

Washington State Low-Income Weatherization Program Evaluation Report For FY2010

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Finally, we acknowledge the U.S. Department of Energy for providing funding to support the Weatherization Program Evaluation.

Executive Summary

Washington's Weatherization Program provides services to improve the energy efficiency, durability, and health and safety of homes occupied by low-income households. Low-income weatherization services have been provided in Washington since 1977. The Housing Improvements and Preservation Unit within the Community Services and Housing Division of the Washington State Department of Commerce (Commerce) manages the Weatherization Program. Commerce contracts with 25 local agencies, ranging from community action agencies to units of city and county governments,¹ to deliver weatherization services including energy conservation education.

The purpose of this evaluation report is to identify and document Weatherization Program outcomes, benefits and costs for Commerce, local agencies and stakeholders to:

- Assure prudent use of funds (accountability).
- Improve the quality and effectiveness of program services.
- Assess progress toward Weatherization Program outcomes as measured by key performance indicators.

This evaluation focuses on the period from July 1, 2009 to June 30, 2010 (FY2010). In 2009 the Weatherization Program received a significant increase in funding from the U.S. Department of Energy through the American Recovery and Reinvestment Act (ARRA). As a result, weatherization production in this period was atypical. Evaluation results should not be extrapolated into the future without accounting for potential differences in funding or other requirements.

This evaluation is based on data from the following sources:

- Weatherization Program Interim Data System: Local agencies entered project information for completed weatherization projects into the Interim Data System.
- Housing Division: Commerce provided data on production, program costs, job creation, and monitoring and inspection along with access to program documents and local agency work plans.

Program Delivery

Total Weatherization Program expenditures in FY2010 were 42 million dollars. This is more than twice historical annual expenditures. ARRA funds accounted for more than half of program expenditures. Expenditures for all the other funding sources declined in FY2010.

¹ Commerce also contracts with tribal entities to deliver weatherization services. This evaluation focuses on the 25 local agencies and the temporary Commerce Housing Trust Fund Pilot that reported data into Interim Data System.

The influx of ARRA funds began driving increased Weatherization Program production by the end of 2009. The Weatherization Program completed more units in the first six months of 2010 than in any of the preceding years. Production was 2.7 times more than the historical average for 2000-2009. In 2010, the U.S. Department of Energy recognized Washington State as one of twelve states “exceeding production expectations.”

The evaluation identified the following key findings related to the delivery of the Weatherization Program:

- The increase in Program production in FY2010 was mostly achieved through the expansion of multi-family weatherization, while single-family weatherization completions have been trending downward, along with owner-occupied units.
- The top five producers account for almost 60 percent of production and the top 10 almost 80 percent in FY2010. This is similar to historical trends.
- About three-quarters of the local agencies delivering weatherization services are community action agencies, but these agencies, many of which are rural, accounted for about a third of FY2010 production.
- Some local agencies use in-house crews to conduct weatherization work, but we estimate that 85 to 90 percent of the work is performed by local subcontractors.
- More than 80 percent of weatherized units were electrically heated.
- Weatherization measures that improve the energy efficiency of the housing unit envelope (insulation and air sealing) were installed most frequently.
- Measures to improve the health and safety of the housing unit and weatherization-related repairs accounted for about a third of the installed weatherization measures.
- The average time from the energy audit to the final project inspection was 140 days.
- There were 12,185 people living in the housing units served by the Weatherization Program in FY2010. We estimate that over half the units had occupants that were over 60 years old, disabled, or children under six years old.

Program Benefits

In FY2010 Washington’s Low Income Weatherization Program installed weatherization measures estimated to save weatherized households \$1.4 million per year in energy costs, which is \$189 per unit. These energy savings will accrue each year during the lifetimes of the energy measures.

Insulation and other weatherization measures that improve the energy efficiency of the building envelope account for almost 70 percent of energy savings. Because these measures are more common in single-family units and in homes heated with natural

gas, the proportion of energy savings from these units is higher than might be expected from the level of production.

The Weatherization Program provides other benefits besides energy savings. These “non-energy” benefits accrue to utilities and ratepayers (mostly due to reductions in delinquent bills), participants (improved comfort, health, property value, etc.), and society (benefits to the economy and emissions reductions).

We estimate the non-energy benefits to be \$196 per year per household, which is similar to the energy benefits. Because non-energy benefits are difficult to measure, there is some uncertainty in our estimates. However, the results of this analysis and others show these benefits are important. They make a significant contribution to Program cost effectiveness.

Program Costs

The average total Program cost to weatherize a low-income housing unit in FY2010 is \$6,070. All program costs are allocated to weatherized units including direct weatherization costs (\$4,000/unit), local agency program operation costs not directly allocated to a project (\$1,110/unit), other local agency costs (\$30/unit), administration costs (\$540/unit), and training and technical assistance, which includes Commerce monitoring and inspection activities (\$390/unit).

This evaluation considered the cost of complying with ARRA requirements by examining aggregate Program expenditure and unit cost data. The results clearly suggest there were added costs, potentially around \$6-8 million through FY2010. A more detailed analysis of contractor bids and project costs and measures would be required to develop more accurate estimates.

Program Cost Effectiveness

The benefit-cost ratio for the Weatherization Program is 1.5 for the mid-range scenario (Table E.1). Program benefits are 50 percent greater than costs. The benefit-cost ratio ranges from 0.9 to 2.1 for different scenarios that vary energy price escalation and energy benefit degradation. This suggests that total Program benefits exceed total Program costs. Note that energy benefits alone do not exceed Program costs for any of the scenarios.

Table E.1. Weatherization Program Benefits and Costs (FY2010)

Present Value	Mid	Low	High
Emissions Benefit	\$380	\$330	_*
Economic Benefit	\$1,310	\$690	\$1,970
Utility Benefit	\$340	\$80	\$680
Participant Benefit	\$2,270	\$920	\$4,660
Total Non-Energy	\$4,300	\$2,020	\$7,310
Energy Benefit	\$4,840	\$3,620	\$5,680
Total Benefit	\$9,140	\$5,640	\$12,990
Total Cost	\$6,070	\$6,070	\$6,070
Benefit-Cost Ratio	1.5	0.9	2.1

*the emissions and economic benefit are combined in the high scenario

Recommendations

The 2006 Weatherization Program Evaluation made recommendations in three areas: estimating benefits, allocating costs, and consistent ongoing data collection. Significant progress has been made in these areas. While steps have been taken to improve cost allocation and tracking, we recommend the following three items for additional work:

- **Tracking and accounting of health and safety, repair, and energy measures and costs:** If these different costs are not accurately tracked, it is difficult to associate costs with benefits. While it can sometimes be difficult to differentiate and allocate these costs, simple and consistent ways to do this need to be developed.
- **Indirect program operations costs should be allocated to project costs:** A significant portion of the total Program cost for weatherizing units is for agency program operations costs. Many of these costs such as audits and inspections are directly related to delivering a weatherization project and should ideally be allocated to project costs.
- **Develop consistent methods for reporting direct project costs:** Local agencies report direct project costs to Commerce in the Weatherization Information Data System. Differences in how local agencies determine these costs need to be understood and consistent definitions for reporting direct project costs should be developed.

The influx of ARRA funding highlighted some important trade-offs for the Weatherization Program. These trade-offs are not “either-or” choices or “good versus not so good” options. In some cases the Program has little choice in what it can do. However, it is important to consider these trade-offs (and others not listed):

- Multi-family versus single-family units
- Higher production versus more comprehensive weatherization
- Energy benefits versus other (non-energy) benefits
- Weatherization worker wage requirements versus production costs

- Accountability/reporting requirements versus administrative/overhead costs
- Urban versus rural production

These trade-offs illustrate important policy choices facing the Program. *First, we recommend the Program focus and clarify its goals considering these trade-offs. Then we recommend the Program more intentionally focus and target its efforts to match these Program goals.* In particular we recommend that Commerce:

- **Target units to be weatherized:** Weatherize units that produce the greatest benefit (based on Program goals) relative to the production cost.
- **Document how the need for weatherization services is being met:** Gain a better understanding of the need for weatherization services and how to strategically meet the need, and then document how the need is met.
- **Clarify the importance of “non-energy” measures and benefits to Program success:** There is little agreement on what these benefits are and what the Program should be credited with.
- **Assess the impact of higher wages on weatherization measure cost-effectiveness:** Higher production costs will result in some weatherization measures no longer being cost-effective.
- **Ensure that reporting requirements add value:** The Program should review reporting requirements and discontinue reporting requirements that don’t provide information that helps the Program to be more successful.
- **Recognize the differences in weatherization service provision between urban and more rural areas and consider how to meet needs in rural areas efficiently:** Successful delivery of weatherization services in rural areas is important.

The Weatherization Program has a complex mix of funding streams with different eligibility and reporting requirements, and different contract periods. Commerce and local agencies expend a fair amount of effort dealing with this complexity. *Commerce should continue to explore opportunities for reducing Program complexity so that local agencies are able to deliver services more efficiently.*

ARRA created unique opportunities and challenges for the Weatherization Program. Commerce and local agencies were able to successfully navigate these challenges and significantly increase production to meet higher expectations. Looking ahead, Program funding will decline, creating new challenges. *We suggest that Commerce, local agencies, and stakeholders work collaboratively to ensure the Weatherization Program continues to successfully provide weatherization services to low income households.* This evaluation report could be a vehicle to initiate those conversations.

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1. Introduction

This evaluation report identifies and documents Weatherization Program outcomes, benefits, and costs for Commerce, local agencies and stakeholders to:

- Assure prudent use of funds (accountability)
- Improve the quality and effectiveness of program services
- Assess progress toward Weatherization Program outcomes as measured by key performance indicators

This introductory section gives a brief overview of the Weatherization Program, previous evaluation findings, and the evaluation methodology. Evaluation results are presented in the Program Delivery, Benefits, Cost Analysis, and Cost-Effectiveness Sections, followed by Summary Conclusions and Recommendations.

Program Overview

Low-income weatherization services have been provided in Washington since 1977, when the U.S. Department of Energy began offering funding for basic weatherization. Over the years other funding sources have been added, broadening program services under a common set of policies and technical specifications.

Washington's Weatherization Program serves Washington's low-income families by installing energy efficiency measures such as insulation, sealing leaks that allow heat to escape, replacing broken windows, upgrading heating systems, and making health and safety improvements and other necessary repairs.² These services directly benefit low-income households by:

- Reducing household energy costs.
- Improving the health and safety and comfort of the dwelling for occupants.

Weatherization services also provide broader social benefits including:

- Preserving the stock of affordable housing.
- Reducing the need for low-income support services and energy assistance.
- Improving the health and well-being of residents.
- Strengthening the economy by providing jobs and workforce development.
- Decreasing greenhouse gases and the other environmental impacts of energy use (particularly the burning of fossil fuels).
- Reducing the need for new electricity generation facilities.

² Energy-related health and safety measures and repairs refer to those that are necessary to eliminate hazards within a structure, which by their remedy, allow for installation of weatherization measures. They are intended to protect building occupants. Weatherization-related repairs are repairs necessary for the effective performance or preservation of weatherization materials.

Management and Service Delivery

The Housing Improvements and Preservation Unit within the Community Services and Housing Division of the Department of Commerce (Commerce) manages the Weatherization Program. Commerce contracts with 25 local agencies, ranging from community action agencies to units of city and county governments,³ to deliver weatherization services including energy conservation education. Many weatherization services are delivered through weatherization departments “embedded” in larger social service delivery agencies. Some of these local weatherization agencies use in-house crews to weatherize homes, but most use subcontractors to conduct some (or all) weatherization.

Funding

Weatherization services are funded by a mix of federal, state, and local sources with different goals and requirements. The major funding sources used during 2010 include the:

- U.S. Department of Health and Human Services, Low-Income Housing Energy Assistance Program (LIHEAP).
- U.S. Department of Energy, Weatherization Assistance Program (WAP).
- U.S. Department of Housing and Urban Development – Home Repair and Rehabilitation Program (administered through the Housing Trust Fund).
- Bonneville Power Administration – Low Income Weatherization Program.
- Matchmakers Program (previously called Energy Matchmakers), a state capital-funded program which generates a dollar-for-dollar match, the majority derived from participating utilities.
- Utility funds.
- Local agency funding.

Commerce administers the federal (including BPA) and the state funding sources. Most utility funding occurs between the local agency and the local utility. Local agency funding can include other city or county sources.

In 2009 the Weatherization Program received a significant increase in funding from the Department of Energy through the American Recovery and Reinvestment Act (ARRA).

³ Commerce also contracts with tribal entities to deliver weatherization services. This evaluation focuses on the 25 local agencies and the temporary Commerce Housing Trust Fund Pilot that reported data into Interim Data System.

This new funding raised production expectations for the Weatherization Program and added new reporting requirements and weatherization worker wage requirements (federal Davis-Bacon and Washington Prevailing Wage). This created challenges and tensions in the weatherization delivery network. A significant amount of effort was expended by Commerce and local agencies to ramp up production and make payroll system changes to meet the new requirements.

Commerce's agreement with the U.S. Department of Energy for ARRA Weatherization funds ends March 31, 2012. All local agency service production and expenditure of ARRA funds will be completed before that date. No additional ARRA funds are expected. Given the current budget situation, funding for weatherization from other fund sources may go down. Post-ARRA funding for weatherization is expected to be lower than pre-ARRA levels.

Previous Evaluation Findings

The Washington State University Energy Extension Program completed an evaluation of the Weatherization Program early in 2008 focusing on calendar year 2006 activities.⁴ This evaluation was the initial step in developing on-going Weatherization Program evaluation processes that support the achievement of Program outcomes. In addition to providing initial estimates of program costs, benefits and outcomes, the report included three specific recommendations to strengthen evaluation and monitoring efforts:

1. Develop systems for consistent, ongoing data collection.
2. Improve estimates of program benefits.
3. Improve cost tracking and allocation of costs.

Commerce has made investments and progress towards addressing these recommendations since 2008, including:

- Establishing the Weatherization Program Interim Data System in July 2009 to collect weatherization project data.
- Developing the on-line Weatherization Information Data System (WIDS). This enhanced Commerce's data collection capacity and replaced previous data systems in February 2011.
- Supporting the development of more robust methods for calculating program benefits that are applied in this evaluation along with better benefits data.
- Conducting audits and holding discussions on program cost accounting and performance cost accounting approaches. An advisory group has been formed to address this topic.

⁴ Kunkle, R. *Washington's Low Income Weatherization Program Evaluation Report for 2006*, Prepared for the Washington State Department of Commerce. Washington State University Extension Energy Program, WSUEEP08-007, 2008.

- Improving monitoring and inspection processes, procedures and tracking systems.
- Improving contract accounting and tracking systems, currently in progress.

Oak Ridge National Laboratory completed an impact evaluation of Washington's Weatherization Program in 2001⁵ that focused on the energy savings achieved by the Program. The results compared favorably with weatherization programs in other states.

Evaluation Approach

To evaluate the Weatherization Program, the following types of data and information were collected:

- *Project Data (Weatherization Program Interim Data System):* Agencies entered information for completed weatherization projects into the Interim Data System. The evaluation created a project analysis data set for projects completed between July 1, 2009 and June 30, 2010. These projects include over 90 percent of the weatherization projects completed by the agencies during this period. The project data is used to estimate program energy savings, direct project costs, and documents weatherization services.
- *Program Data (Housing Division Data and Program Documentation):* Commerce provided data on production, program costs, job creation, and monitoring and inspection. They also provided access to program documents and agency work plans.
- *Interviews:* We conducted interviews with six Housing Division staff to obtain their input on Weatherization Program goals, successes, and changes.⁶

The methods used to estimate Program benefits, costs, and cost effectiveness from the data collected are described in Appendix A.

The evaluation data set used to determine costs, benefits, and measure installations covers July 2009 to June 2010 (FY2010). Because of the increase in Weatherization Program funding due to ARRA, weatherization production in this period was atypical. Evaluation results should not be extrapolated into the future without accounting for potential differences in funding or other requirements.

⁵ Schweitzer, M. and Berry, L. *Evaluation of the Washington State Weatherization Assistance Program*, Prepared for the U.S. Department of Energy. Oak Ridge National Laboratory, 2001.

⁶ We had also planned to interview local agency staff, but due to timing and resource constraints (both for local agencies and the evaluation team) we were not able to conduct them. We suggest interviews (or conversations) be conducted with local agencies as part of the evaluation follow up.

2. Program Delivery

Between 1995 and June of 2010 Washington’s Weatherization Program has weatherized more than 50,000 units (Table 1).

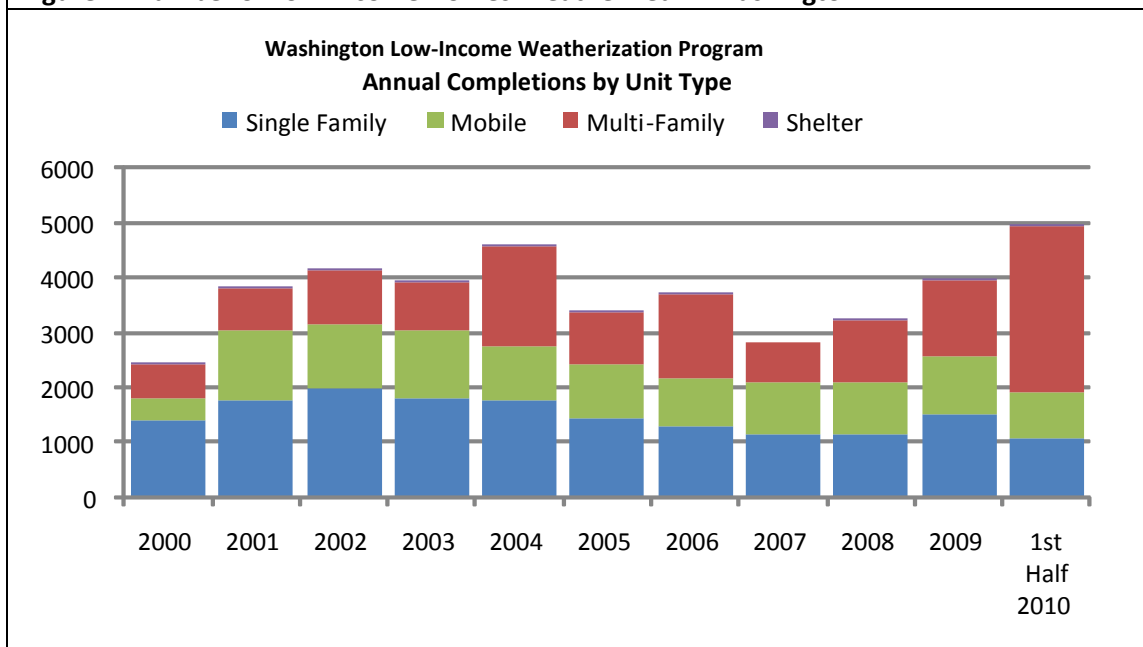
Table 1. Historical Weatherization Program Production (Units)

	1995 – June 2010	2000 – June 2010	2005 – June 2010	July 2009 – June 2010
Total Units	53,034	40,917	22,037	7,474
Single Family		16,305 (40%)	7,620 (36%)	1,810 (24%)
Mobile Home		10,694 (26%)	5,628 (26%)	1,351 (18%)
Multi-family		13,815 (34%)	8,745 (40%)	4,829 (57%)
Shelter		103 (0.3%)	44 (0.2%)	24 (0.3%)
Annual Average	3,422	3,897	4,006	7,474

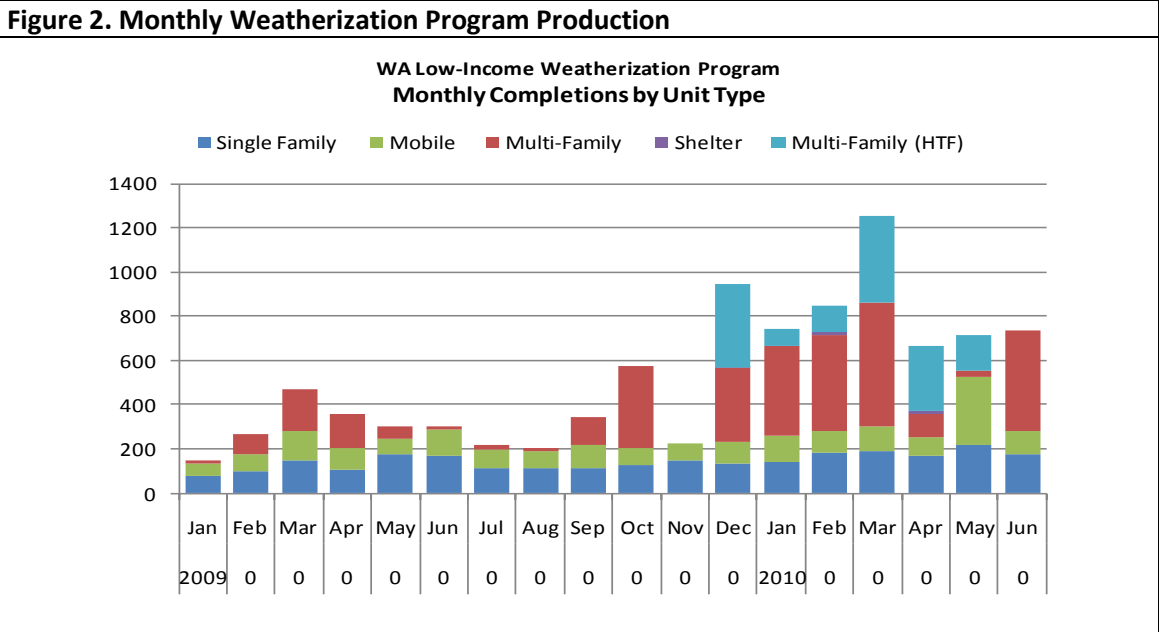
Annual production ranged between 2,442 and 4,575 units from 2000 through 2009 (Figure 1). During this period there has been:

- A decrease in single family completions. Average annual single family completions dropped from 1,821 (2001-2004) to 1,311 (2005-2009).
- A slight decline in mobile home completions. Average annual completions dropped from 1,167 to 958.
- Variations in multi-family completions (by a factor of two) with total production peaking in 2004 due to a surge in multi-family units.

Figure 1. Number of Low-Income Homes Weatherized in Washington



The influx of ARRA funds began to drive increased Weatherization Program production in October 2009. Production hit full stride in December 2009 (Figure 2). Production in the early part of 2009 was less than normal as agencies prepared for ARRA requirements and higher production. The Weatherization Program completed more units in the first six months of 2010 than in any of the preceding years, reflecting more than a doubling of production (approximately 2.7 times greater than the historical average (2000-2009)). In 2010, the U.S. Department of Energy recognized Washington State as one of twelve states “exceeding production expectations.”



Virtually all of the increase was due to expansion of multi-family weatherization (Table 2) among local agencies and through Commerce’s direct install program,⁷ a temporary initiative that completed weatherization in Housing Trust Fund (HTF) multi-family buildings from December 2009 to May 2010. There is significant month-to-month variation due to completion of big projects. The percentage of owner-occupied units dropped from 55 percent (2005-2009) to 32 percent in the first half of 2010.

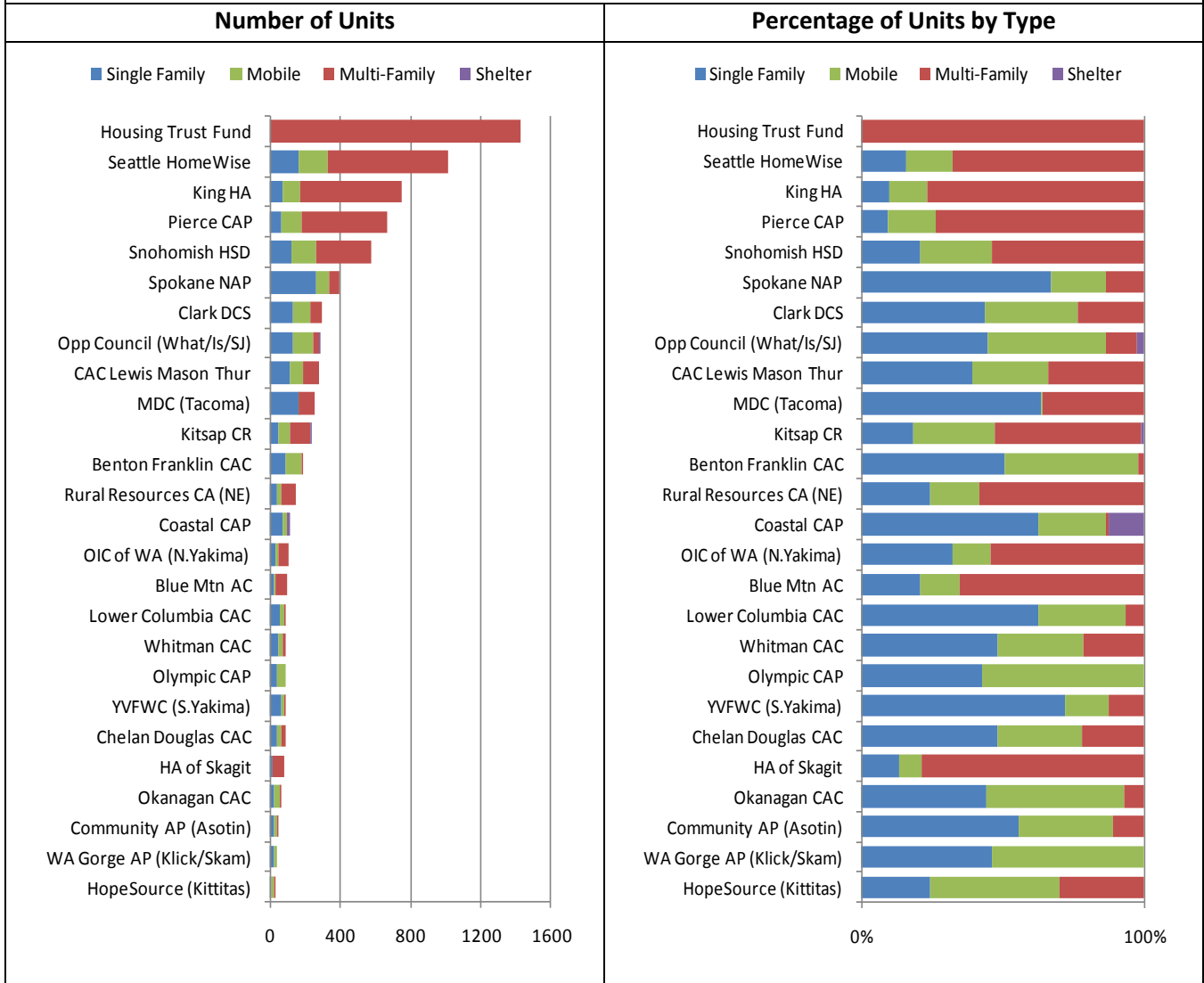
Table 2. Increase in Monthly Production by Housing Type

Average Monthly Production	Jan 2009 – Sept 2009	Oct 2009 – June 2010	% Change
Total Units	289	745	158%
Single Family Units	124	163	31%
Mobile Units	89	122	36%
Multi-Family Units	76	458	505%

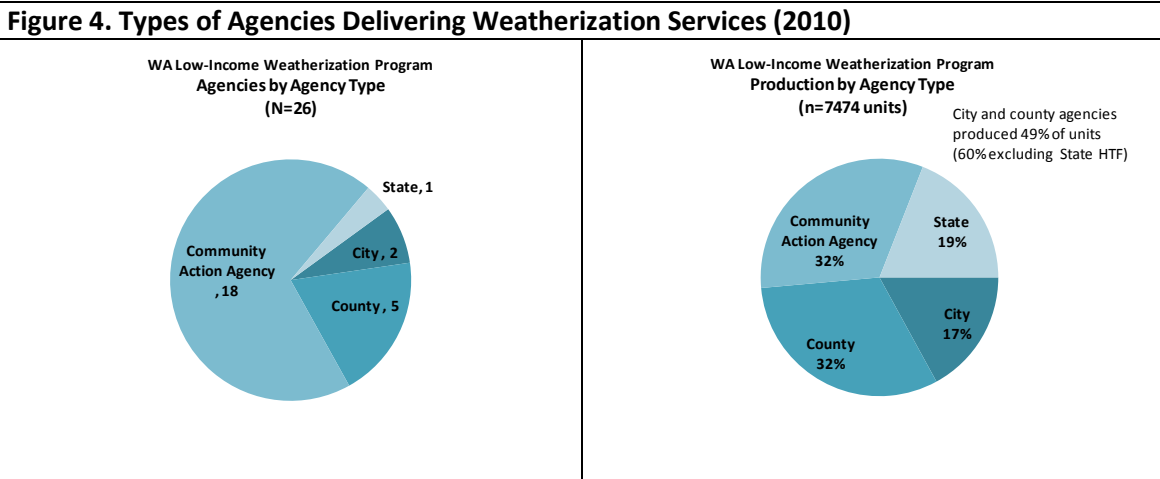
⁷ This was a temporary initiative to help meet the higher production targets of the ARRA funding. Commerce contracted directly with weatherization service subcontractors to weatherize Housing Trust Fund multi-family buildings.

The local agencies in the Weatherization Program service delivery network have differing capacities and weatherize different types of units. Annual production for July 2009 - June 2010 ranged from 33 units for HopeSource (Kittitas County) to 1017 for the City of Seattle HomeWise program (Figure 3), a reflection of rural versus urban service. The Housing Trust Fund pilot weatherized 1424 units in that period. The majority of agencies produced less than 200 units. All agencies but one increased their production. The top five producers account for almost 60 percent of production and the top 10 almost 80 percent. Production is concentrated in the most populous counties. Multi-family units were a significant portion of production for these agencies. As would be expected, smaller agencies serving rural areas with fewer multi-family units were less likely to weatherize multi-family units, and more likely to weatherize mobile homes.

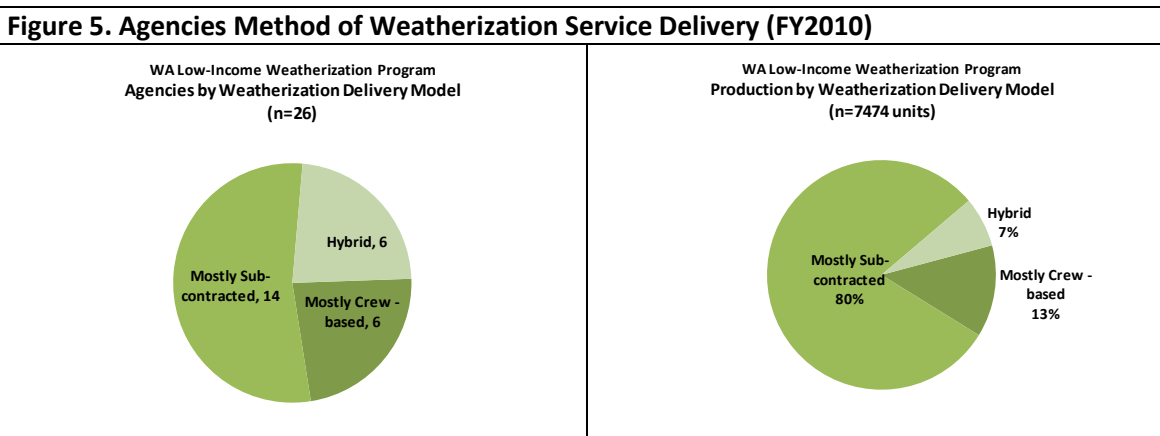
Figure 3. Weatherization Program Production by Agency (FY2010)



Commerce contracts with 25 local agencies throughout the state to deliver weatherization services. Commerce also directly contracted for weatherization work through the HTF pilot, a temporary effort to meet ARRA production goals. Almost three-quarters of the local agencies are community action agencies with the rest being city or county governments (Figure 4). However, the community action agencies, many of which are in rural areas, account for about a third of the production in FY2010.

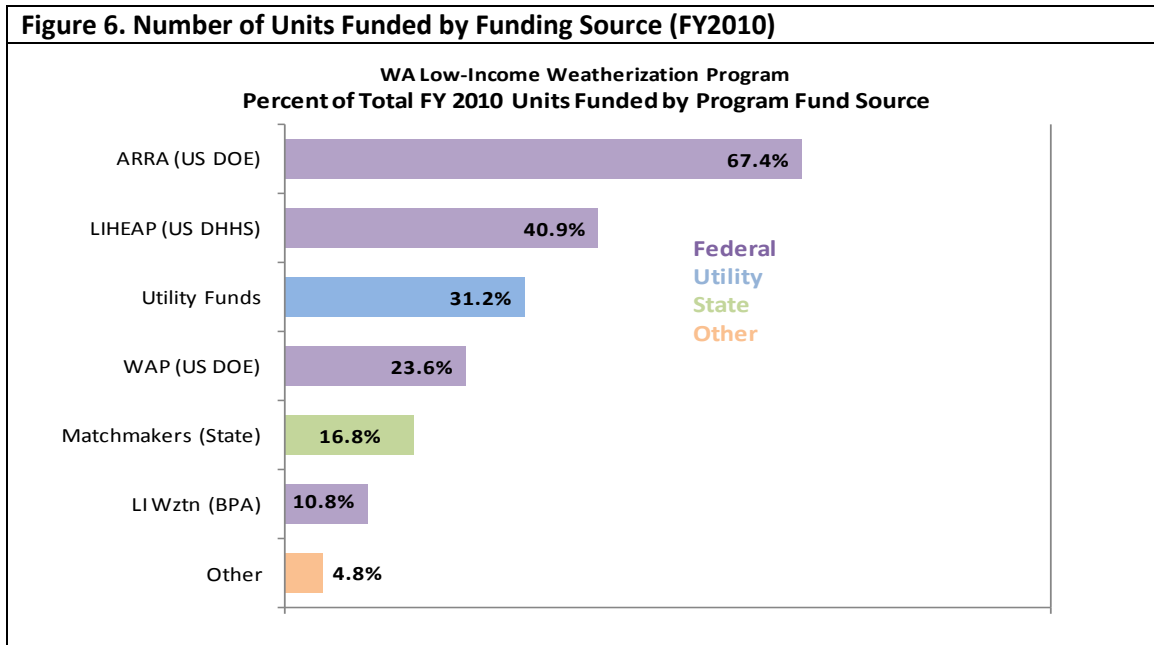


Local agencies may subcontract the entire weatherization job, or subcontract specialized services like plumbing, electrical or heating, ventilation, and air conditioning. All the local agencies use subcontractors for specialized services. More than half use subcontractors to do most or all of their weatherization work. These local agencies accounted for 80 percent of production in FY2010 (Figure 5). The remaining local agencies have in-house crews that do some (hybrid) or most (in-house) of the weatherization work. The largest agencies tend to use subcontractors to do all of their weatherization work. Local agencies have been shifting more of their work to subcontractors.

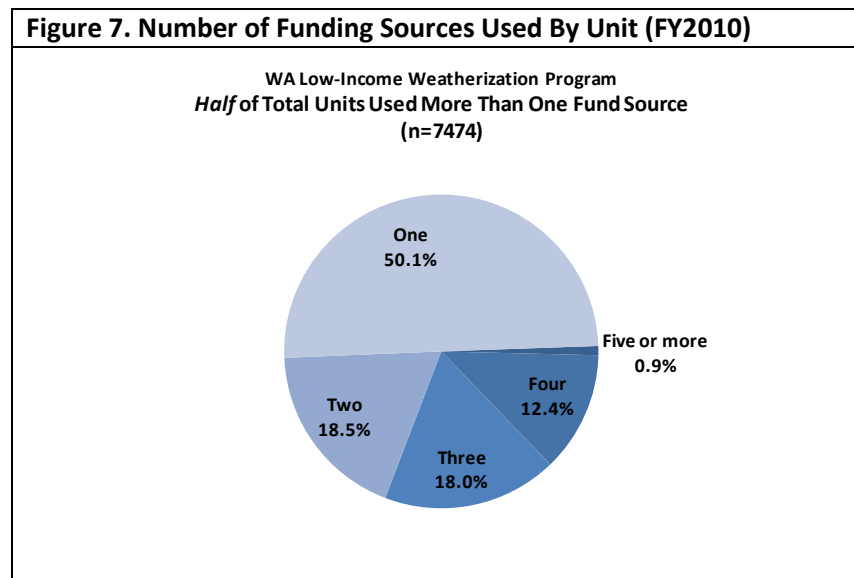


Funding Sources

Local agencies used a variety of funding sources to weatherize and rehabilitate homes in FY2010. ARRA, the most common fund source was used for more than two-thirds of all units (Figure 6).



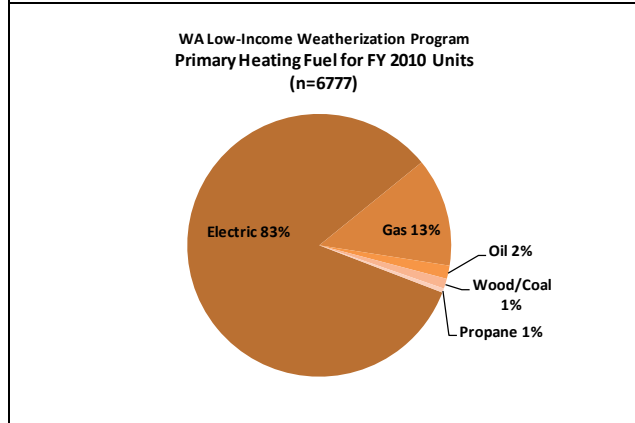
Half of the units used only one fund source (Figure 7). This is a change - in 2006 11 percent of the weatherized units used only one fund source. ARRA was the most common fund source for units using just one fund source and these units tended to be part of large multi-family projects. More than three-quarters of all projects used multiple fund sources.



Heating Fuel

More than 80 percent of the housing units weatherized in FY2010 were electrically heated (Figure 8). This is similar to historical trends. Washington State has a higher prevalence of electric heat than many other parts of the country. This also is a result of the funding that comes from electric utilities. Multi-family units were predominantly electrically heated (96 percent) as were mobile homes (86 percent), while single-family site-built homes were more evenly split between electric and natural gas heat (48 percent and 40 percent respectively). Only three agencies served more gas than electric-heated units and five agencies accounted for almost 70 percent of the natural gas-heated units weatherized.

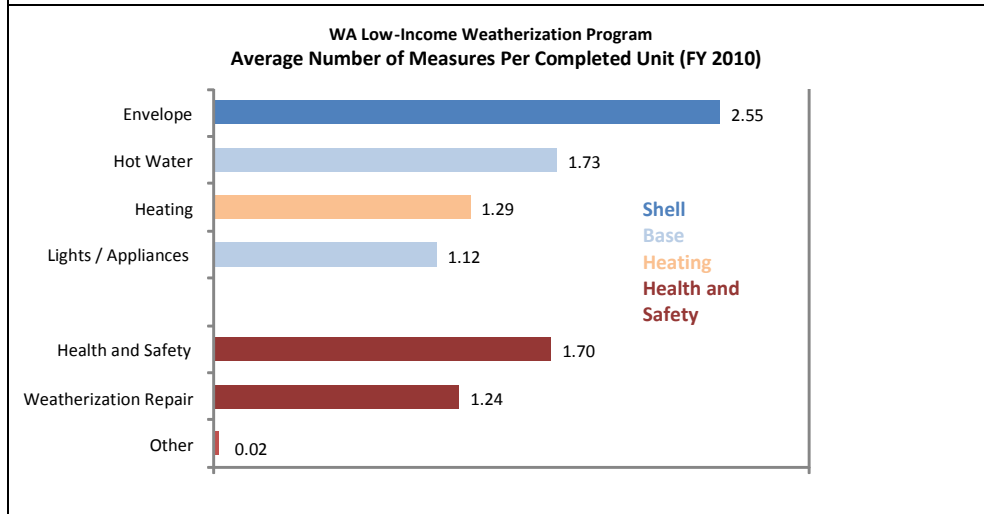
Figure 8. Primary Heating Fuel by Unit (FY2010)



Measures Installed

On average, about 10 measures⁸ were installed in each housing unit weatherized.

Figure 9. Average Number of Weatherization Measures per Unit by Type of Measure



Measures to improve the energy efficiency of the housing unit envelope were the most common (Figure 9). Measures to improve the health and safety of the housing unit and

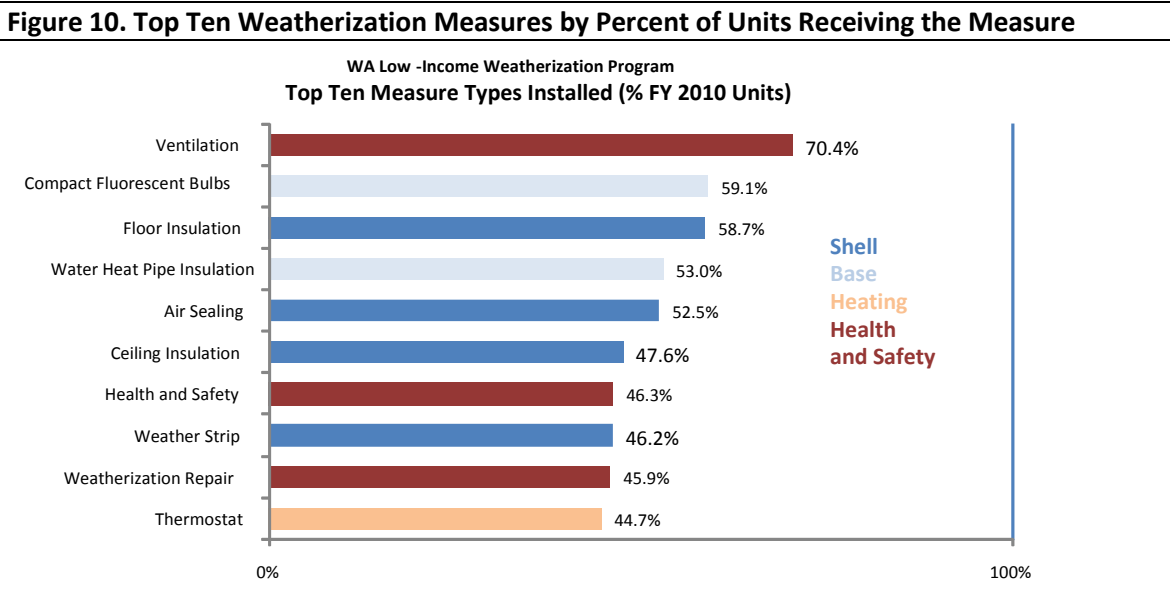
⁸ This counting of measures reflects the measure categories tracked in the Interim Data System and the categories reported by local agencies for each weatherization project. For multi-family projects, the measures reported for a project are assumed to apply to all the units in the multi-family project.

necessary weatherization repairs accounted for about a third of the installed measures. These measures do not increase the energy efficiency of the housing unit, but are necessary for the health and safety of the occupants and to preserve the long-term integrity of the installed weatherization measures.

Single-family stick-built homes tended to have more envelope measures than multi-family or mobile homes, although shell measures were still the most common measure across all housing types. Multi-family units had a higher percentage of hot water and lighting and appliance measures than the other housing types, while mobile homes had more heating measures.

Compared to data from the 2006 Weatherization Program evaluation, there were more lighting and appliance and hot water measures and fewer envelope measures in FY2010. This reflects the shift to multi-family production.

Four envelope measures (ceiling and floor insulation, primary air sealing to reduce outside air infiltration, and weather-stripping) are among the top ten individual weatherization measures installed (Figure 10). Mechanical ventilation was the most frequently installed individual weatherization measure, being installed in 70 percent of all units. This measure along with health and safety repair and weatherization-related repair were the non-energy efficiency measures among the top ten weatherization measures. Thermostats are the only heating measure in this group. Compact fluorescent lights and water heater pipe insulation are the other top ten measures. These relatively inexpensive measures were installed in more than half of weatherized units.

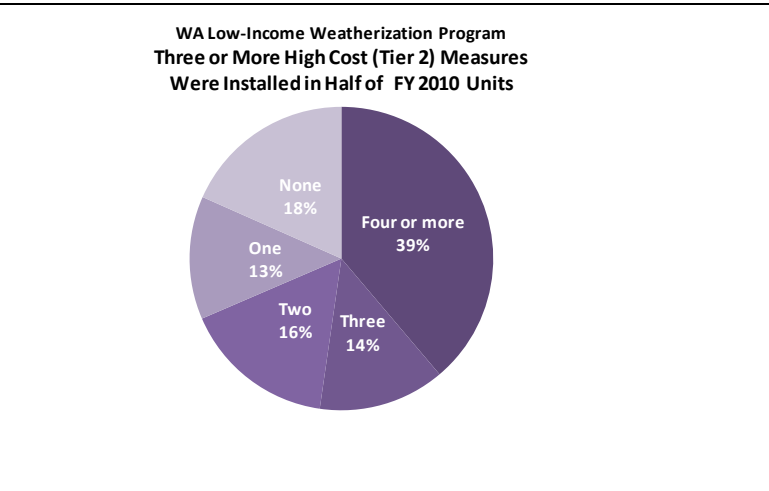


While all these measures were common in all housing types, some were favored in certain cases. For example, ceiling insulation was very common for single-family stick-

built homes (71 percent), while floor insulation was common for mobile homes (79 percent). Air sealing, health and safety repair, and weatherization related repair were more likely in single-family (mobile and stick-built) than multi-family homes. Thermostats were more common for multi-family units (55 percent).

Weatherization measures can also be grouped by their cost. Low cost measures like compact fluorescent lights (CFL) are inexpensive and easy to install. These measures are sometimes referred to as “Tier 1” measures. Higher cost measures like insulation are more expensive and must meet stringent installation requirements to be effective. These “Tier 2”

Figure 11. Share of Units by Number of Tier 2 Measures Installed



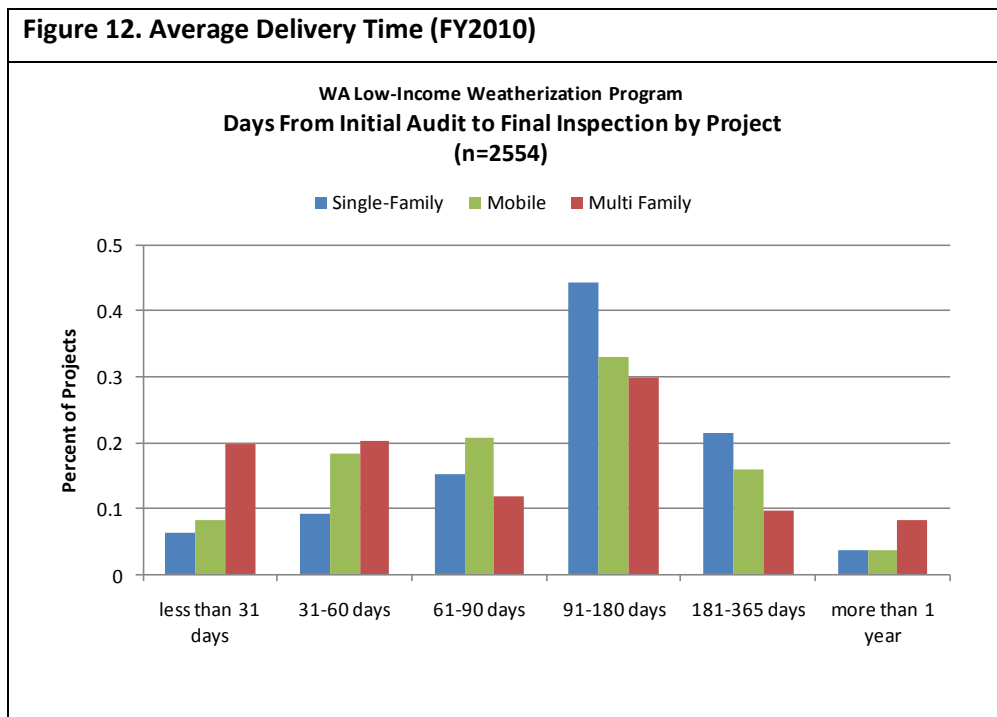
measures include ceiling, wall and floor insulation, heating system replacement, duct sealing, duct insulation, and air sealing. More than 80 percent of the units weatherized had at least one Tier 2 measure and more than half had three or more Tier 2 measures installed (Figure 11). Units with four or more Tier 2 measures account for the largest share.

Ceiling insulation was the most common Tier 2 measure for units with only one Tier 1 measure. For units with two Tier 2 measures, ceiling insulation and air sealing were most common. For three Tier 2 measures floor insulation is added to the mix. Projects with no tier 2 measures were most common in multi-family projects, accounting for 25 percent of the multi-family units weatherized. Six agencies accounted for 77 percent of the no tier 2 measure units.

Project Delivery Time

On average it took 140 days to complete a weatherization project. This is the time from the energy audit to the final project inspection. The average completion time was similar for single-family, multi-family, and mobile home projects, but the distribution of delivery times was different (Figure 12).

Multi-family tended to have more projects with both short and long (more than 1 year) time periods. The complexity of a project, the need for repairs, and the use of multiple subcontractors can extend the time of project completion. For multi-family projects, the building owner often has more responsibility for project implementation and costs. A project might be staged in phases, extending the completion time.



The delivery time for most agencies falls in the 100 to 160 day range. Eight agencies had average delivery times of less than 100 days. The three agencies with the longest average delivery times (over 200 days) are among the agencies with the highest production. In some cases, one large project (for example, a large multi-family building) can skew an agency's average.

Households and Persons Served

There were 12,185 people living in the housing units served by the Weatherization Program in FY2010. This is more than twice the number served by the Weatherization Program in 2006. Over 2,200 of these people were over 60, about 1,500 were disabled and 1,400 were children under six (Figure 13). We estimate that more than half the units weatherized had occupants in one of these groups.

About one-third of the units weatherized were occupied by families with incomes under 75 percent of the poverty level, a little more than a third were between 75 and 125 percent, and a third were between 125 and 200 percent (Figure 14). This reflects a change in the most recent funding cycle where the maximum eligible income was raised from 125 percent of poverty to 200 percent.

Figure 13. Household Member Demographics

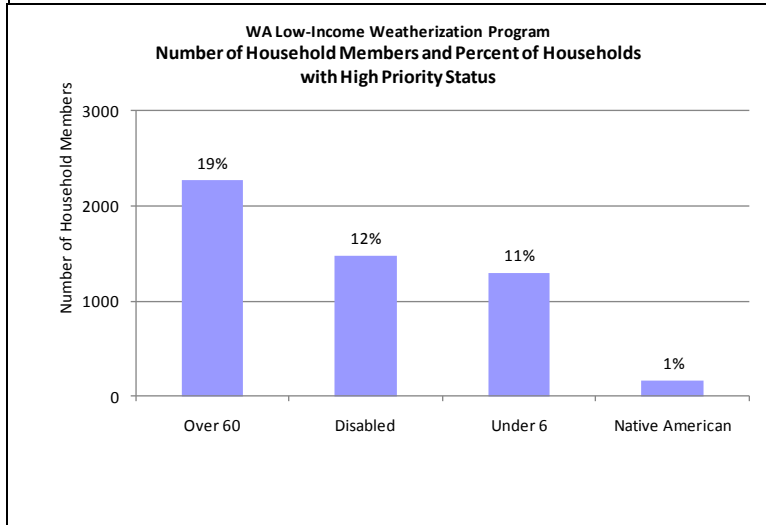
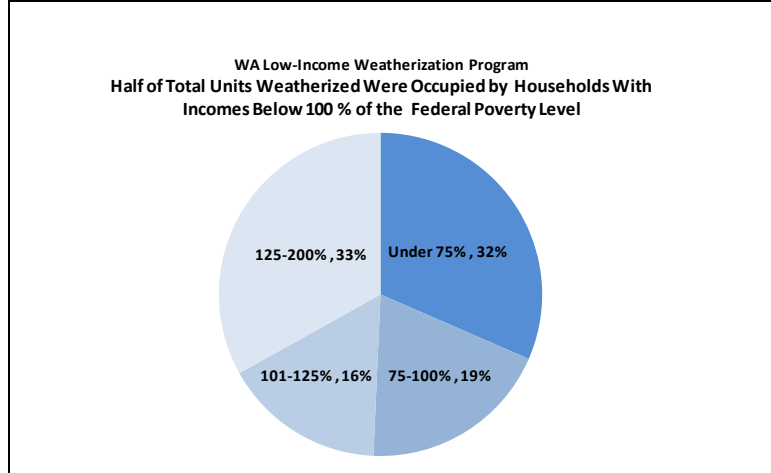


Figure 14. Household Poverty Level



Agency Accomplishments, Challenges, and Recommendations

Each year, local agencies produce a work plan that summarizes their processes, procedures, accomplishments, and challenges. The following information is from the narrative portion of work plans submitted in 2010.

Accomplishments

The agencies report accomplishments in three areas: how they helped people, cooperation with other agencies, and use of other resources to help households.

The agencies emphasized the comprehensive nature of their services. The benefits they identified included lowering energy costs, improving occupant health and safety, increasing occupant comfort, and making repairs that allow the homes to be weatherized and that extend the life and durability of the homes. As one agency reported:

“Our focus is always on health, safety, durability, and energy efficiency of the dwelling unit housing low income families in our three county service territory. We repaired or replaced leaking roofs, faulty plumbing, electric and heating systems. Repaired water damaged flooring and walls in bathrooms. Installed mechanical ventilation, air sealed, and insulated to improve indoor air quality, reduce energy bills, and make homes more comfortable.”

The local agencies reported they cooperated and partnered with a wide variety of organizations. Utilities are a primary partner and significant fund source for the local agencies. The local agencies also identified other government entities (cities, counties, housing authorities) and non-profit housing, elderly, and community organizations. In some cases these entities provided funding to make energy improvements and repairs, stretching agency resources. Some local agencies reported using Community Development Block Grant (CDBG) funds from city or county governments to make housing repairs. Other funding sources included the U.S. Department of Agriculture and various community housing preservation programs.

Local agencies referred clients to some of these other community organizations when a need existed and also partnered with some of them to reach and identify clients. All agencies deal with non-English speaking clients. Many local agencies take advantage of volunteer help from local service organizations and a few allow clients to provide sweat equity for their projects.

Challenges

The local agencies identified problem areas in their work plans. Primary problem areas had to do with subcontractors, repair and rehabilitation needs, and increasing compliance and reporting requirements.

Adding subcontractors to meet higher production goals has been a challenge, which has been aggravated by Davis-Bacon and state prevailing wage requirements and other insurance and training requirements. It takes time for subcontractors to get up-to-speed and this process has been difficult.

Local agencies have consistently highlighted the need for more repair and health and safety funds to serve the low income population and avoid having to defer or walk away from housing units that could benefit from weatherization if more funds for repair and health and safety were available. Local agencies indicated this has become more of a challenge because of recent program changes that combined fund sources and because of higher costs due to Davis Bacon and state prevailing wage requirements. This affects their ability to provide comprehensive weatherization services.

A challenge brought up by some of the more rural local agencies is the large service area they cover. Travel to job sites is a significant portion of their costs. Having to make additional trips because of client 'no shows', or to repeat diagnostics tests because of weather issues, or just to complete work is expensive when there are large travel distances. Winter weather can also make it difficult to get to clients in outlying areas.

Local agencies said it is becoming more difficult and time consuming to comply with program requirements. This is driving up their administration and operating costs and decreasing the cost effectiveness of the services they provide. Ultimately, they feel they have less flexibility in managing their funding resources.

Local Agency Recommendations

Local agencies suggested a mix of recommendations, many of which were related to simplifying and improving administrative requirements, reporting, and communication. Local agencies also made suggestions about training, funding, and client education.

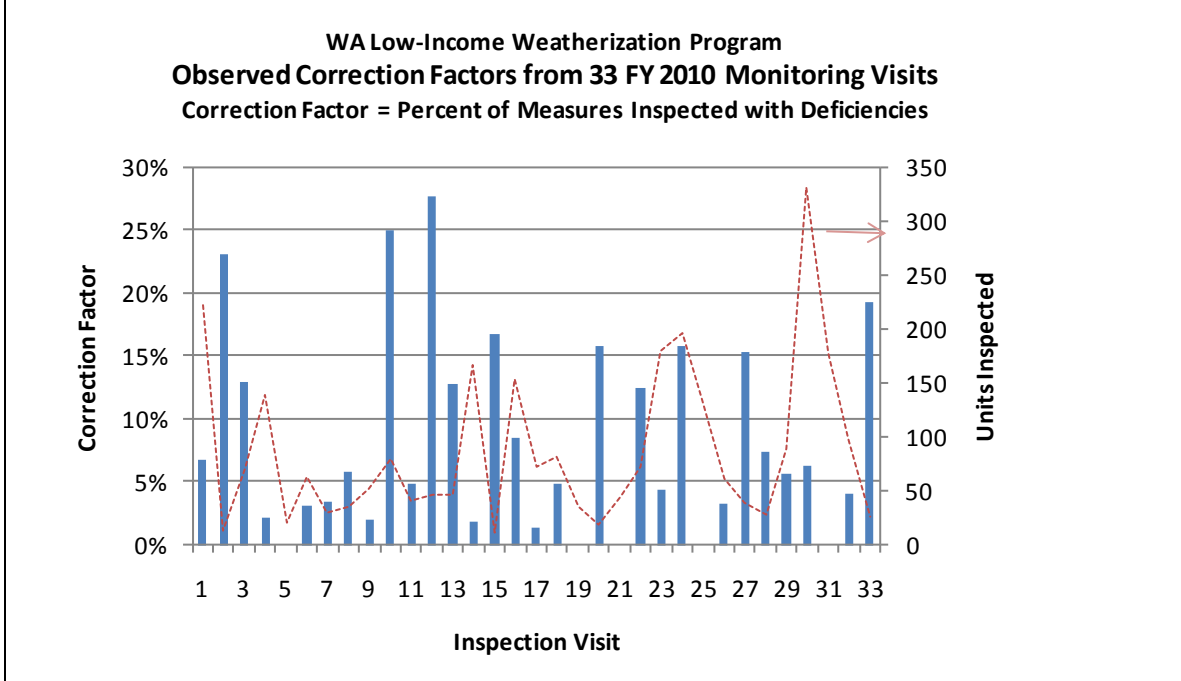
A couple of local agencies mentioned improvements they were making such as implementing more comprehensive client education programs. Another noted they are doing more focused outreach to raise awareness of weatherization services and another is using a new scheduling program to improve service efficiency.

Commerce Quality Assurance Inspections

Housing Division staff conducts regular inspections of weatherization jobs completed by the local agencies. In 2010 Commerce increased the rate of inspections from five percent to at least 20 percent of units served. Commerce made several additional changes to the inspection process to increase efficiency and to improve documentation. The first inspections using this process were completed in August 2010. Through December 2010, Commerce made 33 inspection visits to local agencies and inspected 412 weatherized units, which represented 30 percent of the completed units in the previous quarter for visited agencies. The inspectors identified needed corrections for seven percent of the measures that were inspected. Agencies are required to

implement the corrections identified. Of the 33 inspection visits, five had no corrections and 12 had three percent or less (Figure 15). The correction factor was greater than 15 percent for eight of the inspection visits. However, these eight visits mostly involved smaller agencies and reflected only 11 percent of the units inspected. Note that more units inspected during a visit reflect higher production.

Figure 15. Commerce Inspection Visit Correction Factors



3. Program Benefits

The Weatherization Program delivers a wide range of services to improve the energy efficiency, durability, and health and safety of clients. Energy savings is usually the primary benefit attributed to weatherization programs, partly because it can be quantified and it is one of the primary goals of program funders. However, there are a number of other benefits to client households, the environment, the economy, utilities, and society. These benefits can be difficult to quantify but are as significant as or more significant than energy savings. In this section we quantify these benefits to give as complete a picture as possible of Weatherization Program benefits.

Energy Benefits

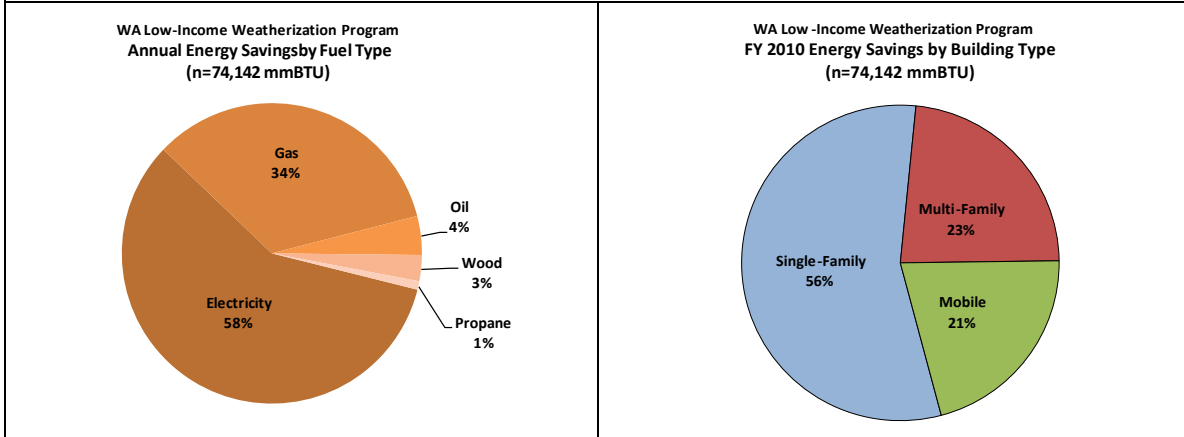
The energy benefits of the Weatherization Program are based on the energy efficiency measures local agencies reported they installed. Energy savings are calculated for each installed measure using accepted calculation methods. This is commonly referred to as a “deemed” approach for calculating energy savings.⁹ More information about the energy savings calculation methods can be found in Appendix A.

In FY2010 Washington’s Weatherization Program installed energy efficiency measures estimated to save 12.6 million kWh/year of electricity, 251,000 therms/year of natural gas, 22,500 gallons/year of oil, 7,400 gallons/year of propane, and 100 cords/year of wood. The average household of a weatherized unit will save \$189/year in energy costs. This ranges from \$89/year for a multi-family household to \$389/year for a single-family household. The total annual energy savings to households whose homes were weatherized in FY2010 is \$1.4 million. These energy savings will accrue each year during the lifetimes of the energy measures.

More than half the energy saved is electricity and about a third is natural gas (Figure 16). This reflects the fact that electricity is the most common energy source in the weatherized units. However, the energy savings for natural gas is higher than might be expected given that 13 percent of the weatherized units have natural gas heat. This is because natural gas heat is more common in single-family homes, which have higher energy savings (see Figure 16). Oil, propane, and wood together account for less than 10 percent of the energy savings.

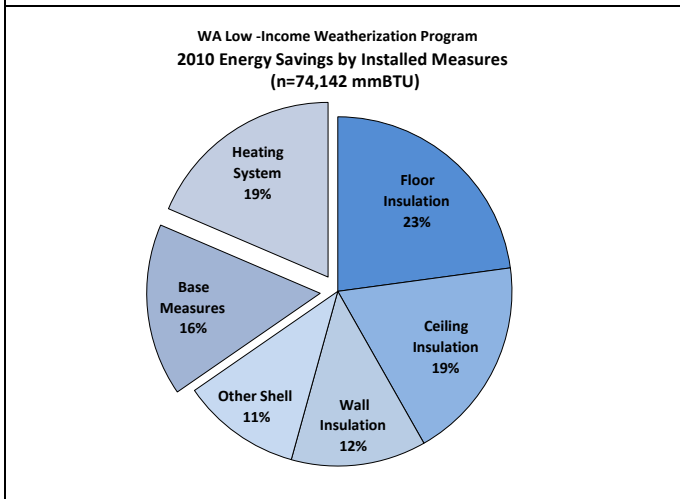
⁹ We developed these calculations in consultation with the Cadmus Group in Portland. We relied as much as possible on energy savings estimates developed by the Regional Technical Forum (RTF) of the Northwest Power and Conservation Council. The RTF has developed “deemed” savings calculations for a variety of basic energy efficiency measures. For weatherization measures that are not included in the RTF savings estimates, we use simple engineering estimates and assumptions that are based as much as possible on actual measurements and research.

Figure 16. Energy Savings by Heat Source and Unit Type (FY 2010)



The majority of energy savings occurs in single-family units (Figure 16). This is despite the fact that significantly more multi-family units were weatherized. Multi-family units are smaller with less exterior surface area and often have fewer opportunities for energy efficiency improvements. As a result, heating energy savings per weatherization measure are greater for single-family homes and more measures were installed in single-family homes.

Figure 17. FY 2010 Energy Savings by Weatherization Measure



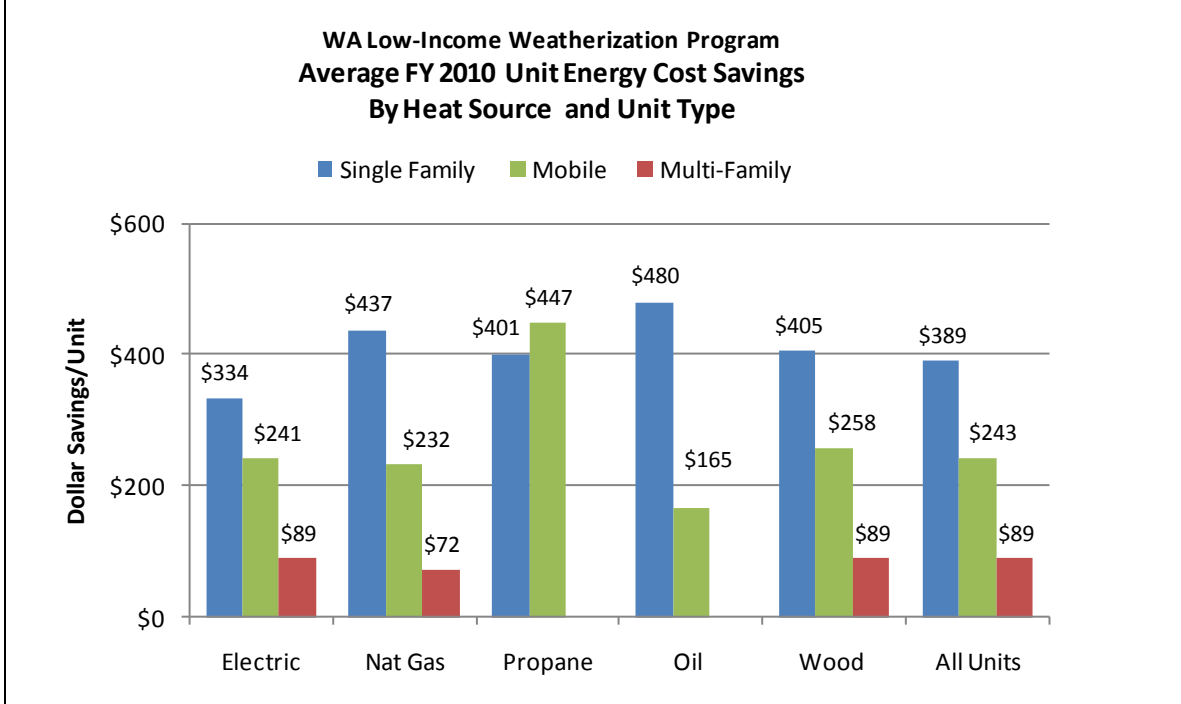
Insulation and other weatherization measures that improve the energy efficiency of the building shell account for almost 70 percent of energy savings (Figure 17). Floor insulation and ceiling insulation resulted in the greatest savings. All the heating system weatherization measures reduce energy use by 19 percent. Base measures (lighting, hot water, and refrigerators) account for 16 percent of the energy savings.

The annual dollar savings per unit¹⁰ reflects the energy savings estimates. Single-family households have three to four times more cost savings than multi-family units and cost savings are also higher than mobile homes (Figure 18).

¹⁰ Cost savings are calculated using average fuel costs for Washington from the U.S. Energy Information Administration.

Single-family units account for 50 percent of the \$1.4 million of annual energy cost savings from the Weatherization Program. Multi-family units were 57 percent of total units receiving energy efficiency improvements, but only 27 percent of Weatherization Program energy cost savings due to lower per unit energy cost savings.

Figure 18. Average Energy Cost Savings by Heat Source and Building Type (FY2010)



Other Benefits

Definitions

The Weatherization Program provides other non-energy benefits. There is a growing body of research concerning how to quantify the other benefits from energy efficiency programs. While methods for estimating non-energy benefits have improved over the past five years, results vary and more work to more consistently quantify these benefits is needed.

Skumatz, Khawaga and Krop’s 2010 summary of best practices for estimating non-energy benefits for low income weatherization programs¹¹ groups other benefits into three categories: utility benefits, participant benefits, and societal benefits.

¹¹ Skumatz, Lisa, M. Sami Khawaga, and Richard Krop. *Non-Energy Benefits: Status, Findings, Next Steps, and Implications for Low Income Program Analyses in California*. Prepared for Sempra Utilities, May 2010.

Utility Benefits: These are benefits to utilities and ratepayers resulting from lower energy costs for weatherized households. Benefits include reductions in delinquent utility bill payments and fewer bad debt write-offs, service shut-offs and re-connects. These benefits are modest compared to the societal and participant benefits. They are easier to quantify and have a higher degree of certainty.

Participant Benefits: These are the non-energy benefits received by households whose homes are weatherized. Participant benefits include water and wastewater bill savings, increased property values, improved equipment performance, fewer moves (able to stay in their home), safety benefits (fewer fires and lower insurance costs), health benefits (fewer illnesses, less asthma, fewer missed days at work/school), and improved comfort (quieter, better lighting, better temperatures). Participant benefits are difficult to quantify. Current methods rely on participant surveys to identify and place a value on these benefits. While estimates of participant benefits vary widely, most indicate that participant benefits are significant and are key program impacts.

Societal Benefits: Societal benefits include benefits that are not received by utilities, ratepayers, or participants. Commonly calculated societal benefits include reduced greenhouse gases and pollutants emissions and benefits to the local economy resulting from Program expenditures and households spending energy savings dollars in the community.

Emission reductions are calculated from energy savings and appropriate emission factors around which there is common agreement. Estimates of the net economic benefits of programs are more uncertain. They rely on complex macroeconomic input-output models. Few of these studies have been done. The results vary depending on the model's assumptions.

Estimates of Other Benefits

Estimates of other benefits rely on three main sources:

- Utility and Participant benefit estimates are based on the mid-point for studies summarized in Skumatz, Khawage and Krop's 2010 best practice review.
- Economic benefit estimates are based on results from an evaluation of Pacific Power's Weatherization Program in Washington.¹²
- Emission benefits are directly estimated from Program energy savings (see Appendix A for more information).

¹² Khawaja, M. Sami, Sara Wist, Doug Bruchs, Eli Morris, and Elizabeth Daykin. *Washington Low-Income Weatherization Program*, prepared for Pacific Power, 2007.

In general we chose moderate to conservative estimates. Table 3 shows the estimates we used in this evaluation (Mid) as well as other values we identified in the best practice review report - high and low values along with the Low Income Public Purpose Test (LIPPT) values developed in California in 2001.¹³

Table 3. Other Benefits Estimated (dollars/household/year)

	%	Mid (\$)	High (\$)	Low (\$)	LIPPT (\$)
Total	100%	196	711	134	104
Utility	8%	16	31	4	12
Participant	53%	103	211	56	48
Economic	31%	60	341	60	36
Emissions	8%	17	128	14	8

Utility and participant benefits

Participants receive \$103 per unit/per year. This is a little more than half of the total other benefits. Utility benefits are a relatively modest \$16 per unit per year.

Economic benefits

Local communities receive about \$60 per unit per year in economic benefits. Benefits research suggests that Weatherization Programs can have greater economic benefits than other options for spending public dollars because they are labor intensive and they result in on-going energy cost savings.

One way these benefits accrue is through supporting and creating jobs. The Department of Energy required Commerce to track and report the FTE (Full Time Equivalent) for jobs created and retained at Commerce, local agencies, and their subcontractors for projects that were supported by ARRA funds each quarter. ARRA funds were 56 percent of total Weatherization Program funding in FY 2010. Based on quarterly reports submitted between July 2009 and September 2010 we estimate ARRA funds:

- Created and retained 180 full-time jobs.
- Supported over 320 jobs.

The ARRA figures are reported as gross jobs, not net jobs. These estimates do not account for what might have happened if money spent on the Weatherization Program was spent on other government programs or returned to taxpayers. Net impact analysis

¹³ The LIPPT estimates were developed for California’s Low Income Weatherization Program and provide a conservative, low-end value. The purpose of the best practices review report referenced in footnote eleven is to examine “advances and patterns in non-energy benefits estimation since the LIPPT model was developed.”

requires running macroeconomic input-output models, which was well beyond the scope of this study.

Emission reductions

The Weatherization Program energy savings result in total annual reductions of:

- 10,290 metric tons of CO₂ (greenhouse gases)
- 24 metric tons of NO_x
- Four metric tons of SO₂

The total dollar value of these emission reductions is \$129,000 per year.

Other societal benefits

Other benefits from the Weatherization Program are not limited to the ones included in this evaluation analysis. There are additional Weatherization Program benefits that could be quantified to support efforts to seek complimentary funding. For example, it is much less expensive to weatherize a low income housing unit than to build a new one. Weatherizing a low income housing unit extends its life and helps avoid the need for new low income housing units. We were unable to find any studies that quantified the avoided costs of preserving low income housing. The issues are not straight-forward since weatherizing a low income housing unit does not necessarily result in avoiding the creation of a new low income housing unit and there are uncertainties around determining the value of a low income housing unit to society.

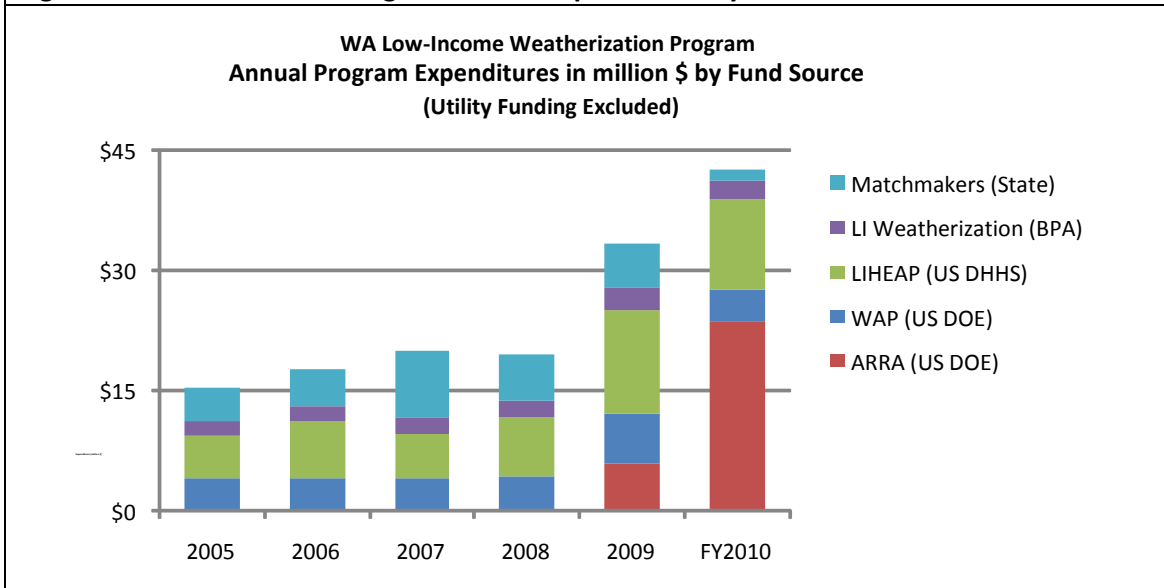
Our initial “back of the envelope” calculations, while uncertain, suggest that the value of housing preservation may have considerable benefit to society.

Energy and utility benefits are and will remain important to current program funders. If, as projected, funding for current programs declines over the coming years, identifying and quantifying other societal benefits may be a valuable tool for attracting and leveraging other funding. It is also important to understand and quantify these benefits to support policy making and decisions in the Weatherization Program’s broader role and position as part of Commerce’s Housing Improvement and Preservation mission.

4. Program Cost Analysis

Total Weatherization Program expenditures in FY2010 were 42 million dollars. This is more than twice as much as annual expenditures in the 2005-2008 period (Figure 19). This is due to American Recovery and Reinvestment Act (ARRA) funds that first became available in 2009. In FY2010, ARRA funds accounted for more than half of program expenditures. Expenditures for all the other funding sources declined in FY2010. In part this was due to a focus on using the ARRA funds, but for some fund sources the available resources declined.

Figure 19. Weatherization Program Annual Expenditures by Fund Source



These Weatherization Program expenditures do not include utility funds, the majority of which are provided directly to the weatherization agencies.¹⁴ They also do not include other funds the agencies may receive directly from cities, counties, or other federal sources or any contributions from the property owner. Homes may also have received rehabilitation and repair services from the Housing, Rehabilitation, and Repair Program (HRRP¹⁵) prior to being weatherized. These costs are not included in Weatherization Program expenditures.

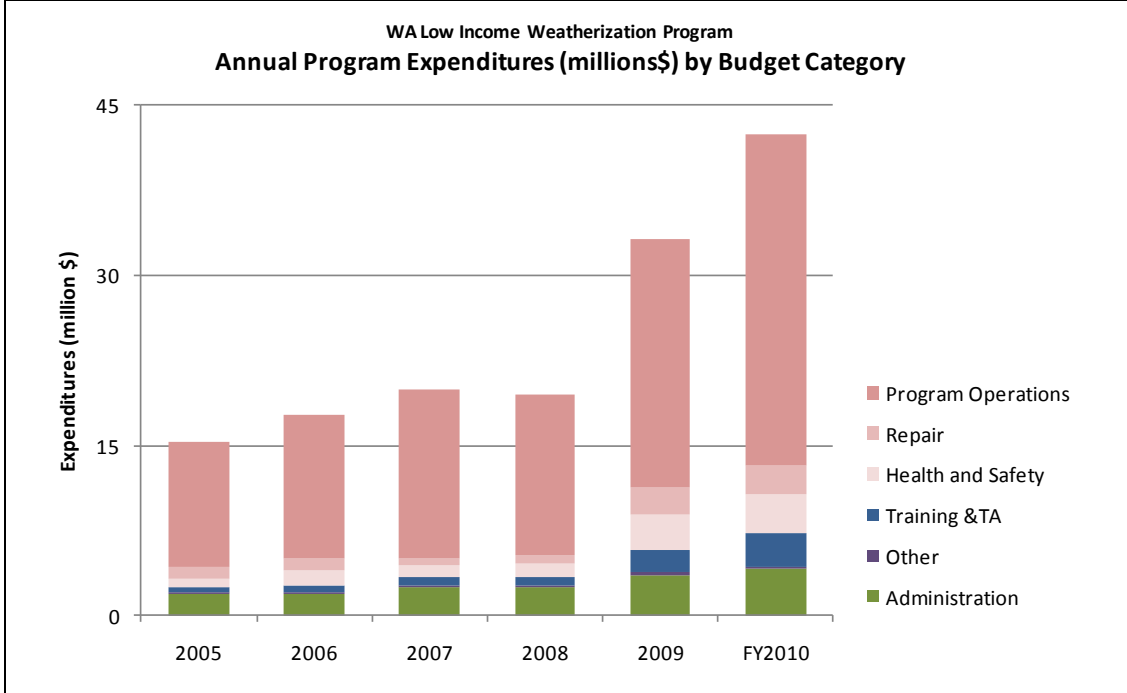
The largest portion of expenditures is for the Program Operations budget category (Figure 20). This budget category includes the costs for installing energy efficiency measures as well as many other program operations costs. Program Operations can also

¹⁴ Utility funding is included in the direct project costs reported by agencies (see below) and is included in the cost-benefit analysis.

¹⁵ Beginning July 2009 HRRP was merged with the new Matchmakers Program, which replaced Energy Matchmakers, removing funds from the Department of Housing and Urban Development budget and relying on state capital funds instead.

include energy-related health and safety measures and repairs, even though separate budget categories also exist for these measures. Administrative costs account for 10 to 13 percent of total expenditures for the 2006-FY2010 period. Training and technical assistance (T&TA), energy-related repairs, and the health and safety budget categories have each accounted for five to 10 percent of program expenditures in recent years.

Figure 20. Weatherization Program Annual Expenditures by Budget Category

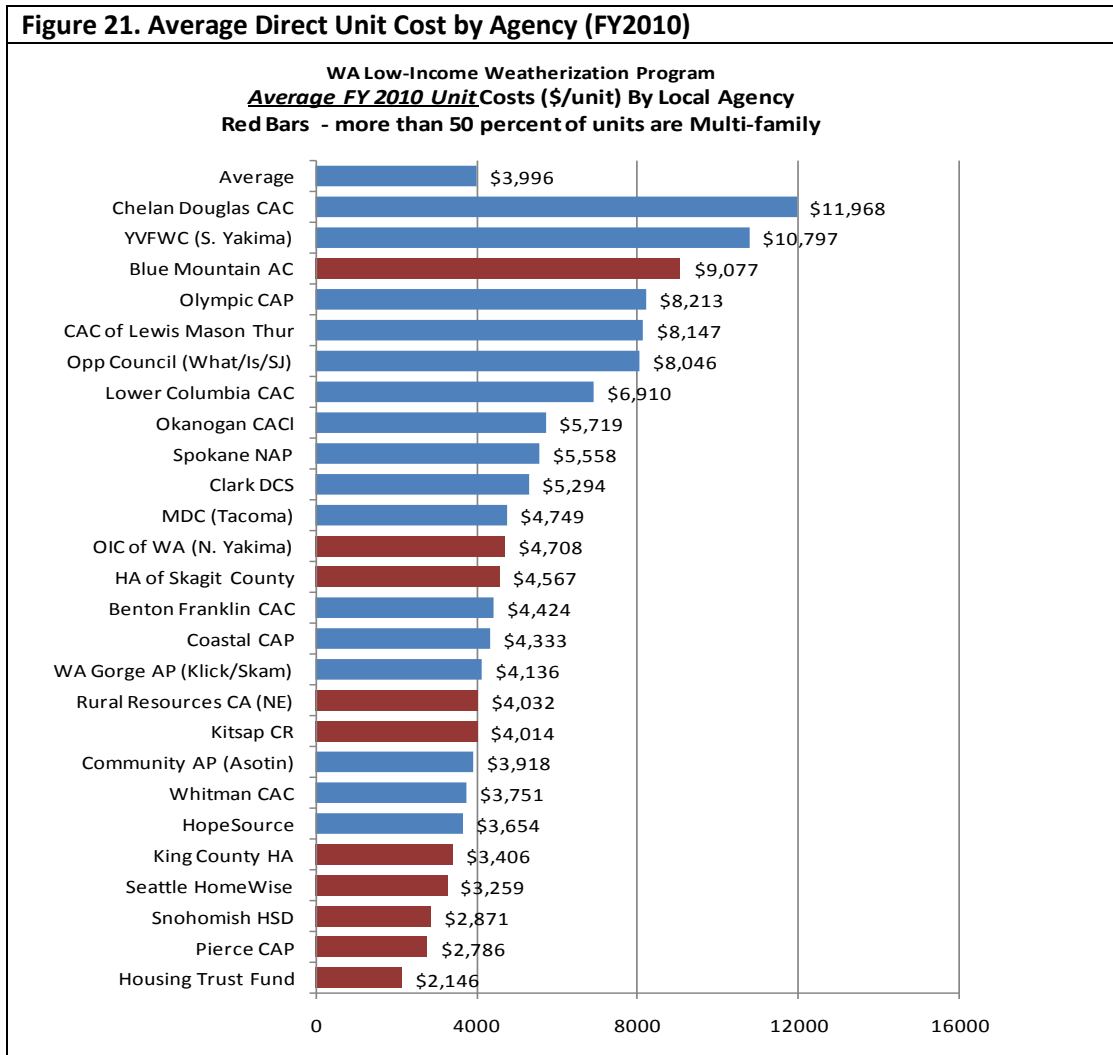


There is some variation in the distribution of expenditures by budget category across local agencies. This is particularly true for the repair and health and safety budget categories. In FY2010 there were eight agencies where repair and health and safety expenditures accounted for more than 20 percent of expenditures (with a corresponding decrease in the share of program operations expenditures), but some agencies spent a much smaller share. Agencies often cite lack of funds for needed repairs in low income housing as an important challenge to effectively serving low income clients. However, these budget category expenditures suggest agencies are not spending up to the limit of repair costs (15 percent).

The differences in expenditures may be partly due to how agencies account for their costs (repair and health and safety measures can be included in the program operations budget category). Differences in expenditures may also be due to differences in client needs (and housing stock) and in how the agencies choose to use their resources.

Direct Unit Costs

Direct unit costs¹⁶ were reported by local agencies in the Interim Data System. We analyzed direct costs using the 6,777 projects with a final inspection date between July 1, 2009 and June 30, 2010.¹⁷



The average direct unit costs by local agency covered a wide range (Figure 21). Key findings include:

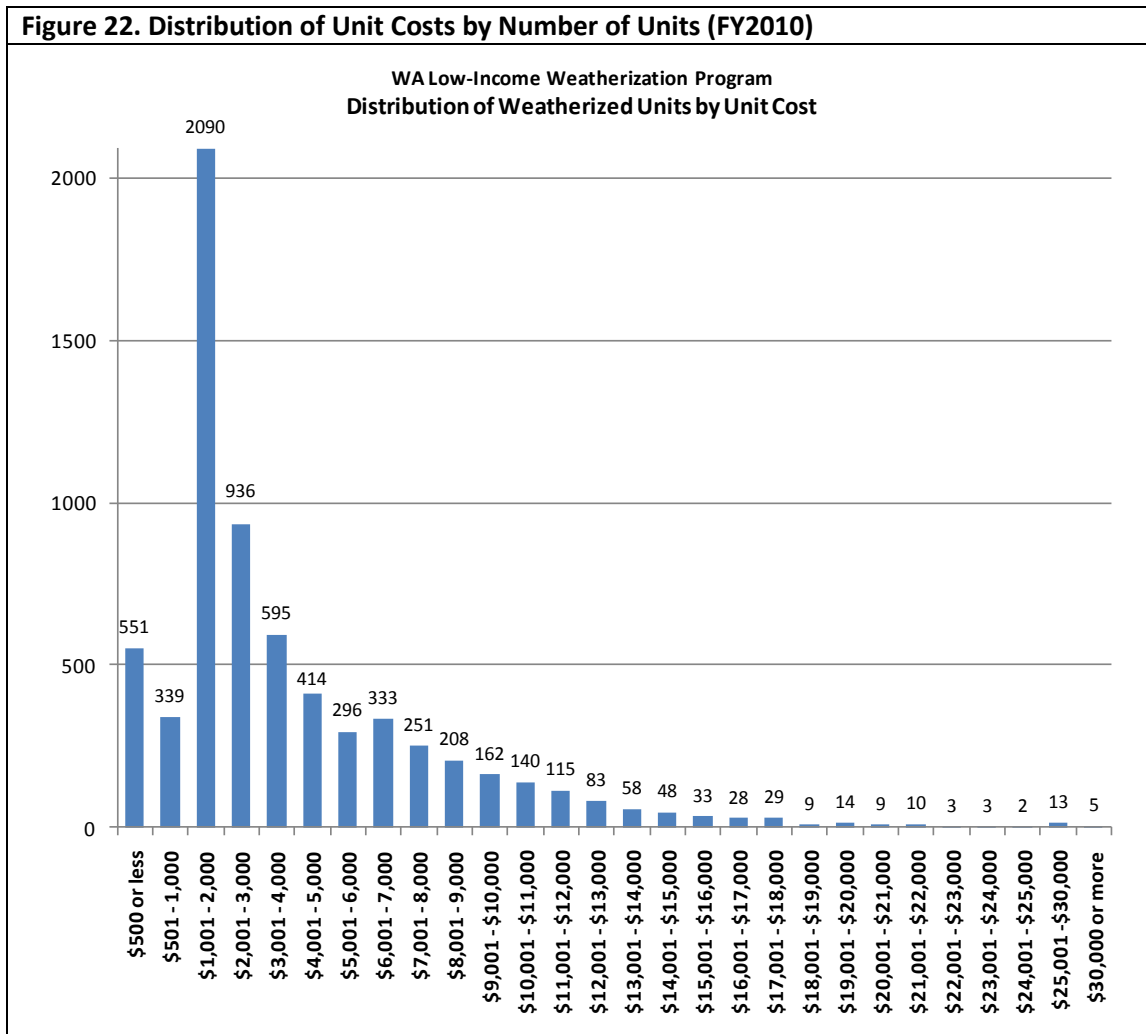
- The average state-wide unit cost was \$4,000.
- Average unit costs for most local agencies ranged between \$3,000 and \$6,000.

¹⁶ Direct unit costs are the labor and materials costs associated with installing weatherization measures for a project. They do not include Program administration costs or other Program operation costs not directly associated with installation.

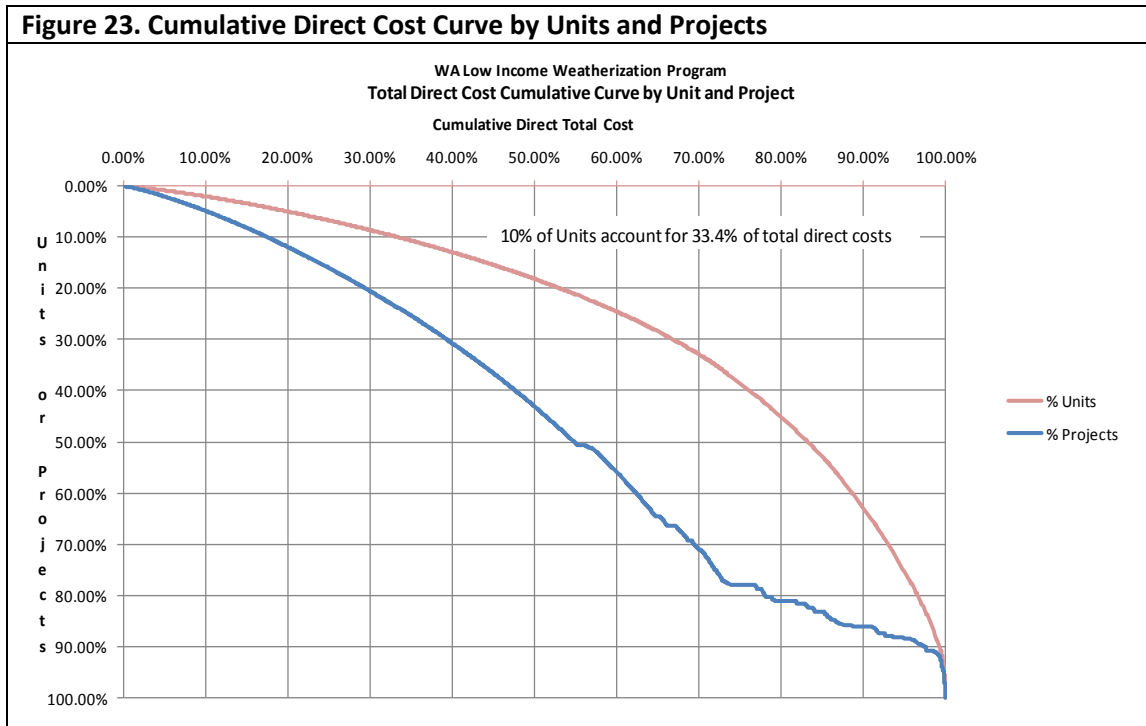
¹⁷ The total production during this period was 7,474 units, so the projects in the Interim Data System are a sample of projects reflecting 90 percent of all projects.

- Local agencies with higher costs typically weatherized fewer multi-family units (which are less expensive) and served rural areas.
- Larger local agencies serving urban areas that weatherized a lot of multi-family units had the lowest unit costs.
- The Department of Commerce Housing Trust Fund Pilot which served large multi-family housing complexes in Western Washington had the lowest unit costs. The lessons learned from this effort to streamline multi-family weatherization could be applied by local agencies.

Almost half (45 percent) of weatherized units reported in the Interim Data System had direct unit costs between \$1,000 and \$3,000 (Figure 22). An additional 13 percent had costs less than \$1,000. A little more than a quarter of the weatherized units had costs over \$5,000.



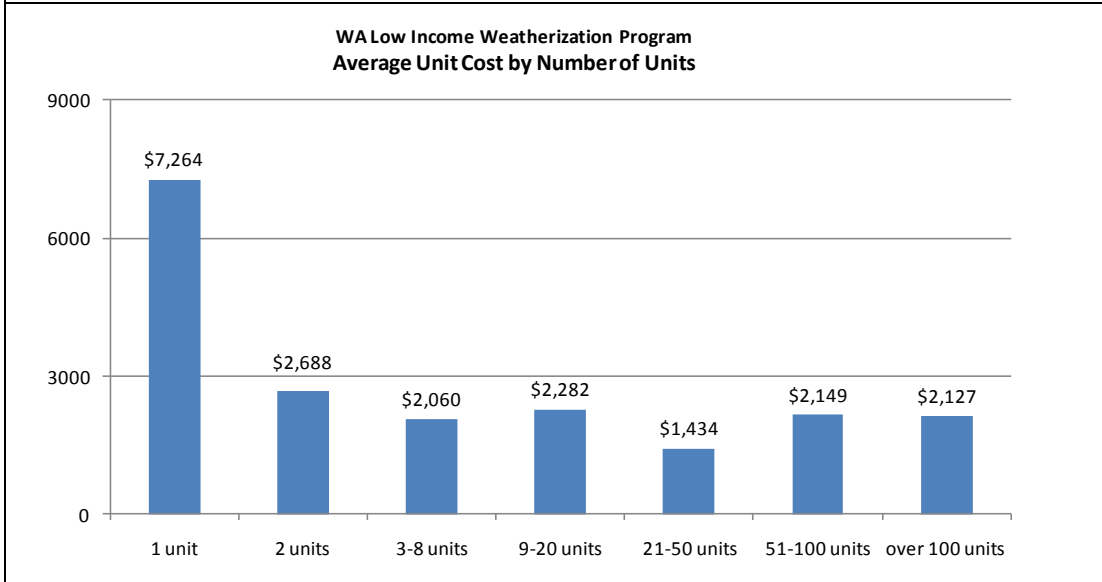
A third of the units accounted for 70 percent of total direct costs reported in the Interim Data System (Figure 23). This is in part driven by the large number of multi-family units with very low costs. There are also a small number of projects with relatively high costs - ten percent of the units accounted for a third of total direct costs. These projects are visible in the fairly long tail of the unit cost distribution in Figure 22 (right portion of the figure). At a project level the distribution is more balanced; a third of projects accounted for 45 percent of total costs.



Cost distributions varied by agency, reflecting the types of units they weatherized. Seven local agencies had unit costs over \$7,000/unit for more than 50 percent of the completed units. Eleven local agencies had unit costs of \$3,000/unit or less for more than 50 percent of the units.

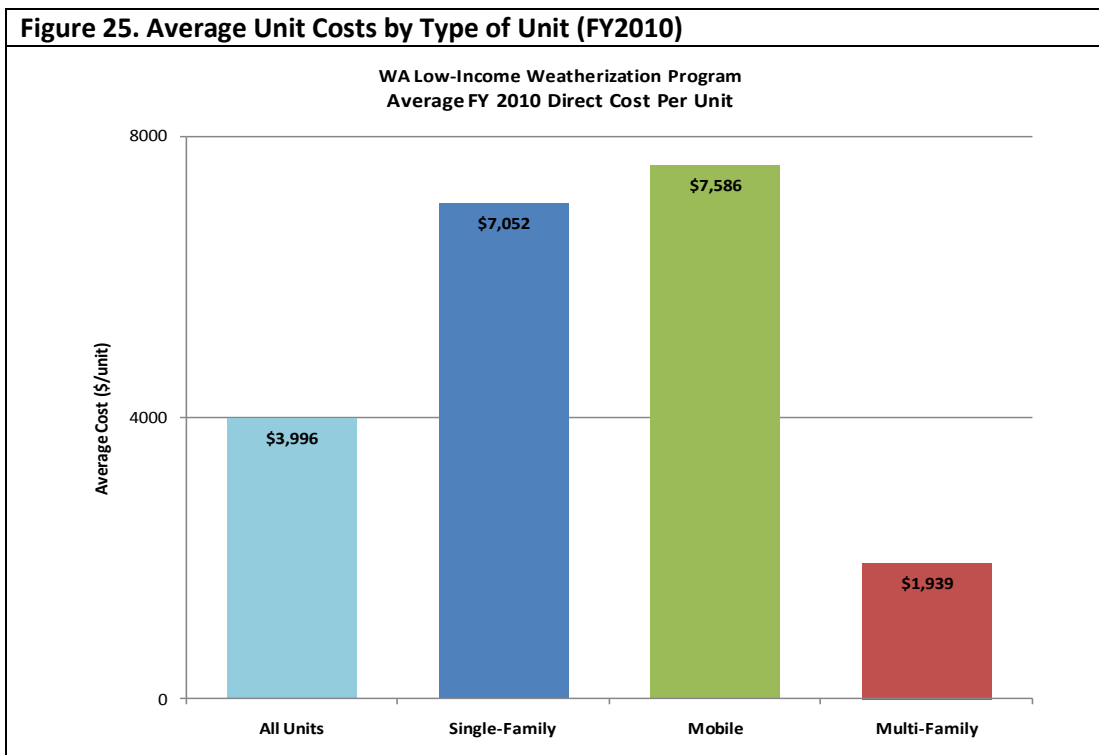
The average cost for a single unit project is significantly higher than the cost for multiple unit projects. Average unit costs would be expected to go down as the number of units in a project increases, in part because there is a modest economy of scale gained, for example ceiling insulation would benefit multiple units. As shown in Figure 24, average unit costs for the largest projects are only slightly lower than mid-sized projects. It may be hard to detect differences because of the small number of projects in some of the size categories.

Figure 24. Average Unit Costs by Project Size (FY2010)

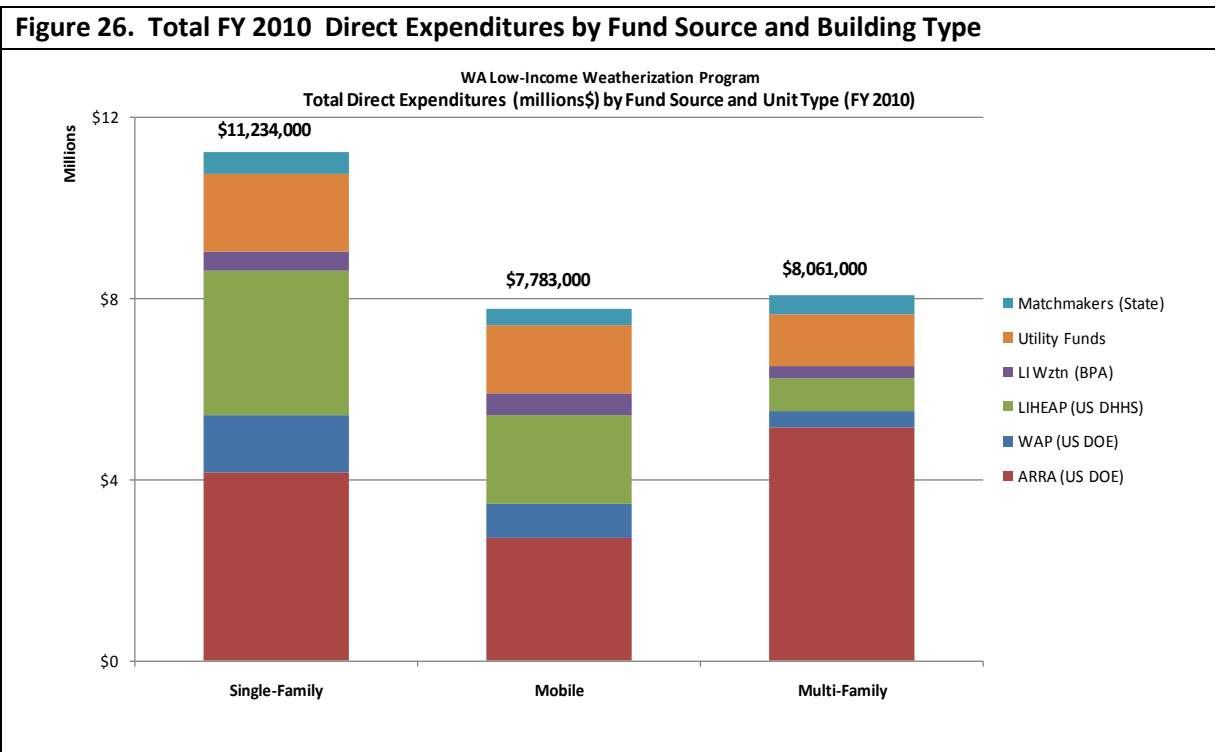


The single-family and mobile home average unit costs are more than three times greater than multi-family unit costs (Figure 25). Several factors contribute to the lower cost for multi-family projects including smaller unit size, less exterior surface area to insulate per unit, fewer measures installed per unit on average, less need for high cost measures and repairs, and all project costs are allocated across more units (the efficiency of serving a large number of units in one place).

Figure 25. Average Unit Costs by Type of Unit (FY2010)



Single-family direct project costs account for about 40 percent of total direct costs while mobile and multi-family projects account for approximately 30 percent each (Figure 26).¹⁸ ARRA funds account for the largest portion of direct project costs reported by the local agencies. This is particularly true for multi-family units and reflects the emphasis by some local agencies on multi-family projects to meet the higher production targets resulting from the stimulus funding. Since DOE and ARRA funding could not be used on the same project, there is very little DOE funding used for multi-family projects. LIHEAP is the next most common funding source, accounting for 22 percent of direct unit costs. Utilities contributed 16 percent of the direct unit costs.



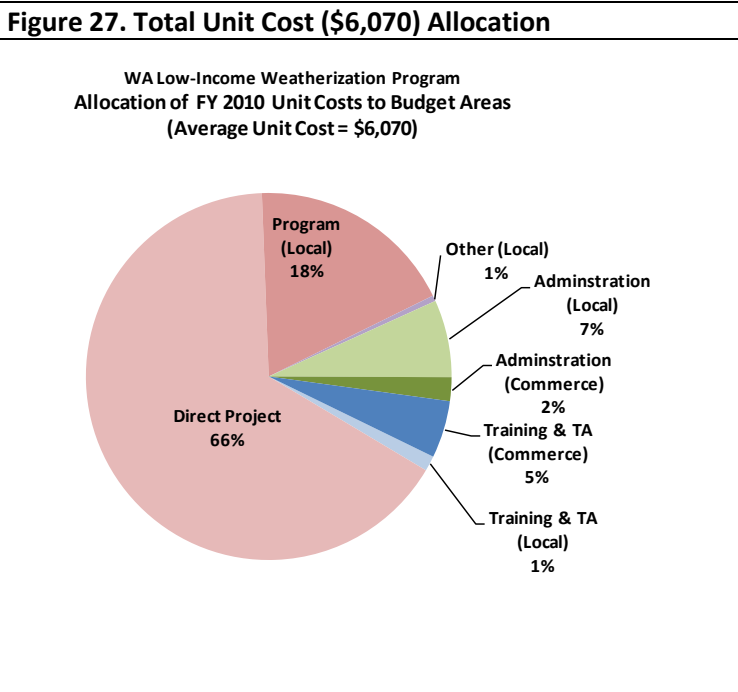
Total Unit Costs

To determine total unit costs, Program administration and other operations expenses need to be added to the direct project unit costs reported above. This requires allocating these Program costs to units.¹⁹ The estimated total weatherization cost is \$6,070 per unit. Figure 27 shows the allocation of these costs.

¹⁸ The costs shown in Figure 26 only include projects in the Interim Data System, which represent about 90 percent of the units weatherized in FY2010. The actual total direct costs are a little higher. The distribution of costs is very similar.

¹⁹ This is not a simple calculation because Program expenditures can be determined for a period (like FY2010), but weatherization projects completed in FY2010 may have created Program expenditures prior to FY2010. For example, a project completed in September 2010 (in FY2010) may have started in February 2010. So the initial expenditures for that project would have occurred in FY2009. Thus the total unit costs are estimates.

The largest portion of unit costs is for direct project weatherization (\$4,000 per unit). Agency Program Operations expenditures not included in direct project costs are the next largest category (\$1,110 per unit). These costs can include supervision and management oversight, client intake and outreach, energy audits and work quality inspections, transportation to weatherization projects, weatherization equipment and tools, vehicle purchase and leasing, office-related expenses, and liability insurance. Many of these expenses could be allocated to direct project costs.



Nine percent of total unit costs were allocated to managing and administering the program at Commerce (2 percent) and at the local agencies (7 percent). An additional six percent were allocated for training and technical assistance (TA) at Commerce (5 percent) and local agencies (1 percent). This primarily includes monitoring of local agencies, and work quality inspections, but also includes other agency training and support.

Cost of ARRA Compliance

The American Recovery and Reinvestment Act (ARRA) provided a significant boost in Weatherization Program funding. This new funding raised production expectations and added new reporting requirements and weatherization worker wage requirements (federal Davis-Bacon and Washington Prevailing Wage). Responding to new requirements incurs two types of costs:

- One-time expenditures during start-up for developing systems and resolving and communicating policy issues.
- Changes in on-going production costs, which may result from additional costs to achieve compliance or changes in wages, measures and reporting requirements.

One-time costs: Activities to develop the processes and procedures to meet ARRA requirements largely occurred in 2009. There were periods in 2009 where monthly

production was below normal while the local agencies and Commerce worked through Program changes. While Program expenditures increased in 2009, production was similar to historical levels. As a result the average Program per unit cost for 2009 is more than \$2,000/unit more than the average from 2005 to FY2010. Adjusting for units in production in 2009, but not completed until 2010, we estimate that \$2-4 million²⁰ was spent in 2009 to prepare for using the ARRA funding.

On-going costs: We compared the direct project costs agencies reported for FY2010 with the costs reported in the 2006 Weatherization Program evaluation. After adjusting for normal construction cost, we estimate that FY 2010 per unit costs were \$400-\$700 higher than unit costs reported in 2006. This translates into \$4 million in additional expenditures in FY 2010.

Estimates of on-going higher costs do not account for any differences in the weatherization measures installed in 2006 and FY2010. A more detailed analysis of contractor bids and project costs and measures would be required to develop more accurate estimates.

Although not precise, aggregate and unit cost data clearly suggest there were significant costs for complying with ARRA. Combined we expect the one-time and on-going costs through FY2010 are in the neighborhood of \$6 million or about 10 to 15 percent of the FY2010 expenditures.

²⁰ We estimate that about \$9 million was spent in 2009 that is not reflected in 2009 production. However, we estimate a significant portion of these dollars were spent on units completed early in 2010.

5. Program Cost-Effectiveness

Program cost-effectiveness is evaluated by comparing the total benefits per unit to the total per unit costs. Benefits and costs from the previous sections are summarized here and used to calculate a benefit-cost ratio (program benefits divided by costs).

Weatherization Program benefits exceed the costs if the benefit-cost ratio is greater than one.

Total program costs are \$6,070 per unit (see Section 4). Program benefits (see Section 3) occur over time and need to be converted into a present value. We estimate the present value of the total benefits to be \$9,140 per unit. The benefit-cost ratio for the Weatherization Program is 1.5. Program benefits are 50 percent greater than costs.

To account for uncertainty, we have generated Program cost-effectiveness estimates for different scenarios by varying the energy price escalation rate and adding an energy benefit degradation factor. Table 4 summarizes the results of our analysis. The benefit-cost ratio ranges from 0.9 to 2.1, suggesting it is likely that Program Benefits will exceed Program costs.

Table 4. Weatherization Program Benefits and Costs (FY2010)

Present Value	Mid	Low	High
Emissions Benefit	\$380	\$330	_*
Economic Benefit	\$1,310	\$690	\$1,970
Utility Benefit	\$340	\$80	\$680
Participant Benefit	\$2,270	\$920	\$4,660
Total Non-Energy	\$4,300	\$2,020	\$7,310
Energy Benefit	\$4,840	\$3,620	\$5,680
Total Benefit	\$9,140	\$5,640	\$12,990
Total Cost	\$6,070	\$6,070	\$6,070
Benefit-Cost Ratio	1.5	0.9	2.1

*the emissions and economic benefit are combined in the high scenario

The U.S. Department of Energy specifies that unit costs exclude administration and training and technical assistance costs. This reduces the unit cost to \$5,140. Using this cost to calculate the benefit-cost ratio results in a mid-point value of 1.8 with a range of 1.1 to 2.5.

If only energy benefits are considered, then the benefit-cost ratio is 0.8. Even under the high scenario, energy benefits do not exceed the costs. If administration and training and technical assistance costs are excluded, the energy only benefit-cost ratio is slightly below one. These results suggest the Program is not cost-effective when only accounting for energy benefits. However, for single-family units the energy only benefit-cost ratio does appear to be greater than one. This is because the energy savings for single-family units is greater than multi-family or mobile units.

The present value of the non-energy benefits in the mid-point scenario is similar to the energy benefits and do not exceed costs. In the high scenario the non-energy benefits exceed Program costs. This illustrates the significance of these other benefits.

It is important to recognize that the Weatherization Program should not be judged solely by these cost-effectiveness numbers. The Program delivers services and benefits that are not easily quantified such as preserving low income housing. It also leverages funding from non-federal and non-state sources and is one of many services offered by local agencies, counties and cities that assist low income households.

6. Summary and Recommendations

In 2009 the Weatherization Program received a significant increase in funding from the Department of Energy through the American Recovery and Reinvestment Act (ARRA). Total Weatherization Program expenditures in FY2010 were 42 million dollars. This is more than twice the annual expenditures for the 2005-2008 period (2.3 times). ARRA funds accounted for more than half of program expenditures. Expenditures for all the other funding sources declined in FY2010.

Production in the early part of 2009 was less than normal as agencies prepared for ARRA requirements and higher production. The influx of ARRA funds began to result in increased Weatherization Program production by the end of 2009. The Weatherization Program completed more units in the first six months of 2010 than in any of the preceding years. Production was 2.7 times more than the historical average for 2000-2009. In 2010, the U.S. Department of Energy recognized Washington State as one of twelve states “exceeding production expectations.”

Key Findings

The evaluation identified the following key findings related to the delivery of the Weatherization Program.

- The increase in Program production was mostly achieved through the expansion of multi-family weatherization.
- Single-family weatherization completions have been trending downward, along with owner-occupied units.
- The top five producers (local agencies and HTF Pilot) account for almost 60 percent of production and the top 10 almost 80 percent in FY2010. This is similar to historical trends.
- About three-quarters of the local agencies delivering weatherization services are community action agencies, but these agencies, many of which are rural, accounted for about a third of FY2010 production.
- Some local agencies use in-house crews to conduct some or most weatherization work, but we estimate that 85 to 90 percent of the work is performed by subcontractors.
- Local agencies use multiple funding sources to weatherize units, but in FY2010 half the units had only one fund source (typically ARRA). This is a change – in 2006 only 11 percent of the units had only one fund source.

- More than 80 percent of weatherized units were electrically heated. This is consistent with historical trends. Units with natural gas heat tended to be focused at a small number of local agencies.
- Local agencies installed weatherization measures that improve the energy efficiency of the housing unit envelope (insulation and air sealing) most frequently. This was also true for the 2006 Weatherization Program Evaluation, but in FY2010 fewer envelope measures and more lighting and appliance and hot water efficiency measures were installed.
- Measures to improve the health and safety of the housing unit and necessary weatherization repairs accounted for about a third of the installed weatherization measures. Mechanical ventilation, a health and safety measure, was the most frequently installed individual weatherization measure, being installed in 70 percent of all units. These measures do not increase the energy efficiency of the housing unit, but are necessary for the health and safety of the occupants and to preserve the long-term integrity of the installed weatherization measures.
- A small number of the weatherized units (18 percent) only had low cost weatherization measures installed (mostly lighting and hot water measures).
- The average time from the energy audit to the final project inspection was 140 days. While the delivery time for different types of projects was similar, multi-family projects tended to have both longer and shorter delivery times.
- There were 12,185 people living in the housing units served by the Weatherization Program in FY2010. This is more than twice the number served by the Weatherization Program in 2006. We estimate that over half the units weatherized had occupants that were over 60 years old, disabled, or children under six years old.
- About two-thirds of the units weatherized were occupied by families with incomes under 125 percent of the poverty level. The remainder had incomes between 125 and 200 percent of poverty, This reflects a change in the most recent funding cycle where the maximum eligible income was raised from 125 percent of poverty to 200 percent.

Program Benefits

In FY2010 Washington's Low Income Weatherization Program installed weatherization measures estimated to save 12.6 million kWh/year of electricity, 251,000 therms/year of natural gas, 22,500 gallons/year of oil, 7,400 gallons/year of propane, and 100 cords/year of wood. The total annual energy savings to households whose homes were weatherized is \$1.4 million. These energy savings will accrue each year during the lifetimes of the energy measures.

- The average household of a weatherized unit will save \$189/year in energy costs.
- Single-family units account for 50 percent of the annual energy cost savings from the Weatherization Program. This is despite the fact that significantly more multi-family units were weatherized.
- More than half the energy saved is electricity and about a third is natural gas. Energy savings per unit for units heated with natural gas is higher than electrically heated units.
- Insulation and other weatherization measures that improve the energy efficiency of the building envelope account for almost 70 percent of energy savings. Floor insulation and ceiling insulation resulted in the greatest savings.

The Weatherization Program provides other benefits besides energy savings. These are often referred to as “non-energy” benefits. These benefits can be grouped into three benefit categories: utility (benefits to utilities and ratepayers), participant (benefits to weatherized households), and societal (benefits to the economy and environment (emissions reductions)).

We estimate the non-energy benefits to be \$196/year/household. While there is some uncertainty in these estimates, the results of this analysis and others show these benefits are important. In this case they are equivalent to energy savings. It would be difficult to justify the Weatherization Program without including these other benefits.

Program Costs

We estimate that the average total Program cost to weatherize a low-income housing unit in FY2010 is \$6,070. This cost allocates all Program costs to weatherized units.

- Two-thirds of these costs (\$4,000) are the direct costs reported by the local agencies to weatherize a unit.
 - The average unit cost for single-family and mobile home weatherization projects is more than three times as much as multi-family projects.
 - Local agencies with higher costs tended to weatherize fewer multi-family units and they also tended to be more rural.
- Local agency program operation costs not directly allocated to a project account for 18 percent of the cost (\$1,110 plus \$30 other local agency costs).
- Administration costs for Commerce and local agencies account for nine percent of the cost (\$540).
- Training and Technical Assistance, which includes Commerce compliance monitoring and quality assurance inspection activities, account for six percent of the cost (\$390).

There is some variation in the distribution of expenditures by budget category across local agencies. This is particularly true for the repair and health and safety budget categories. In FY2010 there were eight local agencies where repair and health and safety expenditures accounted for more than 20 percent of expenditures (with a corresponding decrease in the share of program operations expenditures), but some local agencies spent a much smaller share.

This evaluation considered the cost of complying with ARRA requirements by examining Program costs in two areas: initial one-time expenditures to meet ARRA requirements and higher on-going production costs. We estimate that \$2-4 million was spent in 2009 to prepare for using the ARRA funding. We estimate that higher production costs resulted in about \$4 million more being spent for weatherization in FY2010 than would have been spent if costs were similar to 2006 (adjusting for normal construction cost increases). A more detailed analysis of contractor bids and project costs and measures would be required to develop more accurate estimates. However, aggregate Program expenditure and unit cost data do clearly suggest there were costs for complying with ARRA.

Program Cost Effectiveness

Total program costs are \$6,070 per unit. We estimate the present value of the total benefits to be \$9,140 per unit. The benefit-cost ratio for the Weatherization Program is 1.5. Program benefits are 50 percent greater than costs.

To account for uncertainty, we have generated a range of Program cost-effectiveness estimates using different energy price escalation and energy benefit degradation rates (see Table 4). The benefit-cost ratio ranges from 0.9 to 2.1 for the different scenarios, suggesting it is likely that Program Benefits will exceed Program costs. If Program administration and training and technical assistance costs are excluded, then the benefit-cost ratio ranges from 1.1 to 2.5.

If only energy benefits are considered, then the benefit-cost ratio is 0.8, but the value appears to be slightly greater than one for single-family units alone. It is difficult to justify the Weatherization Program by only considering energy costs. This illustrates the importance of other (non-energy) benefits to Program cost-effectiveness.

Recommendations

The 2006 Weatherization Program Evaluation made recommendations in three areas: estimating benefits, allocating costs, and consistent ongoing data collection. The implementation by Commerce of the Weatherization Information Data System (WIDS) in February 2011 addresses the third recommendation. This evaluation uses data from the Interim Data System along with calculations to directly estimate benefits, which largely addresses the first recommendation. Improvements can continue to be made in

estimating benefits (particularly non-energy benefits), but significant progress has been made in this area.

While steps have been taken to improve cost allocation and tracking, this evaluation has identified three areas to address:

- **Improve tracking and accounting of health and safety, repair, and energy measures and costs:** There appears to be variation in how agencies track and account for health and safety and repair measures. Expenditures seem low. Costs for energy efficiency measures are included in the Program Operations budget category, which includes many other expenses. If these costs are not accurately tracked, it is difficult to associate costs with benefits. This is particularly true for assessing energy cost-effectiveness. While it can sometimes be difficult to differentiate and allocate these costs, simple and consistent ways to do this need to be developed.
- **Indirect program operations costs should be allocated to project costs:** We estimate that a significant portion of the total Program cost for weatherizing units is for agency program operations costs (18 percent). Many of these costs such as audits and inspections are directly related to delivering a weatherization project and should ideally be allocated to projects.
- **Develop consistent methods for reporting direct project costs:** Local agencies report direct project costs in WIDS. This cost data is quite valuable. However, we believe there are some differences in how local agencies determine these costs. These differences need to be understood and consistent definitions for reporting these costs should be developed.

The influx of ARRA funding highlighted some important trade-offs for the Weatherization Program. These trade-offs are not “either-or” choices or “good versus not so good” options. In some cases the Program has little choice in what it can do. However, it is important to consider these trade-offs (and others not listed):

- **Multi-family versus single-family units:** There has been a shift in production to multi-family units. Multi-family weatherization has lower cost per unit, serves more people, and supports higher production. Single-family weatherization has higher energy savings per unit, has more owner-occupied units, and has more natural gas heated units.
- **Higher production versus more comprehensive weatherization:** In FY2010 production increased significantly and more people were served. High production levels can result in less comprehensive weatherization work, which means less energy savings per unit and reductions in other per unit benefits. This can reduce total Program benefits.

- Energy benefits versus other benefits: More emphasis tends to be placed on the energy benefits of the Weatherization Program (particularly recently). Costs for health & safety and repair measures can be viewed as reducing the cost-effectiveness of energy measures. However, these other measures produce benefits of their own, although they do not tend to be measured and the Program is not credited for them.
- Wage requirements versus production costs: The federal Davis-Bacon and Washington Prevailing Wage requirements result in higher wages, which benefit employees doing weatherization work. However, this has resulted in higher weatherization production costs and fewer measures being installed.
- Accountability/reporting requirements versus administrative/overhead costs: Agencies said it is becoming more difficult and time consuming to comply with program requirements. This is driving up their administration and operating costs and decreasing the cost effectiveness of the services they provides.
- Urban versus rural: Most Program production occurs in more populous urban areas that tend to be served by agencies that are part of city or county government. Community action programs tend to serve rural areas where costs can be higher because of the large areas that are served and lower production levels. However, needs and benefits in these areas are important and can be proportionally greater.

We believe these trade-offs illustrate some of the choices the Program needs to consider. *First, we recommend the Program focus and clarify its goals considering these trade-offs. Then we recommend the Program more intentionally focus and target its efforts to match these Program goals.* In particular we offer the following specific recommendations for consideration:

- **Target units to be weatherized:** Weatherize units that produce the greatest benefit (based on Program goals) relative to the production cost. This may mean targeting units with high energy cost burdens, units with other significant needs (e.g., health and safety issues), or units concentrated in a particular geographic area (to reduce costs).
- **Document how the need for weatherization services is being met:** This requires gaining a better understanding of the need for weatherization services, how to strategically meet the needs, and then documenting how the need is met.
- **Clarify the importance of “non-energy” measures and benefits to Program success:** The Weatherization Program installs health and safety and repair measures and provides benefits in addition to energy benefits. However, there is little agreement on what these benefits are and what the Program should be credited with. This needs to be clarified so the Program is not penalized for

installing non-energy measures and so it can go after the benefits that are most important.

- **Determine the impact of higher wages on weatherization measure cost-effectiveness:** Higher production costs will result in some weatherization measures no longer being cost-effective. This could limit the ability of the Program to meet its goals. This will need to be addressed.
- **Ensure, as much as possible, that reporting requirements add value:** Sometimes the Program may have little control over reporting requirements from funders and stakeholders. However, the Program should strive to make sure that reporting requirements provide information that allows the Program to be more successful. Requirements that are no longer needed should be eliminated.
- **Recognize the differences in weatherization service provision between urban and more rural areas and consider how to meet needs in rural areas efficiently:** Successful delivery of weatherization services in rural areas is important.

The Weatherization Program has a complex mix of funding streams with different eligibility and reporting requirements, and contract periods. Commerce and local agencies expend a fair amount of effort dealing with this complexity. *Commerce should continue to explore opportunities for reducing Program complexity so that agencies are more efficiently able to deliver services.* The implementation of WIDS provides a means for efficiency improvements that was not previously available. The Program is already using WIDS to improve monitoring and inspection procedures.

ARRA created unique opportunities and challenges for the Weatherization Program. Commerce and local agencies were able to successfully navigate these challenges and significantly increase production to meet higher expectations. Looking ahead, Program funding will decline, creating new challenges. The Program has demonstrated it can meet these challenges. *We suggest that Commerce, local agencies, and stakeholders work collaboratively to ensure the Weatherization Program continues to successfully provide weatherization services to low income households.* This evaluation report could be a vehicle to initiate those conversations.

Appendix A. Description of Evaluation Methodology

We describe the methods used to estimate Program energy savings, other benefits, costs, and benefit-costs in this section.

Energy Savings

Energy savings for Washington’s Low-Income Weatherization Program are estimated from project data provided in the Interim Data System by local agencies using “deemed” savings calculations developed in consultation with the Cadmus Group in Portland, Oregon.²¹ Our intent was to generate regionally acceptable savings estimates that reflected the work that was performed by the Program to weatherize the homes. This section describes the approach we used to estimate energy savings.

Project data collected in the Interim Data System was used to calculate energy savings. For each weatherization project, the following Interim Data System data was used in the calculations: the weatherization measures implemented (simple check boxes), the housing type (single-family, multi-family, mobile), the heating fuel, the square footage (floor area), and location (zip code in some cases, otherwise determined by the local agency service area).

The energy savings for most measures were calculated by multiplying an energy savings coefficient for a particular measure by the square footage of the home (energy savings = $C \cdot SF$). For some measures not dependent on square footage (like refrigerators), the energy savings coefficient was per home rather than per square foot. Coefficients were developed for each energy efficiency measure by building type, heating fuel, and heating zone.

To develop the energy savings coefficients, we relied as much as possible on energy savings estimates data developed by the Regional Technical Forum (RTF) of the Northwest Power and Conservation Council. The RTF is an advisory committee established in 1999 to develop standards to verify and evaluate conservation savings. Members are appointed by the Council and include individuals experienced in conservation program planning, implementation and evaluation. The standards are used by utilities and others in the Northwest to estimate energy savings from energy efficiency programs. The RTF has developed “deemed” energy savings calculations for a variety of basic energy efficiency measures. These “deemed” savings estimates are based on the best available research and evaluation work and are intended to reflect the energy savings that are likely to occur. They can be used in place of other often more expensive measurement methods.

²¹ The Bonneville Power Administration (BPA) provided funding for this work. The Cadmus Group was under contract to BPA.

We needed to make some assumptions to translate the RTF data into the energy savings coefficients used in our calculations. For example, the RTF energy savings coefficients for insulation measures are based on the square feet of insulation installed rather than the square feet of the home. So we made some assumptions about the relationship between the square feet of the home and the square feet of insulation (wall area, ceiling area, and floor area). We also estimated the amount of insulation typically installed. For other measures like lighting (Compact Fluorescent Lights), the RTF bases savings on the number of efficient lights installed. We assumed how many lights were installed to develop energy savings coefficients for the entire home.

The energy savings coefficients for the following measures were based on information from the RTF:

- CFL lamps
- Energy efficient lighting fixture
- Showerhead
- Water heater pipe insulation
- Water heater replacement
- Water pipe insulation
- Refrigerator replacement
- Duct sealing
- Ceiling insulation
- Wall insulation
- Floor insulation
- Windows
- Doors
- Air sealing

For weatherization measures that are not included in RTF savings estimates, we use simple engineering estimates and assumptions that are based as much as possible on actual measurements and research. The approach we generally used was to identify a reasonable percentage savings estimate for a particular measure and multiply this by typical household energy use. Measures where this approach was used included:

- Faucet aerators
- Water heater insulation
- Thermostats
- Heating system replacement
- Heating system tune up
- Duct insulation

For water heating measures, we did not have information on the water heating fuel. We assumed homes with electric heat had electric water heaters. For gas heated homes, we used data on the saturation of gas water heating to apportion saving to natural gas or electricity.

We accounted for the interactive effects of energy measures that reduce heating energy use. As heating energy efficiency measures are added to a home, the amount of heating energy use goes down, reducing the amount of heating energy available to be saved. Thus savings for each individual heating measure cannot be simply added up, but must account for this interactive effect (reduction in savings potential). To do this we calculate a percent heating energy savings for each measure and we then interact these savings algebraically to calculate an overall percent heating energy savings that accounts for the interactions of all heating measures. Heating energy savings is calculated by multiplying the percent energy savings by an estimate of the total heating energy use (based on regional data for typical heating use per square foot times the home square footage).

Calculate a heating savings factor for each heating measure:

$$F_m = (1 - \% \text{ heating savings for the measure})$$

where % heating savings = (measure savings/sqft)/total heating/sqft
(for some measures this will be calculated with totals rather than per/sqft)

$$\text{Heating Savings} = (1 - F_{m1} * F_{m2} * F_{m3} \dots) * \text{total heating/sqft} * \text{sqft}$$

We describe the energy efficiency measure and the assumptions we made in more detail below. Measure descriptions are from the *Weatherization Program Policy Manual*. This is followed by a table with the energy savings coefficients. Annual energy costs are estimated by multiplying the energy savings by the average energy price for each fuel source. Average energy prices are Washington averages and are from the U.S. Energy Information Administration.

Table A.1. Energy Prices

Fuel	Rate	Comment
Electric	7.68 cents	cents/kWh EIA average WA rate for 2009, 2009 Electric Sales and Revenue
Gas	\$13.95	\$/1000 Cubic Feet EIA average WA rate for 2009
Propane	\$2.09	\$/gallon EIA average West Coast for 2009
Oil	\$2.49	\$/gallon EIA average WA rate for 2009
Wood	\$288.60	calculated \$/cord from EIA SEDS WA 2008

Energy Savings Results

Energy savings are estimated by building type and heat source. We estimate that the installation of shell and heating system weatherization measures reduced heating energy use by 29 percent on average. Table A.2 shows average heating energy savings per unit for different heating sources.

Table A.2. Heating Energy Savings per Unit by Housing Type and Heat Source

	Electric Heat (kWh/unit)	Gas Heat (therms/unit)	Propane Heat (million Btu/unit)	Oil Heat (million Btu/unit)	Wood Heat (million Btu/unit)
Single Family	3,947	304	16	25	25
Multi-Family	659	23	-	-	5
Mobile Home	2,714	149	17	8	15
All	1,424	238	16	25	21

The Weatherization Program also installed lighting, water heating, and appliance measures to reduce the base energy use in homes. Table A.3 shows the average base (non-heating) electricity and natural gas energy savings per unit by housing type and heat source. There is some natural gas savings for units with natural gas water heaters.

Table A.3. Base Electricity and Natural Gas Savings per Unit by Housing Type and Heat Source

	Electricity Savings (kWh/unit)					Gas Savings (therms/unit)
	Electric Heating	Gas Heating	Propane Heating	Oil Heating	Wood Heating	Gas Heat/ Water Heat
Single Family	402	252	486	339	528	3.8
Multi-Family	506	407	-	-	234	6.3
Mobile Home	427	306	678	349	558	4.2
All	479	285	541	339	531	4.3

Other Benefits

This evaluation estimates other benefits (“non-energy” benefits) in addition to energy for the Weatherization Program. To estimate other benefits, we drew on a recently completed report that describes best practices for estimating non-energy benefits.²² This report groups non-energy program benefits into three categories: utility benefits, participant benefits, and societal benefits. We split societal benefits into economic and emissions benefits.

Utility Benefits: We estimated utility benefits to be \$16/yr/household. This is the average of the low (\$4), high (\$31) and LIPPT²³ (\$12) values cited in the best practices reference in footnote 11.

Participant Benefits: We estimated participant benefits to be \$103/yr/household. This is based on the average of the sum of the high (\$211) and low (\$56) values of a group of participant benefits cited in the best practices reference in footnote 11.

Economic Benefits: We estimated the economic benefits to be \$60/yr/household. This reflects the net benefit of the Program on the economy. This estimate is based on an input-output model the Cadmus Group developed for an evaluation of Pacific Power’s Weatherization Program in Washington. This is similar to the low value identified in the best practices reference in footnote 11.

Emissions Benefit: We estimated the emissions benefit to be \$17/yr/household. This value is calculated directly from the energy savings estimates using emissions factors for the different fuels. The generation of electricity and the combustion of fuels for heating and hot water produces greenhouse gases and other pollutants. The energy savings from the Weatherization Program reduces these emissions. Emission benefits were estimated for Carbon Dioxide (CO₂), Nitrous Oxide (NO_x), and Sulfur Dioxide (SO₂). The calculation is based on the energy savings and emission factors for the different fuels and electricity. Emission factors are based on data from the U.S. Environmental Protection Agency and the Energy Information Administration. To translate the emissions savings to dollars, we placed values on the emissions. There is no market for greenhouse gas (CO₂) in the U.S. so we used an average cost from peer reviewed studies (\$12/ton). We used data from Evolution Markets (evomarkets.com) to estimate market prices for Nitrous Oxide (NO_x), and Sulfur Dioxide (SO₂). Prices for these emissions have dropped significantly recently. The values we used were \$220/ton and \$3.50/ton respectively based on data for March 2011.

²² Skumatz, Lisa, M. Sami Khawaga, and Richard Krop. *Non-Energy Benefits: Status, Findings, Next Steps, and Implications for Low Income Program Analyses in California*. Prepared for Sempra Utilities, May 2010.

²³ The LIPPT estimates were developed for California’s Low Income Weatherization Program.

Cost Analysis

Program cost data was collected from two sources. Program expenditures were collected from the Department of Commerce for all major funding sources (ARRA, DOE, LIHEAP, and Matchmakers). This Program data did not include utility funds, which go directly to local agencies. The second source of cost data comes from the Interim Data System. This is direct project cost data entered by local agencies for each weatherization project. These costs include utility funds. These direct project costs do not include administration costs and other Program operations costs not directly attributed to a program.

These two sets of cost data are combined to create a total Program per unit cost allocated to the following categories:

- Direct project costs
- Training and technical assistance for Commerce and local agencies
- Administration for Commerce and local agencies
- Program operations for local agencies (excluding direct costs)
- Other

Costs were directly allocated by budget category, checking to be sure values were reasonable. Program operations (excluding direct costs) is not a specific budget category. It is calculated by subtracting all the other costs from the total.

Benefit-Cost Analysis

All the annual benefit cost estimates are converted to present values using the following assumptions:

- Real discount rate = 2.7% (OMB Circular 94 Appendix C for 2009 analyses uses a real discount rate of 2.7% for a 30 year analysis)
- Annual energy price escalation rate = 1% (this is based on a review of NW Power and Conservation Council and Energy Information Administration data; prices actually drop early in forecasts due to the recession)
- Life = 34 years (this is the weighted average energy measure life based on energy savings; note that the life of insulation measures, which account for the majority of savings, are 45 years)

The benefit-cost ratio was calculated by dividing the present value of the benefits by the costs. We conducted a scenario analysis where we varied the energy price escalation and we introduced an energy savings degradation factor. We also used the high and low values for non-energy benefits. Table A.4 shows these values.

Table A.4. Assumptions for Scenario Analysis

	Low	Mid	High
Discount Rate (%)	2.7	2.7	2.7
Annual Energy Price Escalation (%)	0	1	2
Annual Energy Savings Degradation (%)	1	0	0
Life (years)	34	34	34
Emissions Benefit Present Value (\$)	329	379	-
Economic Benefit Present Value (\$)	689	1,313	1,967*
Utility Benefit Present Value (\$)	77	343	684
Participant Benefit Present Value (\$)	926	2,266	4,656

*This value includes both economic and emissions benefits

Appendix B. Local Agencies

Table B.1. Listing of Weatherization Program Local Agencies

Agency Number	Agency	Jurisdictions	Main Office
100	Department of Commerce HTF Pilot	Western Washington	Olympia
401	Benton Franklin Community Action Committee	Benton & Franklin Counties	Pasco
402	Blue Mountain Action Council	Columbia, Garfield, & Walla Walla Counties	Walla Walla
403	Chelan Douglas Community Action Council	Chelan & Douglas Counties	Wenatchee
404	City of Seattle Office of Housing	City of Seattle	Seattle
405	Olympic Community Action Programs	Clallam & Jefferson Counties	Port Townsend
406	Clark County Department of Community Services	Clark County	Vancouver
407	Coastal Community Action Program	Grays Harbor & Pacific Counties	Aberdeen
408	Community Action Partnership	Asotin County	Lewiston, ID
409	Community Action Center of Whitman County	Whitman County	Pullman
410	Community Action Council of Lewis, Mason, and Thurston Counties	Lewis, Mason, and Thurston Counties	Lacey
412	Housing Authority of Skagit County	Skagit County	Burlington
413	King County Housing Authority	All King County except City of Seattle	Tukwilla
414	Kitsap Community Resources	Kitsap County	Bremerton
415	HopeSource	Kittitas County	Ellensburg
416	Washington Gorge Action Programs	Klickitat & Skamania Counties	Bingen
417	Lower Columbia Community Action Council	Cowlitz & Wahkiakum Counties	Longview
418	Metropolitan Development Council - Weatherization Program	City of Tacoma	Tacoma
419	Rural Resources Community Action	Ferry, Pend Oreille, and Stevens Counties	Colville
420	Okanogan County Community Action Council	Okanogan County	Okanogan
421	Pierce County Community Action Programs	All Pierce County except City of Tacoma	Tacoma
422	Snohomish County Human Services Dept.	Snohomish County	Everett
423	Spokane Neighborhood Action Programs	Spokane County	Spokane
424	The Opportunity Council	Island, San Juan, and Whatcom Counties	Bellingham
425	Yakima Valley Farm Workers Clinic	All Yakima County South of Union Gap	Toppenish
426	OIC of Washington	All Yakima County North of Union Gap	Yakima