting list of about ten dwellings.

Almost all clients who applied for services and were income-eligible received weatherization. A few houses were not weatherized because their condition was so poor (e.g., leaking roofs, deteriorating walls or floors, collapsed ceilings) that it was not possible to install effective energy-efficiency measures.

9.4 USE OF DIAGNOSTICS

Blower door testing, distribution system testing, and heating/cooling diagnostics were not performed on any of the dwellings this agency weatherized in PY 1989. The staff participated in a blower door training session in 1991 and purchased a blower door in 1992. They are beginning to use the blower door to locate areas for sealing as they work on their houses, and they see promising potential for doing air sealing more effectively with this technology.

9.5 SELECTION OF WEATHERIZATION MEASURES

The DOE priority list, as required by the State of Georgia, was used to select measures for all dwellings in PY 1989 (and is still used today). A copy of this priority list is shown in Appendix C. Infiltration reduction measures, were the highest priority measure, followed by ceiling and floor insulation. Storm windows and wall insulation appeared at the end of the priority list. Heating system measures do not appear on the list. In spite of the very poor condition of many houses, the program manager tried to do as little repair work as possible. Because he defined his mission strictly as saving energy, his focus was on weatherization measures. Housing rehabilitation and repairs were done only when no weatherization could take place without them.

The program manager and a member of the crew went to each house to set priorities, make measurements and plan the work to be done. After returning to the office, the necessary materials were ordered. Materials were purchased at retail prices, from Home Depot in Atlanta, loaded into the agency's truck and warehoused for up to one month. After the materials arrived, the crew returned to the house to begin installing the measures selected.

9.6 INSTALLATION OF MEASURES

No water heating, wall insulation, or heating/cooling measures were installed by this agency in PY 1989. The staff tried doing heating system work on a small scale but has discontinued such work because it was considered too time-consuming and labor intensive. Much higher proportions of dwellings received first-time attic insulation (56%), than was typical of agencies in the region (30%) (Photos 9.1 and 9.2). This high rate of first-time attic insulation suggests that homes in Clayton County have particularly low levels of prior attic insulation. More of this agency's dwellings received floor insulation (18% vs. 1%) and storm windows (77% vs. 37%) than was typical for the hot region (Fig. 9.3 and Photos 9.3 and 9.4).

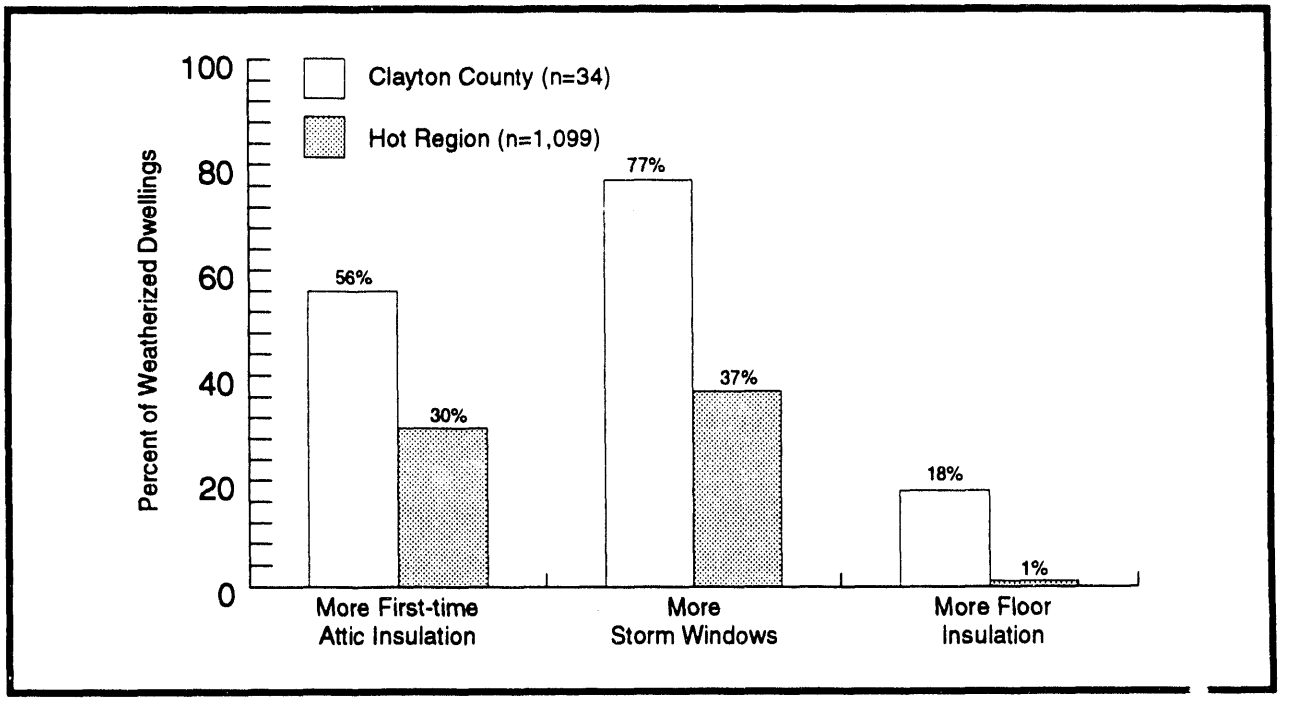
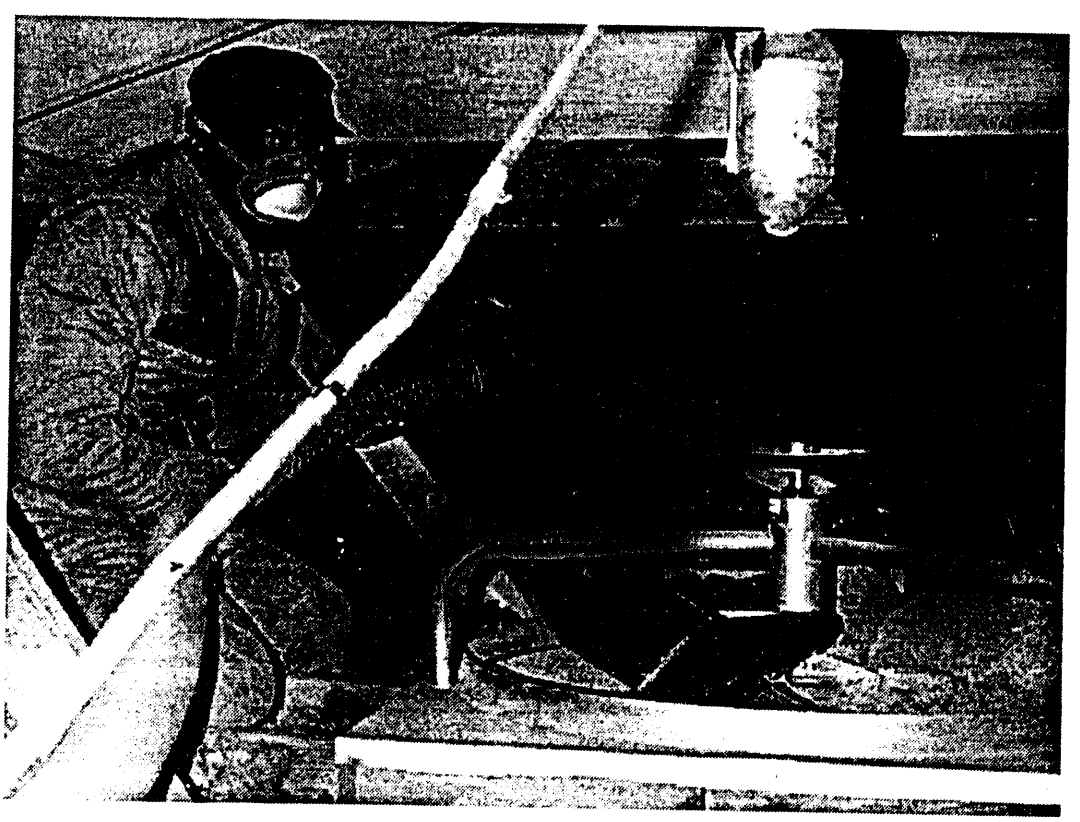
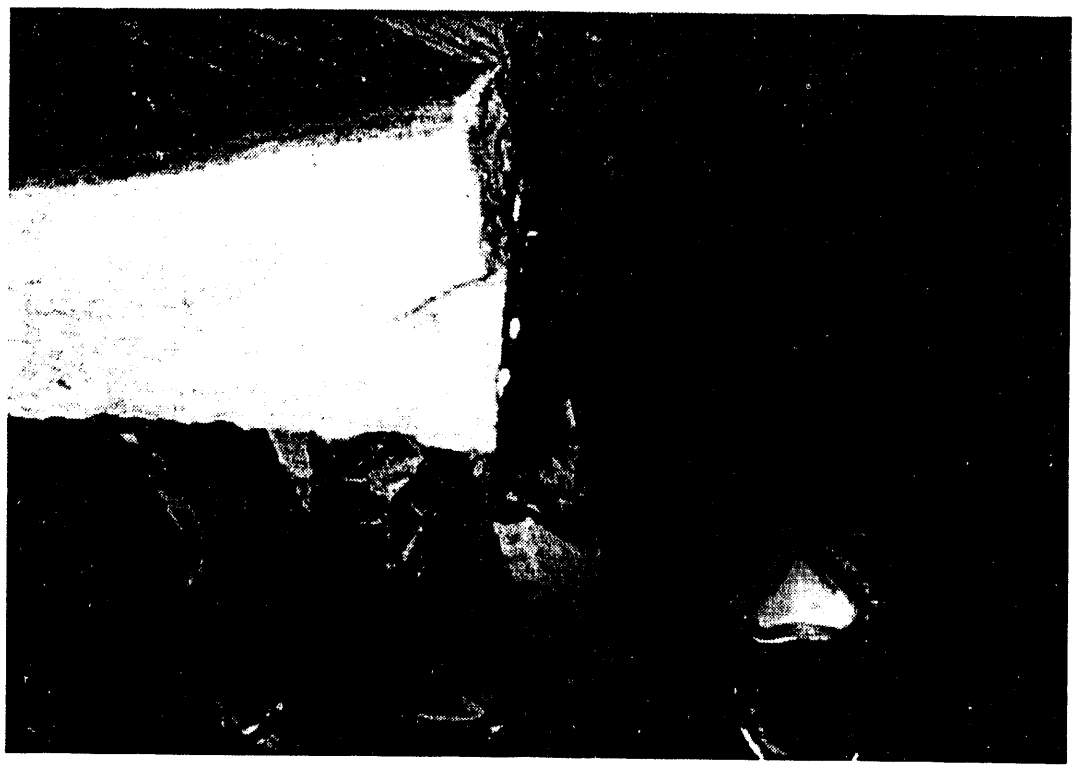
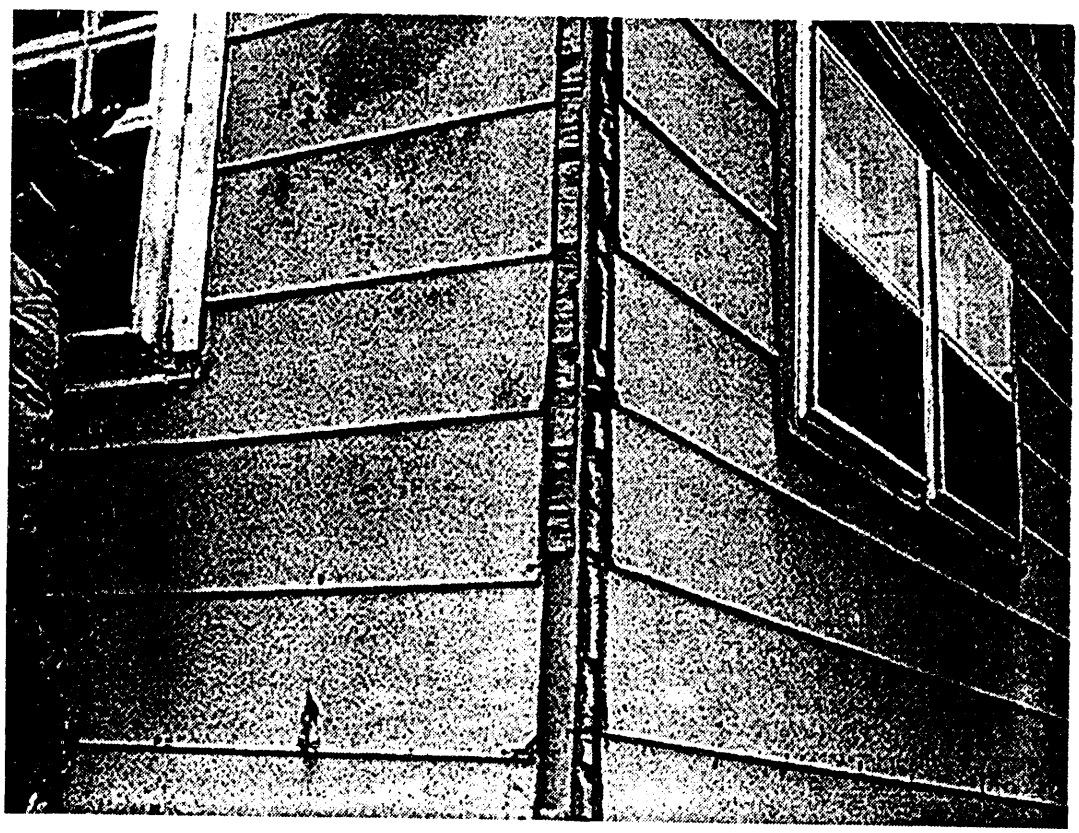


Fig. 9.3 Installation Rates for Selected Weatherization Measures Installed by the Clayton County CSA Weatherization Program



Photos 9.1 and 9.2 More than half of the homes weatherized by the Clayton County CSA received first-time attic insulation.





Photos 9.3 and 9.4 The Clayton County program installs floor insulation and storm windows at more than twice the rate of the hot region as a whole.

9.7 QUALITY CONTROL PROCEDURES

The current program manager, who has extensive experience in residential construction, closely supervises all of the weatherization jobs completed by his agency. He inspects the ongoing weatherization work daily. State inspectors also examine weatherization jobs and recordkeeping about every six months.

9.8 LEVERAGING AND COOPERATIVE EFFORTS

There were no leveraged funds or cooperative efforts in PY 1989. The 1992-93 budget includes Exxon and Stripper Well funds. All of these funds will be used according to DOE guidelines. Georgia's Public Utility Commission has recently mandated that Georgia's investor-owned utilities invest in low-income demand-side management programs, which may provide opportunities for utility support of the agency's weatherization work.

9.9 PROGRAM SAVINGS, COSTS, AND COST EFFECTIVENESS

Pre- and post-weatherization consumption data were available for a random sample of 16 gas-heated houses weatherized by Clayton County CSA with DOE Program funds in PY 1989. Utility billing histories for these dwellings were weather-normalized using PRISM, in order to estimate the normalized annual consumption of these houses before and after weatherization (Table 9.1 and Fig. 9.4).

Table 9.1 PRISM Model Parameters for Clayton County Community Services Authority

	Intercept (ccf/Day)	Heating Slope (ccf/°F Day)	Temperature Dependent Use (ccf/Year)	R^2	Reference Temperature (°F)
WEATHERIZED GROUP (N = 16)					
Pre-Weatherization	0.57 (0.18)	0.18 (0.02)	526 (37)	.95	65.28 (2.23)
Post-Weatherization	0.54 (0.15)	0.15 (0.02)	432 (38)	.97	66.84 (2.61)

The PRISM results indicate that Clayton County's weatherization clients consumed slightly less natural gas prior to weatherization than was typical of gas-heated homes in the hot climate region. This is the case even though the Clayton County area has more heating degree days (3,021 HDD) than the hot region as a whole (2,661 HDD).

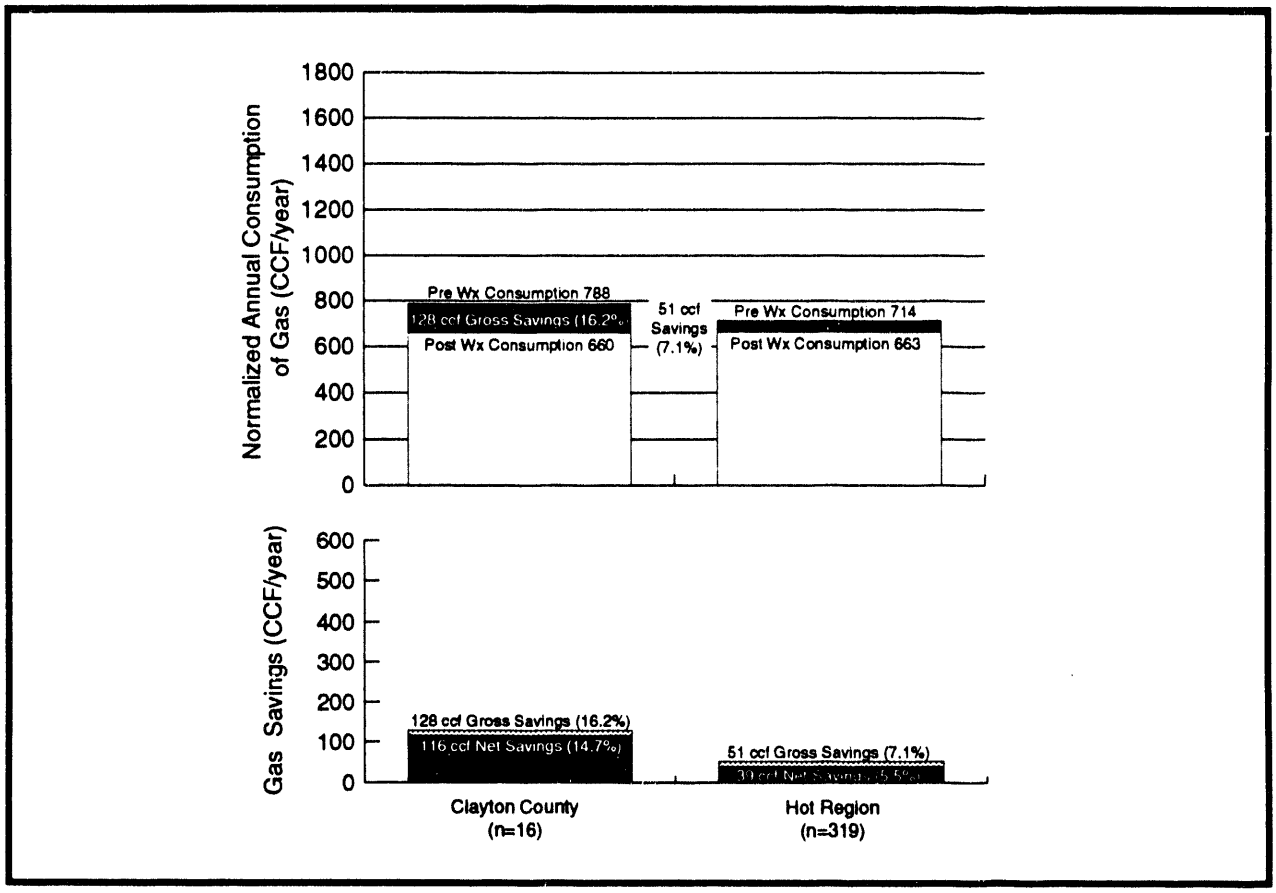


Fig. 9.4 Normalized Annual Consumption and Savings of Dwellings Weatherized by the Clayton County CSA

On average, gas-heated dwellings weatherized by Clayton County CSA had gross savings of 128 ccf/year of natural gas, or 16.2% of their pre-weatherization gas consumption. This is about 150% more than was saved by other agencies in the hot region, which had gross savings of 51 ccf/year (or 12.3% of pre-weatherization consumption). Because the control group in the hot region decreased its consumption by 12 ccf/year after PY 1989, the net (or control-adjusted) savings are slightly lower: 116 ccf (14.7%) for Clayton County and 39 ccf (5.5%) for the hot region (Fig. 9.4). In addition, as Fig. 9.5 illustrates, very few of the dwellings weatherized by Clayton County CSA consumed more gas after weatherization than before. Because Clayton County CSA's weatherization program had higher savings, on average, than other DOE Weatherization Programs in the hot climate region, it was selected as a high performing agency.

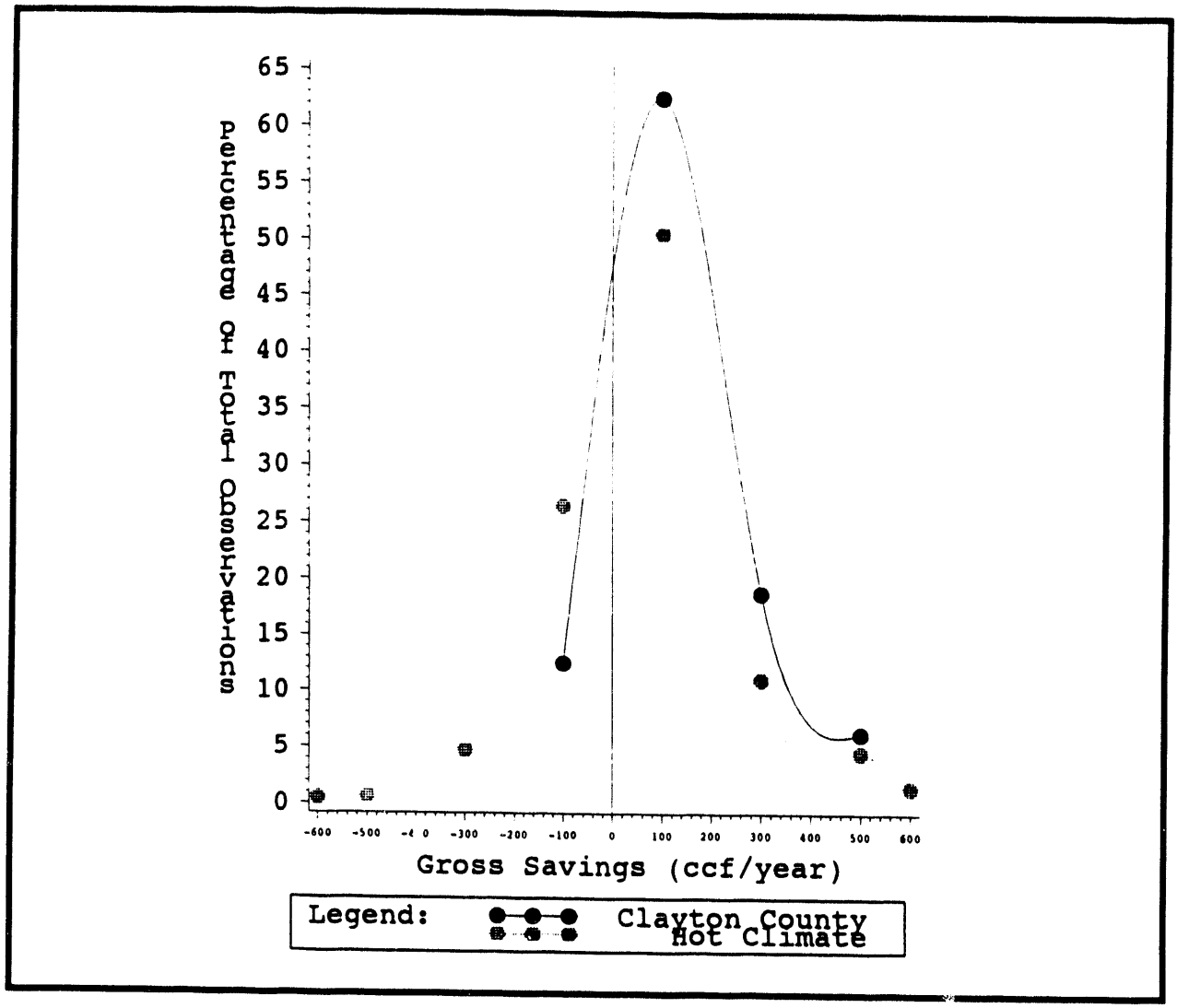


Fig. 9.5 Distribution of Savings in Dwellings Weatherized by the Clayton County CSA vs. Hot Region

In addition to its higher-than-average gas savings, dwellings weatherized by Clayton County CSA also had lower-than-average weatherization program costs. Although the average amount invested in materials ($593) by this agency in PY 1989 was slightly above the regional average ($585), total installation costs (labor and materials) were somewhat lower ($878 vs $916). Average hourly rates in PY 1989 ($7) were less than the regional average of $9. It is estimated that an additional $500 is spent in installation-related overhead and management costs, per dwelling, for both the Clayton County CSA program and the hot region as a whole.

These lower costs combined with this agency's higher energy savings result in a "worst case" benefit/cost ratio of 0.79 for the Clayton County CSA weatherization program compared to a benefit/cost ratio of 0.23 for other agencies in the hot region. These benefit/cost ratios are a "worst case" estimate because they reflect only the value of reduced gas consumption but include all costs

(this is defined in Brown, et al. 1993 as the "program perspective"). If the estimated $976 of nonenergy benefits (Brown et al. 1993) are also included (the "societal perspective"), the benefit/cost ratio increases to 1.49 for Clayton County and 0.96 for the hot region. Thus, the cost effectiveness of the Clayton County CSA program clearly exceeds the average for agencies in the hot region (Fig. 9.6).

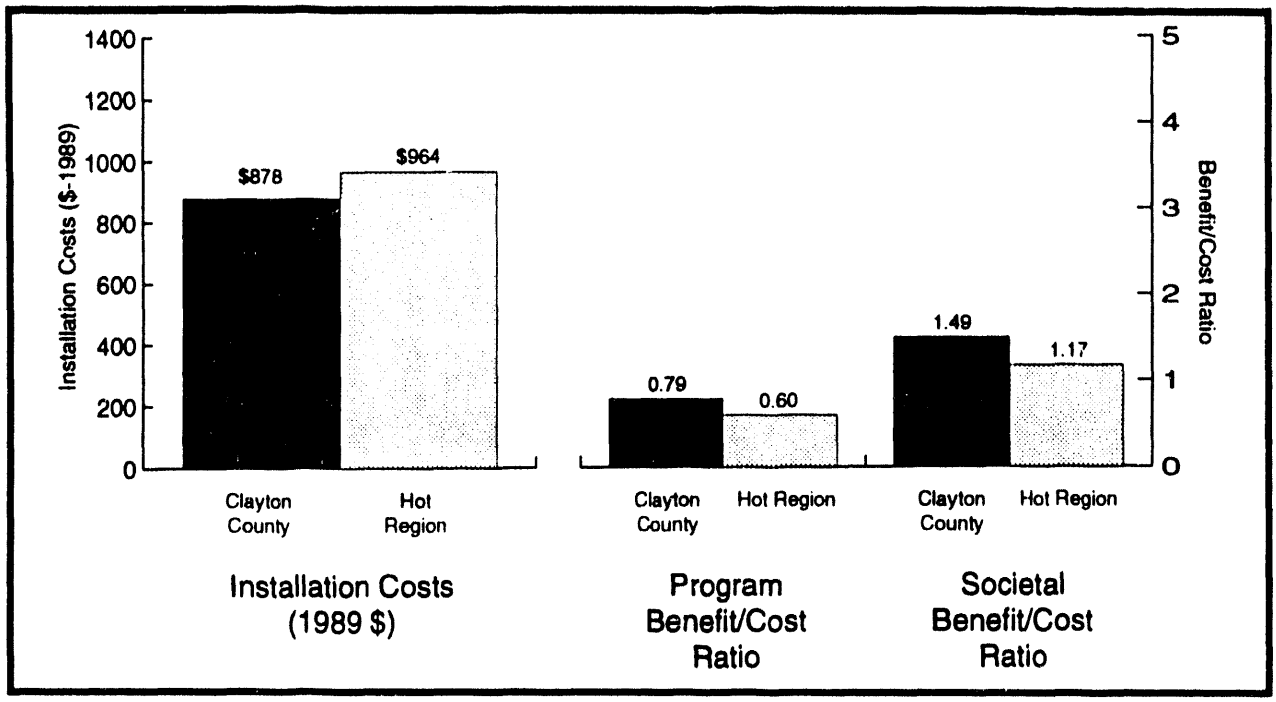


Fig. 9.6 Cost Effectiveness of Clayton County Program vs. Hot Region

9.10 MONITORING AND EVALUATION

No formal evaluations, or measurements of energy savings, have been conducted by this agency. State monitors check weatherization jobs and recordkeeping about every six months.

9.11 REASONS FOR SUCCESS

The crew's extensive experience, both on the job and in related previous work, probably accounted for much of this agency's success. Its staff has an unusually high number of years of experience on the job. The high installation rates of first-time attic insulation, and the strong effort to invest as much of the available money in energy conservation measures instead of in structural repairs, were probably important factors as well. Although this agency did not use advanced audit or diagnostic techniques, it did strive to ensure high quality in all of its installations.

10. TUCSON URBAN LEAGUE TUCSON, ARIZONA

by James O. Kolb

10.1 THE AGENCY AND ITS SERVICE AREA

10.1.1 The Agency

The Tucson Urban League (TUL) was founded in 1971 as an outgrowth of a committee formed by the Tucson Metropolitan Chamber of Commerce to address problems of minority employment.

Ms. Anita Goldberg is the current TUL Housing Department Head which includes the Weatherization Assistance Program. She began as a program manager in 1980 and progressed through all levels of management until she became Housing Department Head in 1989.

The management philosophy of TUL's Housing Department Head is based on the following principles.

1. Integrate and deliver a wide range of social services with programs to improve housing for low-income clients - a "one-stop shop" for as many needs as can be met with available resources.

2. Emphasize high quality workmanship in the weatherization assistance program and housing rehabilitation service areas.

3. Reduce costs of weatherization assistance program measures by producing conservation materials and devices with agency employees that eliminate all profit.

4. Select employees that are sympathetic to the needs of low-income clients, and can provide feedback to the TUL on client's needs and the effectiveness of the TUL's services.

10.1.2 The Housing Stock

The housing stock of clients of the TUL are typically fairly old (40-50 years of age), small (approximately 1,000 sq. ft. of living area), and generally in poor condition, as indicated in Photo 10.1. The poor condition of the housing stock leads to the potential for relatively high benefit/cost (B/C) conservation measures for occupants that use normal or greater than average amounts of energy. Fig. 10.1 also shows that TUL weatherized units in 1989 had more central heating and therefore greater energy savings potential relative to the housing stock weatherized by other agencies in the hot climate region.

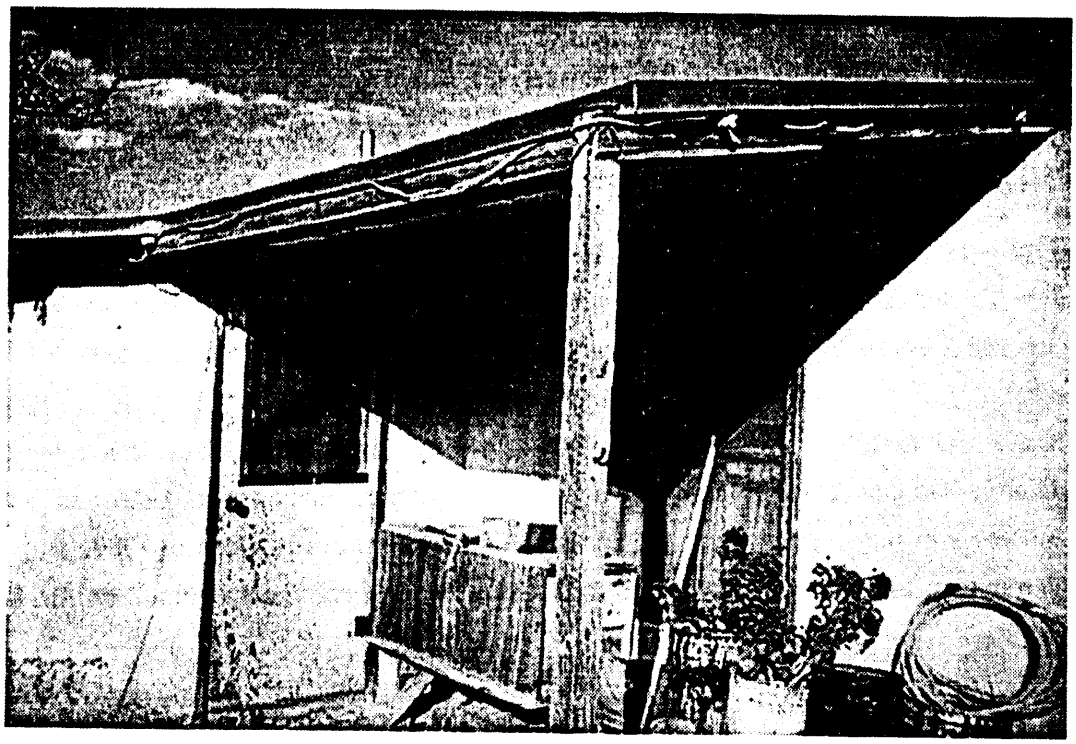


Photo 10.1 A dilapidated home waiting for weatherization by the Tucson Urban League.

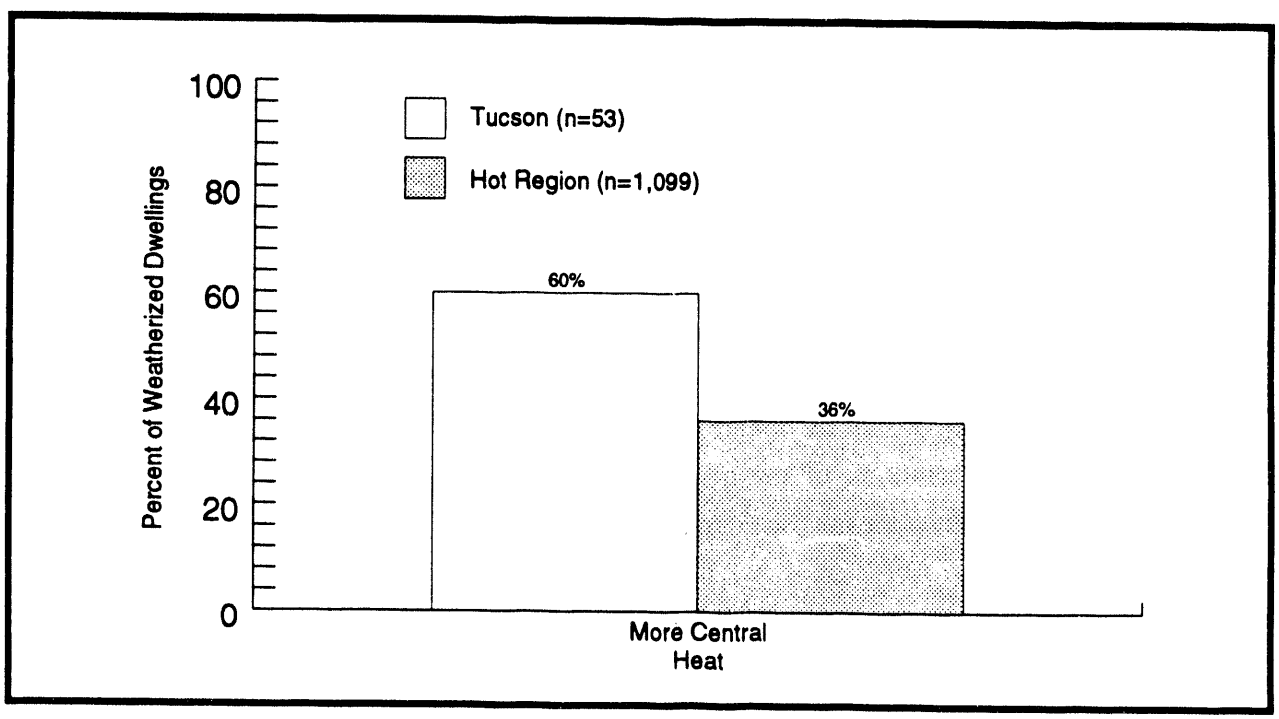


Fig. 10.1 Characteristics of Housing Stock Weatherized by the Tucson Urban League

10.2 WEATHERIZATION STAFF AND TRAINING

10.2.1 Weatherization Staff

The TUL operates a wide range of community assistance programs. In the area of housing assistance, the TUL operates the Weatherization Assistance Program plus housing programs for emergency home repairs, minor home repairs, and home rehabilitation plus housing education programs with city, county, and state funds. In addition, the TUL in 1992 initiated a "Desert Home" project in conjunction with local utilities, the University of Arizona, Pima College, and a team of local experts. This project demonstrates affordable housing strategies, including the operation and economics of selected solar design and energy conservation techniques.

Since 1989, the TUL has developed 16 units of affordable, energy-efficient rental units for the Home Start self-sufficiency program. The goal of this program is to assist families with affordable rentals and other supportive services to prepare them for eventual home ownership.

Other programs of the TUL include employment training, early learning centers, emergency family assistance, juvenile day support, delinquency prevention, and drug education and prevention. The organization of the Housing Programs of the TUL is shown in Fig. 10.2.

The TUL employs two crews to install all weatherization measures except measures requiring licensed personnel - i. e., furnace repair or replacement. This approach has been selected by the TUL Housing Department Head for several reasons. First, employee-based crews can be more accountable and more readily trained than subcontractors, leading to better quality control of measure installations. Secondly, TUL employees can be selected and trained to integrate the client's social and housing needs better than subcontractors. The latter attribute of employee crews also leads to better feedback from clients to the TUL, which the TUL emphasizes as an important feature of its operation.

The TUL's main criteria in hiring weatherization crew members are experience and motivation. Crew labor is furnished in part by a Title V grant from the National Council on Aging to train workers who are 55 years of age or older and are unemployed or underemployed. Crew members who are 55 years of age or older tend to be more stable individuals who will work for the level of wages offered - $4.25/hour starting rate. Crews have been relatively stable with an average tenure of three years even though the TUL does not discourage employees from taking better-paying jobs with private companies.

10.2.2 Training

State-mandated training is currently provided once or twice a year. In 1989, the state provided training on blower door testing to agency auditors. Additional training has been received from the state on weatherizing mobile homes. Some training information has also been received from attending local, regional, and national weatherization assistance program meetings.

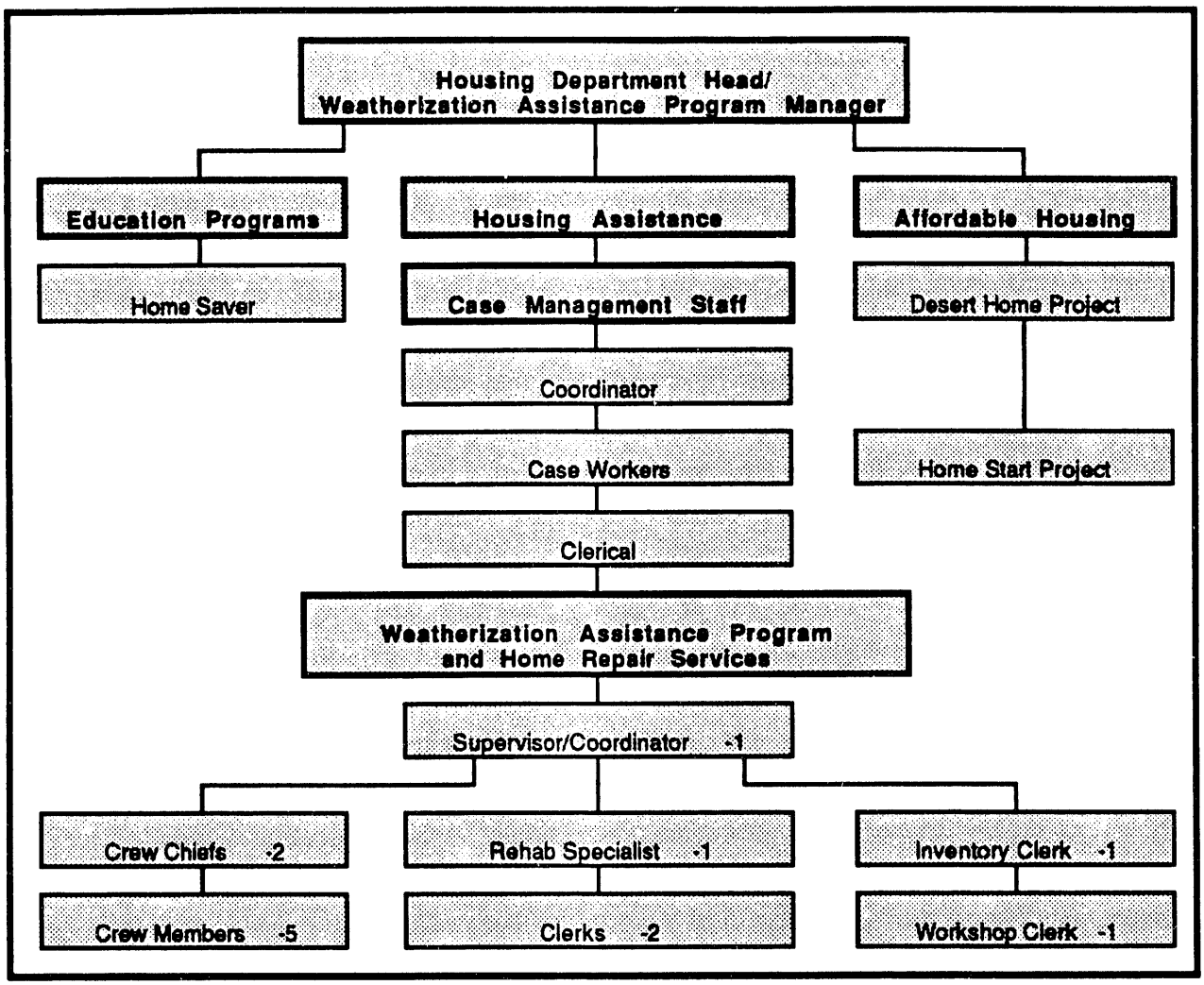


Fig. 10.2 Organization of Housing Programs of the Tucson Urban League

Crews have been trained primarily by the Supervisor/Coordinator of Weatherization Assistance Program and Home Repair Services. In addition to blower door testing, training on CO monitoring of gas-fueled appliances, duct sealing, and mobile home weatherization procedures have been conducted.

Both the Housing Department Head and Supervisor of Housing Services emphasized the importance of training, especially at the local level which is done primarily by the Supervisor of Housing Services. They said that more training was needed on safety and efficiency of combustion appliances and duct leakage diagnostics as they feel that these are areas where they can provide a needed service to their clients.

10.3 CLIENT RECRUITMENT AND SELECTION

As noted earlier, the TUL strives to provide a variety of integrated services to low-income residents of Tucson. Client intake for housing programs is handled by the Case Management Staff (see Fig. 10.2), which screens applicants not only for housing programs but also for all other social programs of the TUL.

10.3.1 Client Recruitment

The TUL has developed brochures to advertise its housing programs usually as new programs are added to the department's activities. A sample of these brochures is shown in Appendix A. These brochures are used in both informal and formal settings. Formal settings include public meetings where TUL staff discuss housing programs. The brochures are used informally in the waiting room of the TUL and other public areas.

In 1989, there was no waiting list for weatherization assistance program services, and 99% of the eligible requests for program services were met. However, by 1992, a waiting list of about 170 clients had developed, which is about a one-year waiting period. Over the past year, the slow economy has caused a greater demand for weatherization assistance. As a result, the agency has reduced its recruitment activities.

10.3.2 Client Selection

In 1989, client selection was based 50% on house or occupant characteristics and 50% on the level of current energy consumption based on utility bills. Occupant characteristics considered were handicapped, elderly, and number of children. In 1991, these selection criteria had changed to 75% energy consumption and 25% house or occupant characteristics. The reason for increasing the weighting on energy consumption was to increase the potential for reducing utility costs from the weatherization measures. No other changes in client selection criteria are contemplated at present.

The one change in types of clients since 1989 is the increased percentage of mobile homes weatherized. This is due to an increasing number of requests from low-income, mobile home residents and the deteriorating conditions in these units.

Large multifamily buildings were not served in 1989 or in more recent years because applicants were typically from single-family units. Owners of apartment buildings have been reluctant to participate because of the extensive effort required to enlist occupants prior to initiating weatherization or rehabilitation work.

10.3.3 Client Feedback

Client feedback is obtained from a post-weatherization visit with each client approximately one month after completing the weatherization activities. All the measures performed are described,

and any maintenance procedures are discussed both for installed measures and energy conserving actions in general for the entire house through a spring and fall checklist. Specific feedback from each client is obtained from an evaluation form mailed to each client to be mailed back to the TUL. Information from these client evaluations are reviewed and kept with the client's file.

10.3.4 Agency Referrals

Approximately 25% of 1989 applications for weatherization were referred to other public assistance programs within the TUL. Home rehabilitation repairs such as roof replacement, electrical and plumbing improvements, and structural repairs were the primary services provided. Home rehab services are integrated into the TUL Housing Assistance department (see Table 10.1). The second most frequent referrals were for social services such as food stamps, social security, supplemental security income, and medical services.

10.4 OPERATIONS

This section summarizes the various aspects of the TUL's operational activities.

10.4.1 Activity Level

In 1989, the TUL weatherized 173 homes with funding of $135,000 from DOE and the Oil Overcharge Program, and $85,000 from LIHEAP. Thus, a significant portion of weatherization funding came from non-DOE sources. In addition, LIHEAP provided $648,000 for fuel assistance and crisis intervention.

10.4.2 Audit Procedures

Energy audits are performed by the Supervisor/Coordinator of Weatherization Assistance Program and Home Repair Services, currently Allen Samuelson. In 1989, the audit procedure was a state-ordered priority list that was evolved from the Project Retrotec audit. The advantages of this procedure were that it was simple to use yet somewhat flexible in application. The auditor would select measures as the audit was performed, beginning with air sealing measures based on blower door testing.

By 1992, measure selection had been modified to an "integrated envelope/HVAC" audit approach. Instead of a set order for considering measures on the state-approved list, the auditor selects both envelope and HVAC measures on the basis of estimated cost effectiveness of each measure, which allows more freedom in selecting measures for a specific house and client.

The reason for changing the measure selection procedure between 1989 and 1992 was the desire of the TUL to improve the measure selection procedure and make it more technically correct. This change was also motivated by assistance from the state Weatherization Assistance Program staff.

Another significant change in the audit procedure between 1989 and 1992 was the transfer of blower door testing from the auditor to the weatherization crews. In 1989, only the auditor performed blower door tests to quantify the amount of leakage and detect the most prominent leakage locations, which were then sealed by crew members with no blower door test to verify the effectiveness of their efforts. By 1992, the auditor did no blower door testing; only the weatherization crews used a blower door to monitor air sealing progress.

10.4.3 Installation of Measures

Crew-Installed Measures. Air sealing and sun screens to reduce solar gains in the cooling season were performed in 1989 in all weatherized homes. As shown in Fig. 10.3, doors and windows were frequently repaired as a part of air sealing. Other measures considered in 1989 were: attic insulation, wall insulation, water heater wrap, indoor storm windows (fabricated by the TUL), low-flow showerheads, tune-up and/or replacement of heating units, tune-up and/or replacement of swamp coolers (with LIHEAP funds), and "maggies" (covers for swamp cooler registers to prevent loss of heated air). Photo 10.2 shows maintenance procedures for a new swamp cooler being explained to a client.

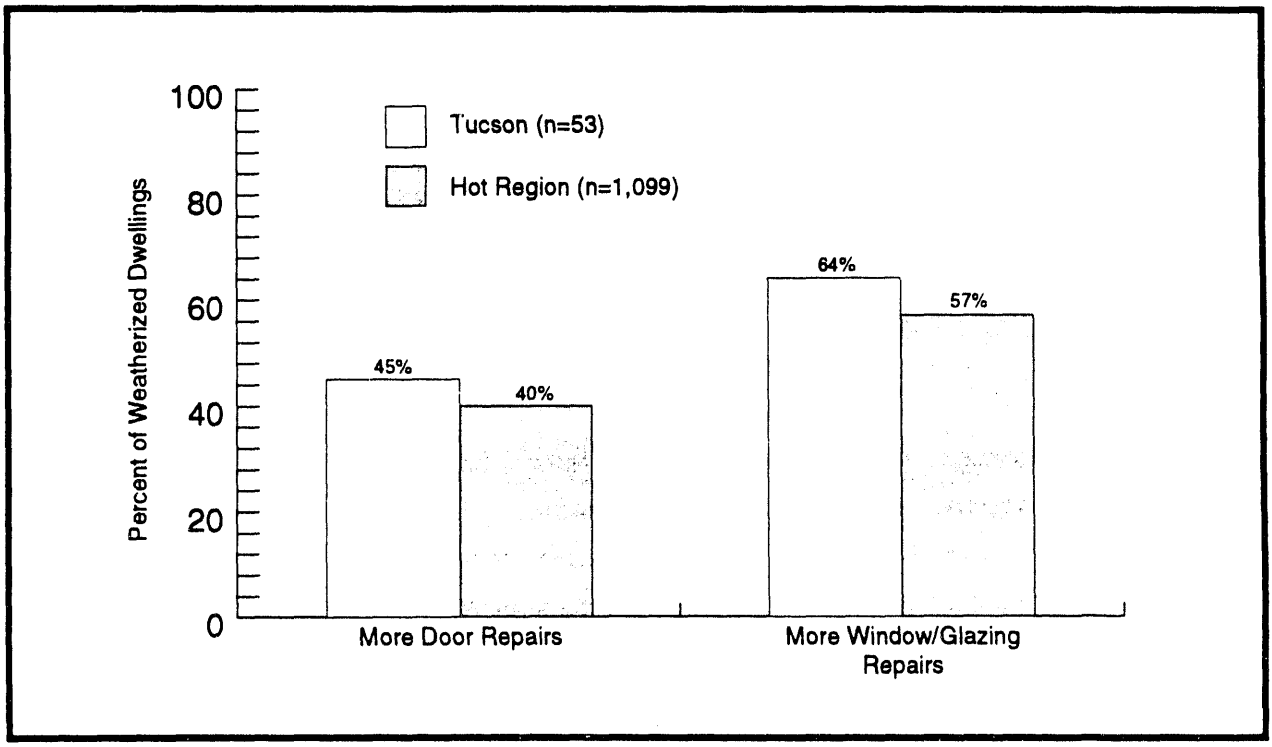


Fig. 10.3 Installation Rates for Door and Window Repairs by the Tucson Urban League

The only measures added between 1989 and 1992 were painting roofs white, to reduce summer cooling loads, and duct sealing.

Crews have limited involvement in the selection of weatherization materials. All materials are selected by the crew leader and the program supervisor. Each crew chief has a personal truck that is stocked with all standard materials. When an unusual material need arises, the crew chief has the authority to spend up to $50 to purchase such materials.

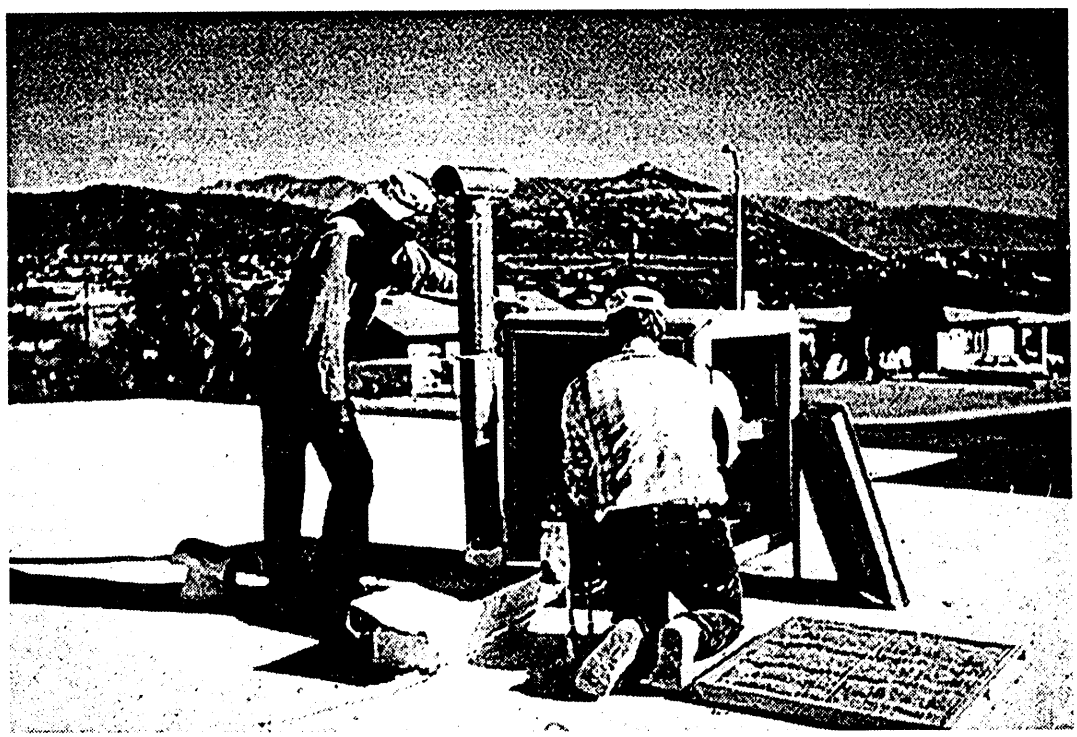


Photo 10.2 Client Education -- Showing a client how to maintain a newly installed evaporative cooler.

Subcontractor-Installed Measures. The main measures installed by subcontractors are furnace replacements and repairs. As noted above, subcontractors are used for these measures in order to limit liability and because the local code requires licensed personnel for furnace installations. HVAC subcontractors are also used for swamp cooler repair and/or replacement when the TUL crews are unavailable because of other commitments.

Subcontractor Management. The TUL selects six to ten HVAC subcontractors annually based on being licensed and bonded, relevant experience, and references - which are verified. The TUL believes that it has been able to obtain reliable and competent HVAC subcontractors through its

selection procedure. The subcontractors work on a competitive bid basis with a minimum of two bids required for each job.

10.4.4 Inspection and Quality Assurance

The Supervisor/Coordinator of Weatherization Assistance Program and Home Repair Services, who also performs the initial energy audit, performs an inspection of the weatherization measures installed. The inspection entails the use of CO monitoring to check for combustion safety problems, but no flue gas analyses were performed. Additional feedback on Quality Assurance is obtained from the client's evaluations one month after completing the weatherization work.

10.4.5 Level of Weatherization Expense

The maximum level of weatherization expense allocated to a specific client was calculated in the following manner. An annual energy utility cost is estimated by adjusting the total utility cost for a base usage. Then, the level of weatherization expense is calculated by (annual energy cost) x (20% - assumed savings fraction) x (20 years - assumed life of weatherization assistance program measures). Thus, the maximum level of expense depended directly on the estimated annual energy utility cost.

10.5 LEVERAGING AND COOPERATIVE EFFORTS

10.5.1 Leveraging with LIHEAP, Local Rehabilitation, and Utilities

DOE Weatherization Assistance Program funds, which provided only 15% of total weatherization funds of $220,000, were leveraged with other funds in 100% of the homes weatherized in 1989 by the TUL. LIHEAP weatherization funds were used for all swamp cooler repairs and replacements and other cooling measures, which represented 25% of the clients. The other source of additional weatherization funds in 1989 was a HUD Community Development Block Grant for emergency home repairs. In 1991, the TUL began receiving funding from a state pool of unclaimed utility deposits. The Utility Repair & Replacement & Deposit fund provides assistance with repair and replacement of utility-related components. In addition, the local gas utility, Southwest Gas, has donated electric portable heaters and domestic hot water heaters to the agency.

The main source of leveraged resources funds was from the LIHEAP Fuel Assistance/Crisis Intervention fund. This fund was used for more extensive structural repairs such as roof replacement, and electrical and plumbing system replacement.

The TUL Housing Director said that the primary advantage of the use of leveraged funds is that the total scope of problems found in a client's house could be addressed by the same agency - from minor repairs and weatherization air sealing to major structural repairs and energy-efficiency

needs. The main disadvantage of the use of leveraged funds is the complication of accounting procedures.

10.5.2 Cooperative Efforts

The TUL is involved in a major cooperative project with the Arizona Energy Office, called the Desert Home Project. This project is the design and construction of a three-bedroom house adjacent to the TUL's office building. The goal of the project is to demonstrate new and established techniques for resource conservation in low and moderate income homes in the hot and dry Tucson environment. The structure is designed to include extensive use of passive solar energy for domestic hot water and space heating. It will also be equipped with extensive electronic instrumentation to monitor humidity and electrical power and water usage during a one-year period of occupancy by a low-income family. Ground-breaking for this project occurred on August 21, 1992, and completion of the structure is scheduled for the spring/summer of 1993.

10.6 AGENCY COSTS

The TUL has reduced its material costs for several measures used commonly with its weatherization clients by having its own employees assemble various components. These components include sun screens, bug screens, room air conditioner covers, "maggies," and indoor storm windows. By purchasing materials in bulk orders and eliminating all wholesale and retail profits, these components are available at less than half the normal cost, which makes them cost-effective in many more cases. Many other standard weatherization materials are obtained through bulk, large volume, low-profit purchases which reduce material costs.

In 1989, the TUL's weatherization program costs totaled $220,000 for 173 clients for an average expenditure of $1,286 per client. Of the total cost, 70% or $896 per client was spent on weatherization materials and labor with the 30% balance spent on program management costs.

10.7 ENERGY SAVINGS AND COST EFFECTIVENESS

Average energy savings, installation costs, and benefit-to-cost ratios for the TUL during the 1989 Program Year were determined by ORNL from a sample of thirty-two units weatherized by the TUL (Table 10.1 and Figs. 10.4 and 10.5).

Annual energy savings per weatherized unit for the TUL are shown in Fig. 10.4 on a comparative basis with results from a sample for the hot region. For the TUL, annual gross gas savings averaged 100 ccf/year, which reduced the average energy use by 16.1%. The average annual gross savings for agencies in the hot region was much lower (51 ccf/year). Further, because the pre-weatherization energy use in the hot region is typically much higher than for Tucson's weatherized homes, its percent gross savings is much lower (7.2%). Thus, the TUL average energy savings was

higher than that of other agencies in the hot region even though the average pre-weatherization energy use for the TUL was lower than that of the hot region.

Table 10.1 PRISM Model Parameters for the Tucson Urban League

	Intercept (ccf/Day)	Heating Slope (ccf/°F Day)	Temperature Dependent Use (ccf/Year)	R^2	Reference Temperature (°F)
WEATHERIZED GROUP (N = 32)					
Pre-Weatherization	0.78 (.18)	0.20 (0.05)	269 (33)	.82	68.4 (3.15)
Post-Weatherization	0.60 (0.12)	0.19 (0.09)	238 (13)	.89	68.3 (6.98)

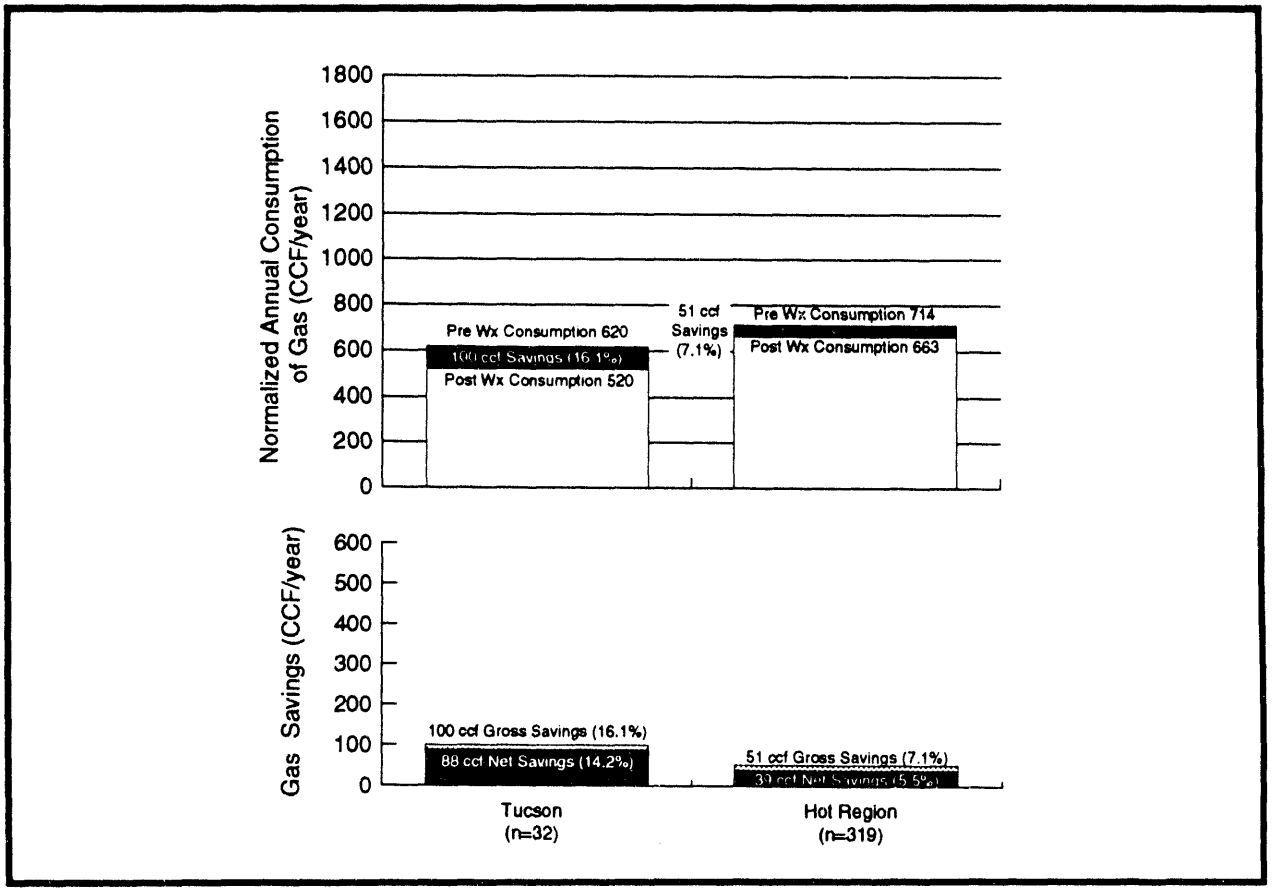


Fig. 10.4 Normalized Annual Consumption and Savings of Dwellings Weatherized by the Tucson Urban League

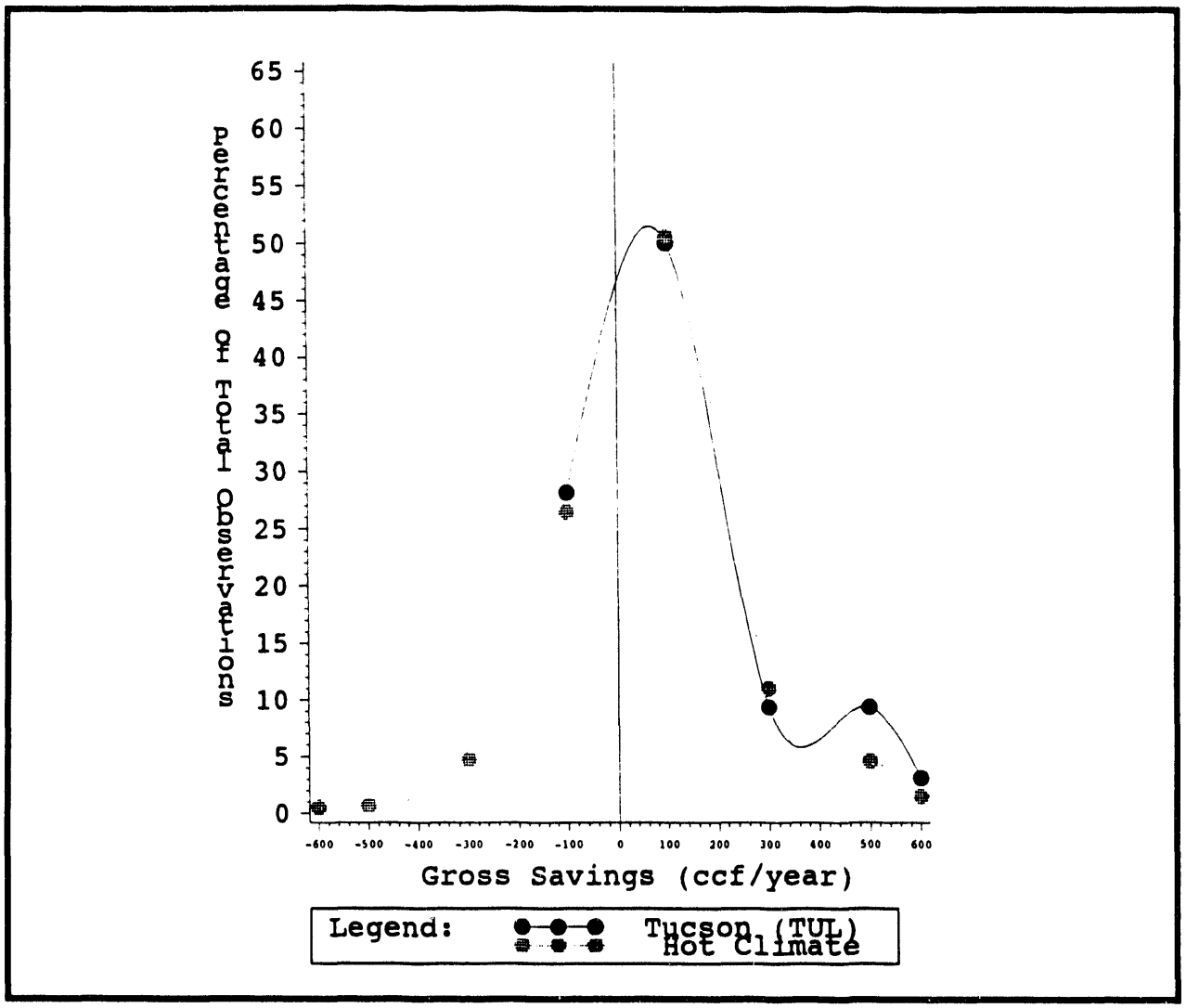


Fig. 10.5 Distribution of Savings in Dwellings Weatherized by the Tucson Urban League

Installation costs for the TUL averaged $690[1] per weatherized unit in 1989 which is 25% less than the comparable installation cost of $916 for other agencies in the hot region, as shown in Fig. 10.6. Thus the TUL achieved both higher energy savings and lower installation costs than were experienced by the "hot region". The energy savings and installation costs achieved by the TUL result in higher benefit-to-cost ratios for the TUL than the "hot region", as shown in Fig. 10.6.

[1] This value is much lower than the $896 average cost reported by TUL for all weatherized homes. This difference is partly definitional: installation-related costs were more narrowly defined and management and overhead costs were more broadly defined in the National Weatherization Evaluation. Total costs for the sample of 32 dwellings ($690 + $500 = $1,190) were quite similar to the TUL average for PY 1989 ($1,286).

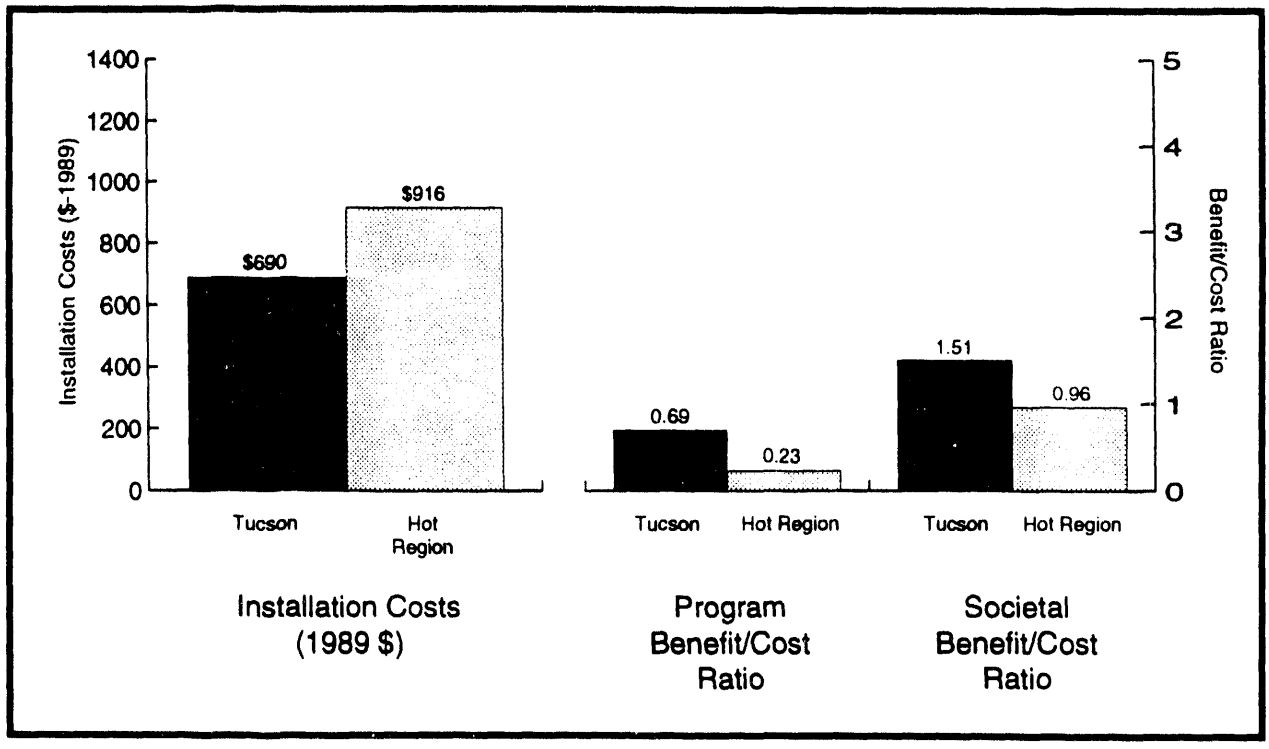


Fig. 10.6 Costs and Benefit/Cost Ratios for Dwellings Weatherized by the Tucson Urban League

10.8 AGENCY EVALUATION

10.8.1 Goal Setting

The TUL Housing Department Head listed the following goals for the weatherization program, not necessarily in order of importance:

1. expand the Affordable Housing Programs and add an additional staff member, Director of Affordable Housing Programs;
2. improve integration of the Weatherization Assistance Program with other social and economic assistance programs;
3. complete Desert Home Project to provide validation of cost effectiveness of energy conservation measures for this unique environment, and disseminate the information obtained;
4. increase funding available;
5. improve staff training; and
6. consider implementing a computerized audit procedure.

10.8.2 Internal Evaluation Procedures

There are no formal evaluation procedures used in the TUL's weatherization program other than the client evaluation letters obtained one month after completing work on each client's home.

10.9 REASONS FOR SUCCESS

10.9.1 Perspective of the Housing Department Head

The Housing Department Head stated that her primary motivations for the TUL Housing Program are:

1. a concern for low-income residents and their social and economic needs;
2. a desire to constantly improve and advance in providing these services;
3. a desire to find more cost-effective ways to deliver Weatherization Assistance Program services; and
4. a desire to help low-income residents by empowering them.

10.9.2 Evaluator's Perspective

The attributes that this evaluator observed during the on-site interview which may explain the exemplary performance of the TUL's Housing Program are the following:

1. effective integration of economic assistance, social assistance, and home improvement programs through a coordinated management structure;
2. talented and experienced staff members in the Housing Assistance Program and the Education and Affordable Housing Programs who are highly motivated to provide the best services in their respective roles;
3. emphasis on reducing program costs, both material and labor, by using in-house production and coordinating weatherization and rehabilitation activities in the same program; and
4. selection of an experienced and highly motivated Supervisor of Housing Services.

Although all of these attributes are important, the last attribute dealing with the role of the Supervisor of Housing Services is especially significant because of the responsibility placed on this single individual.

Finally, this evaluator was particularly impressed with the leadership qualities of the Housing Department Head. It is this individual who is ultimately responsible for the organization's management and effectiveness. In my brief period of time at the TUL, it was very evident that the Housing Department Head has effectively blended the roles of setting challenging goals for the agency and also supporting the staff on a day-to-day basis.

APPENDIX A

CAP SERVICES, INCORPORATED
STEVENS POINT, WISCONSIN

AGENCY CONTACT:

Karl Pnazek
Community Action Program Services, Incorporated
5499 Highway 10 East
Stevens Point, Wisconsin 54481
Phone: 715-345-5200

PERSONS INTERVIEWED:

Karl Pnazek	Chief Executive Director, CAP Services
Lee Duerst	Energy Conservation Director, CAP Services
Mona Aubut	Energy Projects Coordinator, CAP Services
Dave Engstrom	Field/Office Coordinator, Stevens Point Office, CAP Services
Jerry Loker	Field/HVAC Coordinator, Wautoma Office, CAP Services
Bob Winters	Crew Supervisor, Wautoma Office, CAP Services
Ron Reinke	Crew Supervisor, Wautoma Office, CAP Services
Rich Peterson	Heating Technician, Wautoma Office, CAP Services
Jim Lewis	Crew Member, Wautoma Office, CAP Services

Job Tracking Form Used by CAP Services, Inc.

JOB TRACKING

CLIENT NAME _____ JOB # _____

JOB LOCATION: _____ TO BE COMPLETED BY: _____

Checkmark when task is complete. Initial and date at end of tasks and forward.

ALL	OTHER		ALL	OTHER	
[ ]		Contact client		[ ]	Issue Subcontractor workorder
[ ]		Write applic/assign number			_____
[ ]		Request fuel consumption/ income verification		[ ]	Order special materials
	[ ]	Contact landlord/receive verbal permission			_____
[ ]		Request proof of ownership		[ ]	Issue Htg Staff workorder(s) date: _____
[ ]		Receive fuel consumption/ income verification		[ ]	Furnace _____
[ ]		Receive proof of ownership		[ ]	T&C [ ] V.D. [ ] IID
[ ]		Complete application: sign and date		[ ]	Power Burner [ ] Other
[ ]		Forward to Energy Proj Coord	[ ]		Issue insulation/infiltration crew workorder
		_____			_____
[ ]		Review applic. make file	[ ]		Complete crew work
	[ ]	Copy for utility - _____	[ ]		Forward to Auditor
[ ]		Record status on Client DBase		[ ]	Heating work completed
[ ]		Forward COMPLETED APPLICATION to Central Data Clerk		[ ]	Subcontractor work completed
		_____	[ ]		Complete final inspection
[ ]		Enter client info onto computer (WTA)		[ ]	Collect client sign-off
[ ]		Forward to Auditor		[ ]	Collect tenant signature or addendum
		_____		[ ]	Collect landlord sign-off or written waiver
[ ]		Schedule appt for energy audit		[ ]	Forward to Field Coord
[ ]		Create order for spec materials			_____
[ ]		Request bids from subcontractors	[ ]		Review for completeness PO's, subcont. signatures
[ ]		Receive bids from subcontractors		[ ]	Forward to Data Clerk
[ ]		Forward COMPLETED AUDIT to Field Coord			_____
		_____	[ ]		Review for completeness
[ ]		Review/catalog information	[ ]		Printout job cost (WTA)
[ ]		Forward to Energy Proj Coord	[ ]		Printout Mod. Audit BWR
		_____	[ ]		Forward to Energy Proj Coord
[ ]		Review audit			_____
	[ ]	Write landlord contract/send out	[ ]		Review audit
	[ ]	Write utility bid/send out		[ ]	Prepare landlord bill
[ ]		Record status on Client DBase		[ ]	Prepare utility bill
	[ ]	Receive signed landlord contract	[ ]		Record status on Client DBase
	[ ]	Record status on Client DBase	[ ]		Forward to Fiscal Dept
[ ]		Forward to Central Data Clerk			_____
		_____		[ ]	Send bill to landlord
[ ]		Enter job order file onto computer (WTA)		[ ]	Send bill to utility
[ ]		Forward COMPLETED WORKORDER to Field Coord	[ ]		Forward to Central Data Clerk
		_____			_____
			[ ]		Record to computer (WTA) as COMPLETION, file

APPENDIX B

OPPORTUNITIES INDUSTRIALIZATION CENTER OF GREATER MILWAUKEE MILWAUKEE, WISCONSIN

AGENCY CONTACT:

Carl Nelson
Opportunities Industrialization Center of Greater Milwaukee
2835 N. 32nd Street
Milwaukee, Wisconsin 53210
Phone: 414-372-9900

PERSONS INTERVIEWED:

Carl Nelson	Director of Home Improvement Services
Warren Jones	Supervisor of Auditing and Monitoring
Andy Eckland	Auditor
Al St. Lawrence	Supervisor of Production
Troy Oberson	Reynolds Metals Company inventory person and former trainee
Darryl	Crew Trainee originally from Ventures home repair program
Ken	Journeyman insulator
Angel	Journeyman carpenter
Jeff	Journeyman insulator
Al Jenon	Journeyman insulator and former trainee
Doug McFee	State Monitor
Doris Green	Client Education Coordinator

APPENDIX C

OTTAWA COUNTY COMMUNITY ACTION AGENCY
HOLLAND, MICHIGAN

AGENCY CONTACT:

Cathy Simons
Ottawa County CAA
12251 James Street, Suite 300
Holland, Michigan 49424
Phone: 616-393-5644

PERSONS INTERVIEWED

Cathy Simons	Weatherization Director, Ottawa County CAA
Mary Onstatt	Client Intake Interviewer/Client Educator
Arnold Kooienga	Audit/Inspection Contractor
Michael Kessler	State Weatherization Director

MEASURES REVISION PRIORITY SYSTEM

Measures Rank Order

Revised: December 17, 1986

Minimum Measures*	• WATER HEATER TREATMENT / LOW FLOW SHOWER HEAD • CEILING INSULATION (ADD R-19 IF LESS THAN R-8 EXISTS) • WALL INSULATION • DUCT INSULATION (IN UNCONDITIONED SPACE) • FLOOR INSULATION (IN VENTED CRAWL SPACE) • MAJOR INFILTRATION These measures are all required, whenever applicable, REGARDLESS OF HOME TYPE.

Typical Home Type	A. Heated Basement	B. Unheated Basement	C. Slab on Grade	D. Kneewalled Attic
Additional Measures*	- Band Joist Insulation - Clock Thermostat - Oil Furnace Flame Retention Burner - Gas Furnace Thermal Vent Damper - Gas Furnace Electric Vent Damper - Storm Windows - Oil Furnace Tune-Up - Replacement Oil Furnace - Gas Furnace Tune-Up - Replacement Gas Furnace	- Clock Thermostat - Floor Insulation (over unheated basement) - Oil Furnace Flame Retention Burner - Storm Windows - Oil Furnace Tune-Up - Boiler Pipe Insulation - Replacement Oil Furnace - Gas Furnace Tune-Up - Plastic Storm Windows - Replacement Gas Furnace	- Clock Thermostat - Oil Furnace Flame Retention Burner - Gas Furnace Thermal Vent Damper - Gas Furnace Electric Vent Damper - Storm Windows - Oil Furnace Tune-Up - Replacement Oil Furnace - Gas Furnace Tune-Up - Plastic Storm Windows - Replacement Gas Furnace	- Band Joist Insulation (heated basement) - Clock Thermostat - Oil Furnace Flame Retention Burner - Floor Insulation (over unheated basement) - Storm Windows - Oil Furnace Tune-Up - Replacement Oil Furnace - Gas Furnace Tune-Up Boiler Pipe Insulation - Replacement Gas Furnace - Plastic Storm Windows

* See reverse side for BCS policy on "Minimum" and "Additional" Measures.

"Minimum" and "Additional" Measures Policy

1. At a **minimum**, all dwellings serviced shall be retrofitted up to, and including all "Minimum Measures," no matter what the labor/material costs involved.

2. If ceiling, wall, **and** floor insulation are not installed as Minimum Measures on a dwelling, then the LWO **must install at least two "Additional Measures,"** per the rank ordering of the Typical Home Type involved.

3. After the "minimum" installation cited in #1 and #2, it will be at the local agency's discretion to install "Additional Measures." However, any Additional Measures installed shall be installed in the exact rank ordering as specified per each Typical Home Type.

4. The local agency will have to monitor its average cost per unit expenditure level, and set its own policy on the extent of Additional Measures to install beyond the minimum installation standards (per "Limitations on Cost Per Unit" section requirement). BCS does not expect that such discretion will result in wide differences in the services provided to all weatherized dwellings but does expect the local agency to develop a policy for consistent levels of installations for all clients.

Note that it is highly recommended that local agencies pre-inspect a sufficient pool of eligible dwellings so as to be able to select and schedule dwellings that will comply with the $1,600 per unit average maximum cost requirement of the program.

Exclusion of Measures

No measure in the ordering shall be excluded unless (a) the dwellings already has that measure in place, or (b) the measure cannot be properly installed or client refuses installation (client file to be documented).

APPENDIX D

COMMUNITY ACTION AGENCY OF COLUMBIANA COUNTY
LISBON, OHIO

AGENCY CONTACT:

Violet Sevek
Community Action Agency of Columbiana County
7880 Lincole Place
Lisbon, Ohio 44432-1499
Phone: 216-424-4013

Table D.1 Callback Form

COMPLAINT/CALLBACK FORM

CLIENT NAME _____PHONE_____DATE_____

ADDRESS_____

JOB #_____ DATE WORK DONE_____

PROBLEM (COMPLAINT) _____

_____

_____

_____

RECOMMENDED ACTION (CALLBACK) _____

_____

_____

_____

REQUISITION

DATE _____ (Must account for all materials used, including scrap)

Description	Qty. Out	Spec. Qty. Out	Returns		Units Installed	Unit Cost	Total Cost	Comments
			Warehouse	Truck				

_____ _____ _____

(SIGNATURE(S) OF PERSON COMPLETING WORK)

DATE WORK COMPLETED_____

TIME WORKED:

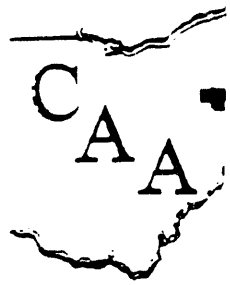
HRS. _____ MIN. _____

HRS. _____ MIN. _____

REVISED BWR_____

HRS. _____ MIN. _____

Table D.2 Client Response Form



COMMUNITY ACTION AGENCY OF COLUMBIANA COUNTY, INC.

7880 Lincoln Place, Lisbon, Ohio 44432-8322
216/424-7221 Fax (216) 424-3731

HOME WEATHERIZATION ASSISTANCE PROGRAM
Phone (216) 424-9512
CLIENT RESPONSE

Job # _____ DATE WORK COMPLETED _____

CLIENT _____

ADDRESS _____

_____

PHONE (216) _____

	GOOD	FAIR	POOR	COMMENTS
QUALITY OF WORK				
ATTITUDE OF CREW				
CREW COURTESY				
CREW CLEAN UP				

ADDITIONAL COMMENTS: _____

_____

_____

_____

I CERTIFY THAT THE WORK HAS BEEN COMPLETED TO MY SATISFACTION.

_____ _____
Client Signature Date

_____ _____
Crew Chief Date

The Community Action Agency is an Equal Opportunity Employer and Service Provider.

Table D.3 Home Weatherization Assistance Program Home Visit Survey Form

HOME WEATHERIZATION ASSISTANCE PROGRAM
HOME VISIT SURVEY

DATE: _____ JOB NUMBER: _____

I. GENERAL DESCRIPTIVE INFORMATION

Name _____

How long have you lived in your home/apartment? _____
How many people live there? _____
How many people living in your home are:

under 5 _____
5-18 _____
19-40 _____
41-64 _____
65 or older _____

Has anyone moved in or out of your home in the past year? Yes____ No

If yes, number of persons moving in. _____
Number of persons moving out. _____

Do you pay for water usage? Yes____ No____
If yes, how hign is a typical monthly bill? _____

II. WEATHERIZATION AND OTHER ENERGY ASSISTANCE PROGRAMS

A. Have you received assistance from any of the following programs? (Please check all that apply)

_____ Ohio Energy Credits Program
_____ Home Energy Assistance Program (HEAP)
_____ Percentage of Income Program (PIP)
Other, Please list _____

III. ENERGY CONSERVATION

A. During the heating season (October-April), at what temperature do you set your thermostat? _____

B. How often do you have your furnace inspected? _____

C. How often do you check your furnace filter during the heating season? _____

Table D.3 Home Weatherization Assistance Program
Home Visit Survey Form (cont'd)

D. Before you leave your home or before you sleep, at what temperature do you set your thermostat? _____

E. Do you have heating vents/air return grills blocked by furniture? _____

F. Do you keep all windows and doors shut when the furnace is on? _____

G. How often do your clean and inspect your wood/coal stove chimney or flue? _____

H. At what temperature do you have your hot water heater set? _____

I. Do you have a washer? _____

J. Do you use cold, warm, or hot water to wash clothes? _____

K. Have you repaired all leaking faucets? _____

L. Does the gasket on your refrigerator seal tightly? _____

M. Is the refrigerator near a heat register, stove, or in direct sunlight? _____

N. Do you turn lights off in rooms that are not being used? _____

O. Do you use an air conditioner? _____

P. At what temperature do set the thermostat? _____

Q. How often do you check the filter? _____

R. Do you keep your windows closed during the day? _____

S. During early morning hours or at night, do you open windows opposite one another for cross ventilation? _____

T. Do you close curtains/blinds during the day to help block the sun's heat? _____

COMMENTS:

_____

_____

_____

_____

_____

_____

COMPLETED BY _____

ENERGY SAVERS PARTNERSHIP PLAN

In order to reduce the energy used in this house and maintain, or increase, the physical comfort for the people who live here, we are forming this partnership. The Home Weatherization Assistance Program (HWAP) will correct how the house loses energy and the household will improve how it uses and manages energy.

Agency: _____

Address: _____

Phone #: _____

Contact Person: _____

Job Number: _____

Name: _____

Address: _____

Phone #: _____

PARTNERS' RESPONSIBILITIES:

Agency

The HWAP will perform or install the energy conservation measures checked below to correct how the house loses energy:

_____ Perform a safety inspection and tune-up/repair of the heating unit(s)
_____ Reduce the air leakage (caulking, weatherstripping)
_____ Insulate the hot water heater
_____ Insulate the attic
_____ Insulate the sidewalls
_____ Others _____
_____
_____

State of Ohio
Department of Development

DEV0076 (Rev 1/1991) Distribution: White--Originating Agency Canary--Client Pink--ODOD

Table D.4 Energy Savers Partnership Plan Form (cont'd)

HOUSEHOLD

The household will perform the energy conservation actions listed below, to reduce energy used and increase the comfort of this household:

Area	*Action*
Living Room	
Kitchen	
Bathroom	
Bedrooms	
Basement	
Other	

PARTNERS' AGREEMENT

We agree to the energy savers plan to help reduce this household's energy cost. The agency agrees to provide the highest quality work and service in the most expedient time possible. The household agrees to involve all family members in good energy management practices and to maintain the materials installed by the HWAP.

Signed on this date, _____ by:

_____ _____

Agency Representative Head of Household

_____

Job Number

DEV0076 (Rev 1/1991) Distributor: White--Originating Agency Canary--Cre Pink--ODOD

State of Ohio
Department of Development

APPENDIX E

ENERGY CONSERVATION ASSOCIATION
DENVER, COLORADO

AGENCY CONTACT:

Patricia Gallegos
Energy Conservation Association
635 Bryant Street
Denver, Colorado 80202
Phone: 303-572-3604

APPENDIX F

GOLDENROD HILLS COMMUNITY ACTION COUNCIL
WISNER, NEBRASKA

AGENCY CONTACT:

Craig Malmberg
Goldenrod Hills Community Action Council
P.O. Box 280
Wisner, Nebraska 68791
Phone: 402-529-3513

Table F.1 Eligible measures in the Nebraska Weatherization Assistance Program

MODEL 1

- GENERAL HEAT LOSS
  - Eligible Heating Systems
  - Disposable Furnace Filters
  - Primary Air Leakage
  - Uninsulated Electric Water Heaters and Water Heaters Located in Unheated Spaces
  - Uninsulated, Accessible Ductwork and Hydronic Pipes
  - Protective and Comfort Measures
- UNINSULATED WALLS AND EXPOSED FLOORS
  - Uninsulated Sidewalls
  - Uninsulated, Accessible Kneewalls
  - Uninsulated, Accessible Band Joist Cavities
  - Uninsulated, Accessible Exposed Floors and Floors over Unheated Spaces
  - Uninsulated, Inaccessible Exposed Floors
- UNINSULATED CEILINGS
  - Uninsulated Attics
  - Uninsulated Enclosed Ceilings
- INEFFICIENT HEATING PLANTS
- UNINSULATED FLOORS AND CRAWL SPACES
  - Uninsulated, Accessible Floors over Unconditioned Crawl Spaces
  - Uninsulated, Accessible Crawl Spaces
- BLOWER DOOR GUIDED SEALING
- OPTIONAL MEASURES (low-flow showerhead, water-heater insulation, and other cost-effective measures)

MODEL 2:
Mobile Homes (some measures are trailer-specific like "underbellies")

- GENERAL HEAT LOSS
- SINGLE PANE GLASS
- INEFFICIENT HEATING PLANTS
- UNINSULATED UNDERBELLIES
- BLOWER DOOR GUIDED SEALING
- OPTIONAL MEASURES

INELIGIBLE MATERIALS/MEASURES (29 count, e.g., storm doors, energy recovery equipment, automatic setback thermostats, etc.)

Table F.2 Weatherization Questionnaire Form

WEATHERIZATION QUESTIONNAIRE

Please answer the following questions regarding the weatherization of your home, and return in the enclosed envelope.

How did you learn about the program?_____

Are you elderly? Yes_____ No_____

Do you own your home? Yes_____ No_____

What year was your home weatherized? _____

How old is the house in which you live? 1-5 years___ 5-10 years___
10-25 years____ 25-50 years_____ over 50 years____

What type of home do you live in? Frame/Masonry_____ Mobile_____
Apartment_____

Was the weatherization work done satisfactorily? Yes_____ No_____

How has fuel savings affected your family life?_____

_____

How do you feel about the weatherization program?_____

_____

Other than the weatherization measures done to your home, is there any repairs that need to be done to your home? Yes_____ No_____
If so, please state the type of repair needed._____

_____

OTHER COMMENTS:

Table E.3 CAC Flyer Explaining Each Agency Service

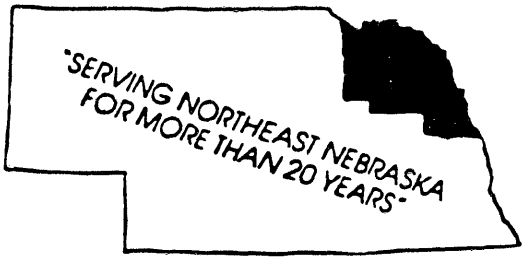
GOLDENROD HILLS COMMUNITY SERVICES

"A KEY TO PEOPLE HELPING PEOPLE HELP THEMSELVES"

JIM DEITLOFF, EXECUTIVE DIRECTOR

Phone (402) 529-3513 • FAX: (402) 529-3209

P.O. Box 280 • Wisner, Nebraska 68791-0280



COUNTIES SERVED: Antelope, Burt, Cedar, Cuming, Dakota, Dixon, Knox, Madison, Pierce, Stanton, Thurston, & Wayne.

WIC is a program which provides nutrition education and special foods to WOMEN who are pregnant, breastfeeding, or have recently had a baby, INFANTS through 12th month, and CHILDREN ages 1 to 5. Proper nutrition and health care are very important to the growth and development of children. This is especially true during pregnancy and early childhood. WIC clinic sites are held throughout the twelve county area.

COMMODITY SUPPLEMENTAL FOOD PROGRAM (CSFP) is funded by the USDA to provide nutrition education and high-iron foods to pregnant or post-partum Women, Infants, Children to the age of 6 and Persons 60 years or older who meet income/residency guidelines. Clinics are held monthly at Walthill, Wisner, Crofton, Norfolk, South Sioux City and Neligh.

WEATHERIZATION program is to help lower heating and cooling costs for the low income and elderly in the area by applying weatherization materials and practices to your home. Weatherization leads to increased home energy savings. There is no cost to the applicant or homeowner for the work. In addition to serving the twelve counties, they also serve Dodge and Washington counties.

HEAD START helps to create a greater degree of social competence in children from low-income families. Head Start emphasizes the importance of health, education, parent involvement and assists in developing the individual strengths of families.

DRUG FREE HEAD START is a pilot program which implements the programs of prevention and intervention activities through training and support for staff, children, parents and caregivers. This program continues a cooperative relationship of a comprehensive community based approach to problems with alcohol and other drugs funded by the Office of Substance Abuse Prevention (OSAP).

NORTHEAST NEBRASKA INTERVENTION/PREVENTION PROJECT is a federally funded grant administered by the Division on Alcoholism and Drug Abuse of the Nebraska Dept. of Public Institutions. Goldenrod Hills coordinates the prevention services of the Alcoholism and Drug Abuse Council of Nebr. (ADACN) and the intervention services of the School Community Intervention Program (SCIP) of the Lincoln Medical Education Foundation.

GOLDENROD JOINT HOUSING AUTHORITY is a Section 8 Housing program designed to enable very low-income families to live in decent housing at an affordable rent.

Table E.3 CAC Flyer Explaining Each Agency Service (cont'd)

FAMILY SERVICES provides assistance to evaluate and work with area residents to promote self-sufficiency. This is done by the following variety of programs and projects throughout the year.

IMMUNIZATION CLINICS are sponsored by Goldenrod Hills and Nebraska Dept. of Health to serve area families. DTP, OP, MMR and HBPV Innoculations are performed monthly in Neligh, Norfolk, Ponca, Wisner and Wayne. Rotating clinics are held in Creighton, Bloomfield, Verdigre, Laurel and Hartington. Call to confirm location and times of clinics.

WELL CHILD CLINIC provides a well baby check for children up to the age of five during the Wayne Immunization Clinic. Children must reside in Wayne, Cedar or Dixon County.

FOOD PANTRIES are an emergency service offered to those in need of an immediate source of nourishment. Food Pantries are located in Walthill, Wisner, South Sioux and Norfolk.

GARDENING AND NUTRITION program provides planting information, seeds, canning/freezing equipment and use of tillers to low-income families to increase nutritional needs in their diet. This project can help alleviate hunger and increase pride and self-sufficiency among the less fortunate.

TAX COUNSELING FOR THE ELDERLY AND LOW INCOME (TCE) is provided by volunteers who have been trained to help prepare tax forms and/or answer tax questions.

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) provides emergency food and shelter services to individuals in need.

CAR SEATS program provides federally approved safety car seats to parents who meet the income guidelines for INFANTS up to 20 pounds or 1 year of age, and TODDLERS up to 40 pounds or 4 years of age, which ever comes first.

HOMELESS program provides one-on-one support in which intervention is used during a crisis to solve problems that contribute to homelessness. The goal of this program is to assist individuals and families to reach self-sufficiency.

TOYS FOR TOTS serve needy children in the twelve county area at Christmas time each year. Donations of new toys, cash, books and manpower are accepted and utilized to brighten the holidays for those less fortunate.

Besides the above programs, we provide referrals to local and state agencies in fields such as social services, job placement, veterans assistance, mental health and alcoholism.

APPENDIX G

NORTH BUFFALO COMMUNITY DEVELOPMENT CORPORATION
BUFFALO, NEW YORK

AGENCY CONTACT:

Norma Davis
Clarkson Center for Human Services, Inc.
111 Elmwood Avenue
Buffalo, New York 14201
Phone: 716-885-6400

APPENDIX H

SCRANTON/LACKAWANNA HUMAN DEVELOPMENT AGENCY
SCRANTON, PENNSYLVANIA

AGENCY CONTACT:

Bill Firjone
Scranton/Lackawanna Human Development Agency
200 Adams Avenue
Scranton, Pennsylvania 18503
Phone: 717-963-6600

PERSONS INTERVIEWED:

Fred Lettieri	Executive Director, SLHDA
Walter	Developer of the Computerized Client Tracking System, SLHDA
Bill Firjone	Weatherization Program Manager, SLHDA
Joe Haddock	Operations Supervisor, Weatherization Program, SLHDA

APPENDIX I

CLAYTON COUNTY COMMUNITY SERVICE AUTHORITY
FOREST PARK, GEORGIA

AGENCY CONTACT:

Bill Green
Clayton County Community Service Authority
667 South Avenue
Forest Park, Georgia 30050

PERSONS INTERVIEWED:

Charles Grant	Executive Director, Clayton County CSA
William Green	Weatherization Director
Cliff Jones	Weatherization Materials Specifier
David McGill	Crew Member
Lee Findley	Crew Member

Exhibit D

JOB NUMBER _____

D.O.E. WEATHERIZATION PROGRAM, U.S. DEPARTMENT OF ENERGY

4/92

BUILDING CHECK AND JOB ORDER SHEET

Each block on this sheet provides basic ordering and control information for the various weatherization jobs on a given building (unit). During the inspection of a unit, indicate in writing any item which does not apply or any item already weatherized. Indicate any special instructions or measurements required to successfully weatherize the unit properly.

Recommended Weatherization Measure Priorities All Regions/Zones	Refer unit to _____ Date Referred _____/_____/_____

FOUNDATION TYPE

House on Piers (Exposed Floor)	**House Above Basement or Crawl Space or Slab on Grade**
1. Infiltration Reduction 2. Ceiling Insulation[1] 3. Floor Insulation - R19 4. Skirting[2] 5. Skirting Insulation[2] 6. Partial Ceiling Insulation[1] 7. Storm Windows[3] 8. Wall Insulation[4]	1. Infiltration Reduction 2. Ceiling Insulation[1] 3. Foundation Insulation 4. Partial Ceiling Insulation[1] 5. Floor Insulation - R19[5] 6. Storm Windows[3] 7. Wall Insulation[4]

[1]Maximum of R30 statewide (if ceiling can support weight).
[2]As an alternative to floor insulation.
[3]Not recommended in south Georgia.
[4]Cost not to exceed $1.50/ft.[2] Not recommended in south Georgia.
[5]As an alternate to foundation insulation only.

Signature of Auditor	Signature of Final Inspector
Date:	Date:

_____ (Client's Signature) _____ (Date)

I certify that all weatherization work has been satisfactorily completed.

Month/Year Reported to OER
_____/_____

Reweatherization:
Yes_____ No_____

Major Heating Source
_____

Utility Company
_____

Account Number
_____

Number of Air Conditioners or Central Units
_____

Square Ft. of Unit _____

Total Household Income
$_____

Name_____

Address _____

City_____

County_____

Zip Code_____

Phone (_____)_____

BREAKDOWN OF EXPENDITURES

Repair Materials Installed	$_____
Weatherization Materials Installed	$_____
Total Materials Installed	$_____
Additional Materials Installed	$_____
Funding Source of Additional Materials	_____
Leverage Materials	$_____
Other	$_____

BREAKDOWN OF HOUSEHOLD MEMBERS

Unit Data		Client Data	
A. Single Family Owner Occupied	_____	B. No. of Elderly	_____
Multi-Family Owner Occupied	_____	No. of Handicapped	_____
Mobile Home Owner Occupied	_____	No. of Elderly/Handicapped	_____
Single Family Renter Occupied	_____	No. of Native American	_____
Multi-Family Renter Occupied	_____	No. of Migrant/Seasonal Farm Workers	_____
Mobile Home Renter	_____	No. of Persons 20 years of age and younger living in household	_____
		No. of Other(s)	_____
		Total Number of People Residing in Household	_____

Job Orders For Unit

Infiltration

	Kitchen	Bathroom(s)	Bedroom(s)	Living Room	Dining Room	Entire Unit	Utility Room	Hallway	Den	Estimated Quantity	Estimated Cost ($)	Actual Quantity	Actual Cost ($)
replace window panes (list sizes on pg. 4)													
reglaze window panes													
threshold(s)													
door sweep(s)													
weatherstrip windows													
weatherstrip doors													
caulk windows													
caulk doors													
caulk and pack cracks													
close off fireplace(s)													
insulate attic hatch													
storm window(s)*													
Other _____													

Additional Items Required (e.g. doors, window units, etc.)				

Repair Materials Required (e.g. stain, lumber, paint, nails, etc.) **(Materials used to protect weatherization materials)**				

Sub Total
(carry over to pg. 4)

*Not recommended in S Georgia

	Estimated Quantity	Estimated Cost ($)	Actual Quantity	Actual Cost ($)
Do **Hot Air Ducts** pass through cold areas? Yes ☐ No ☐ Insulate ducts leading to _____				
Can any **Unused Rooms** be closed off? Yes ☐ No ☐ Close off heat leading to _____				
Should water heater temperature be reduced? Initial Setting _____ °F, Reduced to _____ °F Can **electric water heater** be insulated? Yes ☐ No ☐				
Can **control** of heating system be improved? Yes ☐ No ☐ Turn thermostat down from _____ °F, to _____ °F				
CEILING INSULATION AND VENTING*				
1. What is the **R-Value** of the **existing** insulation, R _____				
2. Type of **existing** insulation _____				
3. Joist spacing in attic is _____ inches on center				
4. Type of insulation to be added to attic _____				
5. Amount of insulation to be added to unit, R _____, which is equal to _____ inches of _____ insulation.				
6. Total amount of vapor barrier to be added _____				
7. Amount of **existing** attic ventilation _____				
8. Total amount of attic ventilation to be added _____				
9. Types of attic vents to be added to unit (type) _____ location(s) _____ (type) _____ location(s) _____ 10. This number of vents equals _____ square feet of venting				
Sub Total (carry over to pg. 4)				

Notes:

*1 Square foot of ventilation for each 150 square feet of attic. If roof and soffit vents are used, 1 square foot of ventilation per 300 square feet of attic is adequate. Upper roof vents must be 50% or more of the required area.

**2 square feet of screened ventilation for each 100 linear feet of foundation perimeter plus 1/3 square foot per each 100 square feet of crawlspace. (This may be reduced to 1 square foot of vent area per 1500 square feet of crawlspace when the earth in the crawlspace is covered with a vapor barrier.)

	Estimated Quantity	Estimated Cost ($)	Actual Quantity	Actual Cost ($)
FLOORS (Insulation, skirting, venting)**				
1. Skirt crawl space with (type) _____				
2. Skirting required in _____ foot lengths, _____ foot widths.				
3. Additional items required on skirting. _____ _____ _____ _____ _____				
4. Type of insulation to be used in floor _____				
5. Amount of insulation to be installed in floor, R-_____ which is equal to _____ inches of _____ insulation.				
Sub Total				

Storm Windows		Description	Window Light Replacements			
Width X Length	#		Width X Length	#	Width X Length	#
X			X		X	
X			X		X	
X			X		X	

Indicate the reason(s) for storm window installation.

Wall Insulation (Cost not to exceed $* 50 %; *Not recommended in South GA)	Estimated Quantity	Estimated Cost ($)	Actual Quantity	Actual Cost ($)
1. (Requires prior approval)				
2. Should walls be insulated? Yes ☐ No.				
3. Type of insulation: _____, R-Value _____				
Totals for wall insulation				
Sub Total For Page 4				
Sub Total For Page 3				
Sub Total For Page 2				
Grand Total For Unit (Should match breakdown of expenditures on page 1)				

Notes:

APPENDIX J

TUCSON URBAN LEAGUE
TUCSON, ARIZONA

AGENCY CONTACT:

Anita Goldberg
Tucson Urban League
2305 S. Park Avenue
Tucson, Arizona 85713
Phone: 602-791-9522

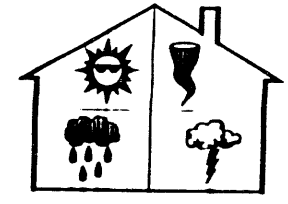
Tucson Urban League, Inc.
2305 S. Park Ave.
Tucson, Arizona 85713

The Weatherization Program is funded by the Department of Economic Security and the Arizona Energy Office.

TUCSON URBAN LEAGUE
2305 S. Park Avenue
Tucson, AZ 85713

Tucson Urban League

WEATHERIZATION PROGRAM

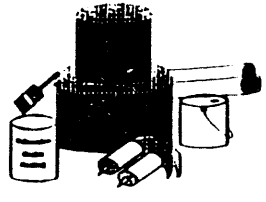


J.2

The TUL Weatherization Program is designed to help you cut down on your utility bills by making repairs to your home which will lower your energy consumption. These repairs may include items like caulking areas where outside air can get in the house, repairing doors and weatherstripping them, making sure your furnace and evaporative cooler work properly, repairing broken windows, and other repairs that can make your home more comfortable to live in year round.

Once your application is processed and you are determined eligible, it will take from 3 - 6 months for a crew of weatherization specialists to come to your home to do the repairs.

Remember, the TUL Weatherization Program will only be able to do those repairs which will seal up your house and bring down your gas and electric bills.



If you qualify, the Weatherization Specialists will:

Weatherstrip

Caulk

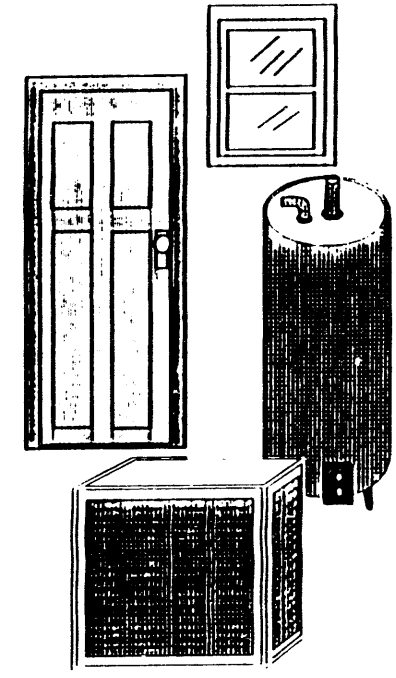
Insulate

Seal Cracks

Repair/Replace
Doors
Windows
Cooler
Heaters

To find out if you qualify, call

791-9522



Other services available at the Tucson Urban League:

Housing/Energy
Energy Assistance
Housing Counseling
Education Programs
Employment & Training
Juvenile Support
Day Care

The Tucson Urban League Weatherization Program is designed to help you cut down on your utility bills by making repairs to your home which will lower your energy consumption. These repairs may include items like caulking areas where outside air can get in the house, repairing doors and weatherstripping them, making sure your furnace and evaporative cooler work properly, repairing broken windows, and other repairs that can make your home more comfortable to live in year round.

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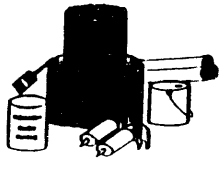
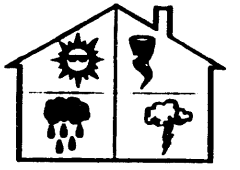




ENERGY CHECKLIST

Tucson Urban League, Inc.

LOWER YOUR GAS AND ELECTRIC BILLS

NAME: _____

PHONE: _____

DATE: _____

Use this checklist to help you cut down on your gas and electric bills. Go through your home with the rest of the family and make sure that the statements in this checklist are true for you. Let me know how much you saved on your next gas and electric bills.

ALREADY DO		WILL DO
☐	Doors and windows are closed when heater is on.	☐
☐	Closet doors are closed when heater is on.	☐
☐	Heater vents, and doors to unused rooms are closed.	☐
☐	Curtains are opened on sunny days to let the sunlight (free heat) in.	☐
☐	Curtains are closed at night to keep the heat in.	☐
☐	We wear our clothing in layers to keep warm instead of raising the heat.	☐
☐	Thermostat is set at 65° - 68° during the day.	☐
☐	Thermostat is set at 55° - 60° at night.	☐
☐	Furnace filter is clean. (I clean or change filter every month.)	☐
☐	My stove is never used to heat the house.	☐
☐	Cooler is ready for winter. It has been drained, water to cooler is off.	☐
☐	There is a damper in the cooler duct (if ducts are shared by the heater and cooler).	☐

ALREADY DO		WILL DO
☐	The house is not drafty. We have sealed every place where cold air comes in.	☐
☐	Broken windows (if any) are sealed.	☐
☐	Cracks in walls, foundation, ceiling, floors, etc. are sealed.	☐
☐	Doors and windows fit tightly.	☐
☐	Dishes are washed all at once instead of several times a day.	☐
☐	When cooking, large pots are used for large burners and small pots for small burners.	☐
☐	When cooking, lids are used on pots.	☐
☐	When baking, oven is turned off 15 minutes before the end of baking time.	☐
☐	Refrigerator coils are clean. (Remember to clean them every 2 - 3 months.)	☐
☐	Gaskets around refrigerator door seals tightly.	☐
☐	Hot food is allowed to cool before it goes in the refrigerator.	☐
☐	When nobody is using them, lights, radios, TVs stereos, etc. are turned off.	☐
☐	Clothes are only dried outside by the sun.	☐
☐	Clothes are washed in cold or warm water only.	☐
☐	Clothes are only washed when the washing machine is full.	☐
☐	Put in my application to have Tucson Urban League Weatherize (energy conservation repairs) my home.	☐

BELOW IS A LIST OF THINGS THAT I WILL DO TO LOWER MY UTILITY BILLS:

_____

_____

_____

_____

_____

_____

_____

_____

_____

I will sign up for Tucson Urban League's Weatherization Program

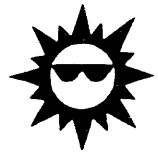
_____
Signature

To sign up for Weatherization, I will need:

_____

_____

_____



Tips for Hot Weather

When running your evaporative cooler, open a window slightly in each room you want to be cooled. The best airflow will occur if the opening is opposite the cooler vent.

• • • • • • • • •

Let in the early morning coolness by opening doors and windows. Circulate it with a fan, if needed. Close doors and windows before it begins to feel warm.

• • • • • • • • •

Keep drapes closed on the side of the house where the sun is shining.

• • • • • • • • •

Try not to use the oven when it is hot.

• • • • • • • • •

Use fans as much as possible when the weather is hot. When it's humid fans will help your cooler circulate the air and keep you feeling cooler.

• • • • • • • • •

TUCSON URBAN LEAGUE
2305 S. Park Avenue
Tucson, AZ 85713

Weatherization Program

Spring/Summer Home Tune-up

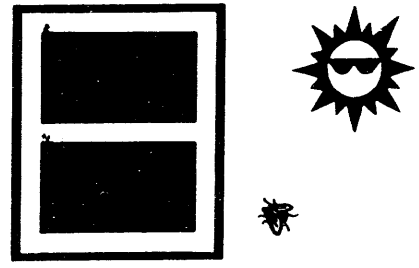
Funded by:
Arizona Department of Economic Security
&
Arizona Energy Office

TUCSON URBAN LEAGUE

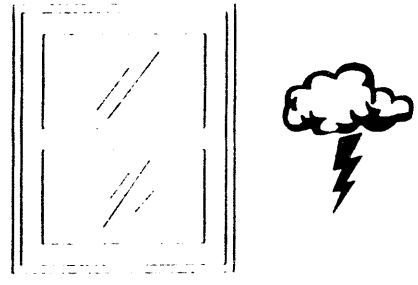
Housing Department
2323 South Park Avenue
622-3651

When Spring rolls around it's time to get ready for the warm weather ahead. Here are a few items to check before the weather gets too hot.

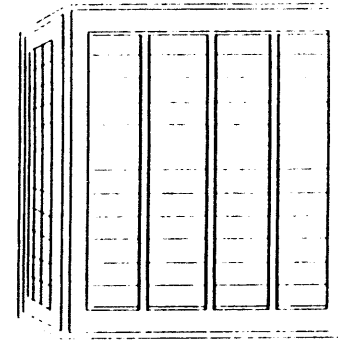
Check and repair bug screens. Put up sunscreens on windows that get direct sun.



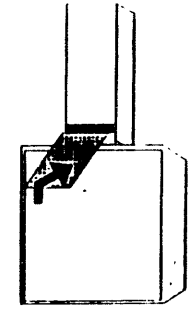
Remove storm windows where ventilation is needed and store them in a safe place.



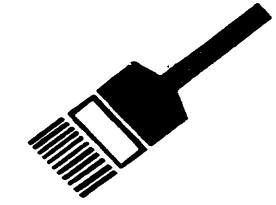
Do the regular maintenance on your evaporative cooler. (Contact the Tucson Urban League for our pamphlet on Cooler Maintenance.) Check the water lines and pads at least once a month to make sure there are no dry spots on any of the pads.



Put the damper in the furnace duct to prevent damp cooler air from rusting the furnace.



Check all doors and trim and touch up with paint or varnish. Don't leave bare wood or metal unprotected. Paint metal with rust proof paint.



After a rain, check in the attic for signs of leaks. Check at least twice a year; more often if the roof is older. On the roof, check caulking around the pipes, cooler down-duct, and the chimney.

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