Non-Energy Benefits of Weatherization and Low-Income Residential Programs: The 1999 Mega-Meta-Study

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ABSTRACT

This paper summarizes the results of a 1999 meta-study of the non-energy benefits resulting from weatherization and other low-income residential energy programs which install comprehensive energy efficiency measures. Non-energy benefits are program impacts that are other than therms of natural gas, kilowatts of electricity, gallons of oil or other units of energy; but instead are impacts such as carbon dioxide or arrearage reductions, increased jobs in the community and other benefits not related to a unit of energy. The information in this paper comes from secondary sources rather than primary research and summarizes the benefits compiled from 91 evaluations and program studies. While this subject is not new to ACEEE, the extent of this meta-study goes considerably beyond what we have seen to date. Other meta-studies have focused their reviews on a few key studies, typically less than 10 to 12. This project is the first comprehensive review of the literature to identify, obtain, classify and report the range of non-energy benefits attributable to weatherization or other low-income residential energy efficiency programs.

The paper presents and discusses a wide range of benefits and benefit values reported in the literature and provides a limited discussion of their implications. These findings indicate that when all of the benefits are counted, the non-energy benefits alone often exceed the cost of a typical weatherization program by a wide margin and provide significant private, public and environmental benefits.

Introduction

This paper presents the results of a 1999 meta-study conducted by TecMRKT Works. The study focused on quantifying the types of benefits currently reported in the literature and cataloging the values of these into a non-energy benefits database. This study summarizes the quantified non-energy benefits from 91 publications. The study is the first comprehensive review of the literature to identify and report the range and extent of quantified non-energy benefits attributable to low-income weatherization and residential energy programs. We hope this paper and the TecMRKT Works database developed as a result of this effort will begin to bring all the non-energy benefits literature together in a way that is easily reviewed and made available to the energy community. This effort is a start toward this process rather than a conclusion. As more research is completed the database and this paper will need to be up-dated and expanded. This paper also extends an invitation to other evaluation and energy program professionals to assist and support this continued goal. The single greatest weakness of this effort is that it focuses only on low-income energy programs and weatherization programs that install a comprehensive set of energy efficiency measures in participant's homes. However, this is also its greatest strength, because low-income and weatherization programs are often judged on a benefit-cost basis, yet these calculations seldom include non-energy benefits that may typically match or exceed the energy benefits. The inclusion of non-energy benefits into these calculations provides a more comprehensive picture of the worth of these programs to the customer, the energy provider and to the society as a whole. To exclude these benefits from the benefit-cost calculation is to, in many cases, not recognize the majority of the programs' impacts. As global warming issues and the need for finding ways to reduce the growth of greenhouse gas emissions becomes more urgent, policy makers will begin to rely more heavily on energy efficiency programs to meet emission reduction goals.

A second weakness of this paper is the exclusion of specific citations for specific reported data. The page limitations of this paper prohibited the authors from referencing all of the 91 publications reviewed and summarized in this paper and, as a result, necessitated the exclusion of the accompanying citations. As a result, we were forced to limit the references in this paper to a short listing of key works in the field, and instead refer readers to the availability of a citation listing from the authors. This citation list can be obtained via e-mail by contacting Mr. Jeff Riggert at jriggert@TecMRKT.com. We apologize for this weakness in this paper. Including all the citations and references made the paper significantly exceed the maximum page length permitted for this proceeding. We were required to make a choice of what to include in this paper. We trust we made the correct choice for most readers.

Benefit Metrics and Study Goal

The authors of the documents reviewed for this paper use a variety of metrics to quantify non-energy benefits. Wherever possible these metrics were converted to the most commonly used units of measure for each of the reported benefits. Our goal for this effort was not to establish standard metrics or to report per-program or per-measure metrics, but to summarize the information currently available, to bring this information together in a single location, and to build a flexible database to assist future efforts to quantify non-energy benefits. This goal is achieved through this paper and the supporting non-energy benefits database. The use of the database was granted to the USDOE and to Oak Ridge National Laboratory by TecMRKT Works for use in program evaluation studies and to support public planning a policy formation efforts.

Methodology

The authors began the project by conducting an extensive effort to identify studies that contained information about non-energy benefits. Multiple sources of information were contacted to acquire these publications, some of which were purchased or loaned to TecMRKT Works for this effort. The information sources used to collect documents included public, non-profit and private libraries; internet searches; use of extensive peer networks; interviews with key authors; proceedings from key conferences (ACEEE, The

Evaluation Conference, Affordable Comfort, etc.); private and public energy information centers; and both published and unpublished documents submitted by key authors. In all, 91 publications were collected in hard copy or electronic formats containing information detailing one or more non-energy benefit. These documents were then cataloged, read, and summarized in a non-energy benefits relational database. Upon completion of this effort, a total of 300 non-energy benefits were cataloged.

The database was constructed because of the number of publications that needed to be reviewed and the need to rapidly sort and identify the range of reported benefits within each category. The non-energy benefits are grouped into five primary categories. These are:

- General benefits, (benefits that bridge more than one of the following categories and/or are not specific enough to classify into a single category),
- Economic benefits,
- Environmental benefits,
- Health and Safety benefits,
- Utility Service benefits, and
- "Other" benefits (such as DSM spill-over, increased participant knowledge and customer loyalty, and reduced transaction cost).

The benefits are further sub-categorized in the database by more specific secondary categories such as tons or pounds of carbon dioxide. The database also specifies each benefits' definition, the underlying methodology used to quantify the benefit, the quantitative value of the benefit, a description of the benefit units reported, and applicable baseline data when available. The database also includes primary and secondary references of each entry and annotates the 91 publications where the benefits are found. The results and content of this database are summarized and described in this paper. Unfortunately, the volume of data included in the database, together with the length requirements for this paper, necessitate that that only summary information be included in this paper. The entire database will be available for review during the poster presentation of this work at the 2000 ACEEE Summer Study. Finally, the implications of these findings are discussed as they relate to low-income and weatherization programs, global warming issues and the making of public policy.

General Non-Energy Benefits

Several authors have done meta-studies that present non-energy benefits for more than one, or all of the above-identified categories combined.

The 1993 National Weatherization Study (ORNL) presented a benefit-cost (B/C) ratio of the energy and non-energy benefits divided by the program cost. This ratio was identified to be 1.72 to 1, or 0.63 to 1 when only the non-energy benefits are included. Another author estimated the non-energy benefits to utilities, society, and participants of a "generic" low-income program to be from $33 to $823 per participant per year. This same author estimated a value of $507 per participant per year for PG&E's Venture Pilot Program and $269 for PG&E's Low-Income Weatherization Program. A study of Ohio's HWAP estimated the net present value (NPV) of all non-energy benefits to be $2,381 per weatherized home.[1]

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[1] This included: $42 for the NPV of disconnections avoided, $1,208 for the NPV of ratepayer saving in PIPP (Percent of Income Payment Plan) from reduced PIPP participation, reduced arrearages, bills and

A study done for the State of Massachusetts computed a NPV B/C ratio multiplier that is added to the energy benefits of between 0.17 and 3.27 to account for non-energy benefits.[2]

Economic Benefits

Several authors have completed studies that lumped all economic benefits of low-income and weatherization programs together into a single dollar value. One author estimated economic benefits of from $2-$210 per year per participant for a west coast weatherization program and another computed an economic benefit adder equivalent to 17%-70% of the energy dollar savings. Lastly, one author estimated the B/C Ratio of the first years' economic benefits over program expenditures to be 3.1-3.2 for several Wisconsin weatherization programs.

There are many studies that have estimated the economic benefits of low-income and weatherization program spending. These economic benefit sub-categories include:

- Local economic stimulus in dollars,
- Number of jobs created via the economic stimulus, and
- Increased property values.

A few authors have estimated some additional economic benefit sub-categories. These include:

- reduced home mortgage failures,
- reduced damage to furniture, and
- Economic value of improved national security.

According to several of the reviewed studies, weatherization spending creates three benefits for local economies; 1) direct effects of employment, 2) the indirect effect of employment from supportive industries, and 3) an "induced" economic effect. Various authors have modeled and estimated these using input-output analysis. Most authors include both the direct and indirect economic effects of program spending on local economies, and a few also include an "induced" economic effect defined as when program dollars are re-spent in the economy more than once. Across these reports the value of the economic stimulus is estimated to be from a low of 17% of the value of the energy savings to customers to a high of 182% of the savings. Authors on the lower end of this range tend to estimate more conservatively by not including the "induced" effects and also use higher energy costs in proportion to the economic stimulus impacts. Those on the higher end, tend to include all

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payments, $317 for health and safety as quantified by the cost of health and safety measures, $442 for the NPV of the net value added to the Ohio economy, and $22-510 ($264 midpoint) for the NPV of reduced air emissions. This totals to $2,273 for the NPV of non-energy benefits on a program that costed $2,381/home.

2 This is the sum of: 1) 0.6-8.8% for arrears, 2) 2.2-8.1% for uncollectables, 3) 0.3-1.1% for termination and reconnection costs, 4) 5.8-37.6% for reduced rate discount payments, 5) 0.2% for fire prevention, 6) 0-11.7% for reduced unemployment insurance payments, 7) 0-75% for equity/reduced energy burden concerns, 8) 0-116.8% for reduced mobility, 9) 0-59.1% for reduced loss of service due to termination, 10) 8.1% for improved maintenance/property values. This totals to a 17.2% - 326.5% adder for quantified non-energy benefits for generic low-income programs.

three local economic effects and use lower energy cost when proportioning economic stimulus benefits in relation to energy savings.

Weatherization induced economic stimulus is also measured in terms of job creation and employment related benefits. Various authors have estimated the number of jobs created for every $1 million spent on weatherization programs to be from 5.6 to 52 jobs. Job creation can also be stated in terms of the ratio of DSM[3] jobs created to energy supply jobs created. This equals (DSM gross employment + DSM re-spending employment) / energy supply gross employment. A series of studies that modeled 7 diverse geographic regions in North America showed a DSM/Energy Supply Job Ratio of from 1.5 to 4.3.

In terms of dollars per weatherized home, the NPV of indirect employment is reported at $506 and the NPV of the avoided unemployment benefit is $82 for the "National Weatherization Program." Also, the NPV of federal taxes generated from the direct employment associated with the National Weatherization Program is reported to have a NPV of $55 per weatherized home.

Several authors suggest that weatherization increases home property value in proportion to energy savings. The "National Weatherization Program" study estimated the NPV of increased property value at $126 per weatherized home. Another author estimated this annually for a "generic low-income program" as being worth from $0-$150 per home per year. According to some authors, increased property value can also be stated in terms of the annual energy savings that resulted from program installed measures. One author computed the NPV of weatherization induced energy savings for a variety of home and fuel types. The result was an increased property value of from $21 to $36 for every $1 in annual energy savings.

Other reported benefit categories include; reduced mortgage failure, reduced damage to furniture, and reduced reliance on imported fuels. One study found that 2.5% of HUD mortgage failures in 1974-75 resulted from high utility bills. One study reported that UV damage and discoloration to furniture and other materials is reduced from 16% to 74%, when replacing single pane windows with more energy efficient models. One author estimated the dollar value benefit of reduced reliance on imported fuels as being equivalent to 10% of the energy savings.

Environment

Weatherization induced environmental benefits occur when power plants and home heating emissions are avoided as a result of reduced energy use. There are also reported weatherization related water benefits, land use impacts, and avoided federal subsidies. One author estimated the total environmental benefit to be from $3-$20 per participant per year for a "generic low-income program such as PG&E's Venture Pilot Program."

Much has been published about avoided air emissions attributable to weatherization and DSM generally. For "the National Weatherization Program," the NPV of avoided SOx and NOx emissions is valued at $172 per weatherized home. Several studies have estimated the NPV of from two to five specific[4] avoided air pollutants associated with Ohio's HWAP[5]

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3 Demand Side Management

4 CO_2 and NOx are included in all four Ohio HWAP estimates within the range. SOx is included in three and NH_4 and particulates are each included only in one study.

5 Home Weatherization Assistance Program (HWAP)

at from \$25 to \$510 per weatherized home. A New England study estimated the benefits of avoided greenhouse gases, SOx, NOx, VOC, particulate, and CO emissions at 5.4 cents per kWh and from 1.5 to 27.8 cents/kWh for avoided air toxic emissions.[6] Another New England study estimated the total benefit of all emissions to be worth from 15% to 666% of the energy savings priced at 4.0 cents/kWh.[7]

Many authors have estimated specific values of avoided air pollutants. The results are summarized for each air pollutant type in Table 1. There are several air emissions that are regulated under the Clean Air Act, including; Sulfur Oxides (SOx), Nitrogen Oxides (NOx), Volatile Organic Compounds (VOCs), Particulate Matter (PM), and Carbon Monoxide (CO). There are three primary greenhouse gases; Carbon Dioxide (CO_2), Methane (CH_4), and Nitrous Oxide (N_2O). Additionally, there are eleven heavy metal emissions that are reported to occur from certain power plants that are listed toward the bottom of the table.

Table 1 Reported benefits of avoided air emissions from energy savings

Air Pollutant	\$/ton of pollutant	\$/lb of pollutant	cents/kWh	lbs/MMBTU	lbs/MWh
SOx (Sulfur Oxides)	\$110-\$2,030		1.15	0.001-2.71	18.57
NOx (Nitrogen Oxides)	\$44-\$8,143		1.86	0.002-0.98	7.58
VOCs (Volatile Organic Compounds)	\$530-\$6,673				
Particulates	\$40-\$9,953		0.19	0.001-3.05	0.31
CO (Carbon Monoxide)	\$1,086-\$920		0.02	0.001-3.05	0.33
CO_2 (Carbon Dioxide)	\$10-\$77		2.1	121-2,145	
CH_4 (Methane)	\$150-\$252		0.04	0.002-4.65	
N_2O (Nitrous Oxide)	\$4,140		0.08		
Arsenic		\$920			
Beryllium		\$359-\$94,488			
Cadmium		\$143-\$37,795			
Trivalent Chromium		\$0-\$55			
Hexavalent Chromium		\$1,430			
Copper		\$0-\$70			
Lead		\$540			
Manganese		\$55-\$\$1,404			
Mercury		\$14-\$3,779			
Nickel		\$1-\$210			
Selinium		\$0-\$70			

Land use benefits are also reported to occur from saving energy. One study estimated the amount of land avoided for construction and operation of power plants at from 0.1 to 2.7 square yards per MWh saved. Another study specifically estimated the cost of acid rain to

6 Benefits from reductions in NEPOOL's (New England) air toxic emissions due to DSM programs. The sum total is: 0.005 cents/kWh for Arsenic, 0.000-0.021 for Beryllium, 0.000-0.021 for Cadmium, 0.000-0.070 for Trivalent Chromium, 0.009 for Lead, 0.000-0.002 for Mercury, 0.001-0.170 for Nickel. This totals: 0.015-0.278 cents/kWh for toxic air emissions. Note: Hexavalent Chromium, Copper, and Selinium are "N/A" in this study.

7 Percentage adder to avoided electric supply @ 4 cents/kWh for air pollutants for air emissions. A 1%-114.5%, midpoint 57.8% adder for Clean Air Act criteria gases (SOx, NOx, VOCs, particulates, and CO) + a 13.9%-57.3%, midpoint 35.6% for greenhouse gases (CO_2, NH_4, N_2O) + a 0.4%-494.5%, midpoint 247.4% for heavy metal emissions (this includes arsenic, beryllium, cadmium, chromium, copper, lead, manganese, mercury, nickel, and selenium). This totals for air impacts to (15.3% - 666.3%, midpoint 341.1%).

the Eastern United States in terms of losses to agriculture, man-made structures, forestry, fisheries and wildlife at $5 billion per year in 1978 dollars.

Several authors have looked at the benefits of energy savings in terms of water resource impacts. The water and sewer savings of a "generic" low-income program such as PG&E's Venture Pilot Program to be from $10-$155 per participant per year. The avoided cost of fish kills near power plant cooling water intake grids was estimated by one author to be worth from 0.005 to 0.02 cents/kWh. Another author restated the benefit of avoided fish kills as a 0.1%-0.5% "adder" to avoided electric supply priced at 4 cents/kWh.

One author estimated the environmental benefits in terms of avoided federal subsidies to the coal and nuclear industries. These subsidies may occur directly or indirectly through related industries. For coal fired electric generation, the subsidy is reported at from 0.4 to 0.7 cents/kWh and for nuclear electric the subsidy is reported at from 1.1 to 1.9 cents/kWh. Another author quantified the damage from the nuclear fuel cycle itself at from 0.00125 to 228 cents/kWh.[8]

Health and Safety

Health and safety benefits may occur from low-income and weatherization services in the form of:

- Reduced incidence of fire,
- CO reductions,
- Fewer emergency calls,
- Fewer illnesses and nursing home avoidance, and
- Improved home comfort.

One Ohio HWAP meta-study set the total dollar value of health and safety benefits from weatherization programs equal to the cost to administer the program, at $317 per home.

A "National Weatherization Program" study estimated the NPV of fewer fire deaths at $3 per participant. In a study done for the State of Vermont, the NPV of reduced fire deaths was estimated at $423 per home.

Weatherization related indoor carbon monoxide (CO) reduction has been documented by various studies. However, the amount and cost of CO related illness and death has not been estimated in the literature. This is a difficult subject for authors to address because of the legal risks associated with suggesting causality between CO levels and participant illness or deaths from weatherization programs.

Several studies have put the annual benefit of fewer emergency calls induced by weatherization measures in a range from $10-$27 per participant. These studies limit avoided emergency calls only to natural gas heated homes.

One study reported a 28% to 69% reduction in participant perceived health problems attributable to weatherization. Another study estimated the benefits of fewer illnesses at from $0-$150 per participant per year attributable to weatherization. One unpublished paper

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8 The damage from the nuclear fuel cycle avoided by DSM in NEPOOL (New England). Range includes: 0.00016-224.46 cents/kWh for the front end of the fuel cycle, 0.00002-0.13 for reactor operations, 0.00001-3.39 for accident risk, 0.00081-0.05 for reactor decommissioning (occupational), 0.0-uncertain for reactor decommissioning (public), 0.00024-uncertain for low-level waste disposal, and 0.00000-uncertain for high-level waste disposal. This totals to a range of 0.00125-228.04 cents/kWh for the nuclear fuel cycle.

currently being reviewed for inclusion in the 2000 ACEEE Summer Study Proceedings suggests increased health related problems as a result of weatherization programs, especially increased asthma problems and costs, but provides no supporting data.

One author used an innovative survey technique to estimate the value of increased home comfort related to weatherization measures. The respondent's perceived benefits of home comfort was correlated to energy savings to produce an estimate of comfort increase that was valued at, on average, 12% of the energy dollar savings. Increased home comfort is also evidenced in another study, which reports a reduction of 13%-18% in the frequency and magnitude of home occupant thermostat adjustments occurring after weatherization.

Utility Issues

A number of non-energy benefits relating to utility service issues are reported in the literature. These include:

- Utility bill arrearage reductions,
- Reduced carrying cost of arrears for non-participants,
- Reduced collection costs associated with non-payment and arrears,
- Reduced levels of utility debt "write-offs",
- Reduced costs for shut-offs and reconnections,
- Reduced customer calls and non-emergency service requirements,
- Lower rate subsidies, and
- Reduced customer "mobility"

The impact of weatherization and low-income programs on reducing arrearages has been analyzed by a number of authors and expressed in various units of measure. There is a wide range of annualized per-weatherized participant arrearage level reductions reported in the literature (ranging from $32 - $1,008 per home). In terms of the average percent decrease in bill payment shortfall, the range is from (5%-65%) of a customers' utility bill. The gross number of accounts in arrears or classified as "troublesome" has been shown to decrease 2%-69% after weatherization. The wide variation is often due to differences in program services. Some programs provide bill payment assistance and installation of major weatherization measures, while others are only educational in nature with small impacts.

Arrearage carrying costs occur to the utility when uncollected balances are born by the ratepayers. One author estimated the weatherization induced avoidance of uncollected debt to be worth from $0.50-$7.50 in annual per participant benefits to ratepayers and the utility for a "generic low-income program."

Many authors have estimated and measured the cost of credit and collection activity related to utility bill non-payment. On a per incident basis, this has been estimated at from $19-$117 per incident.

Utility debt write-offs are also reported to be reduced with weatherization and low-income programs. This has been estimated to be worth from $2 to $31 per participant.

Several authors have suggested that when participants experience weatherization induced energy savings, on-time utility bill payment is more likely to occur. And as a result, several authors have estimated the savings from fewer service terminations to be from $0-$86 per incident.

One author estimated that rate subsidies avoided due to a "generic low-income program" is from \$5-\$32 per participant per year. This is based on a low-income rate subsidy program that discounts 15% of utility bill costs to participants.

Several authors have examined household occupant mobility in terms of income and utility service termination. It has been reported that occupant mobility is highest among low-income populations. Also, it is reported that mobility is greater in un-weatherized homes and occurs more frequently after utility service terminations. For this benefit only one author has specifically assigned a dollar value to the benefit of reducing mobility through weatherization programs. This benefit is reported to be worth from \$0-\$100 per participant per year for a "generic" low-income weatherization program.

Weatherization and low-income programs may provide clients with new and upgraded systems and technologies that need little repair and maintenance compared to older technologies in un-weatherized homes. However, no quantification of this benefit is found in the literature.

"Other" benefits

Several "other" non-energy benefits identified in the literature search include;

- DSM spillover benefits,
- Increased participant knowledge,
- Increased utility customer loyalty, and
- Reduced transaction costs.

DSM spillover is reported to occur in three ways; 1) when weatherization participants adopt non-program provided measures, 2) when non-participants adopt program measures and 3) when non-participants adopt non-program measures. For DSM spillover, one author estimated a benefit expressed as a 20% adder to the energy savings.

The educational impacts of low-income and weatherization programs are difficult to measure. Despite this, one author showed that there was a 50% increase in the number of energy efficient actions that participants could show or demonstrate after participation in a Detroit Edison Program.

In a competitive utility service environment, customer loyalty is valuable to utility providers. In one study, utility customer loyalty was shown to increase with weatherization participation. In another study for Cinergy, customer loyalty was shown to be higher for weatherization program participants than 5 other programs, each measuring customer loyalty in the same way.

When weatherization participants no longer need to research and purchase items that are installed through a program, there are avoided transaction costs. One study estimated that participant transaction costs are reduced by \$0-\$5 per weatherized participant per year for this avoidance.

Non-Energy Benefits Greater than Energy Benefits

When we selected the mean or what we considered the most reasonable (from a measurement methodology perspective) projected value of the non-energy benefits applied to specific weatherization programs, we found that the dollar value of the non-energy benefits typically exceed the energy benefits by a wide margin. This was the case in providing benefit estimations for two different weatherization programs using the non-energy benefits database to estimate total program benefits. In both cases, the total value of the non-energy benefits were twice the value of the energy benefits, making the programs far more cost effective than when only the energy benefits are considered. This has important implications for policy makers that base decisions about funding or not funding low-income and weatherization programs using economic tests such as NPV computations and B/C Ratios. When non-energy benefits are included, weatherization programs are typically three times as cost-effective as when the non-energy benefits are excluded.

Better Research and Relationships Needed

In reviewing the 91 publications used to build the database and to summarize the findings into this paper we came away with a recognition of the need for the evaluation and research community to work more closely with policy makers, research funding sources, and in some cases with the authors estimating non-energy benefits. We found that, in some cases, authors made projections without a good understanding of the strengths and weaknesses of the underlying research methodologies. We also found, in other cases, that some authors made projections without good underlying research or made projections based on unsubstantiated assumptions.

In discussing these issues with several authors, we found that a major reason for these conditions is a lack of resources to support their work. Several authors reported self-funded research where only a small amount of time could be devoted to the research. If the research community is to obtain a better understanding of the non-energy benefits and provide more accurate estimations of the full range of these benefits to policy makers, then we must convince funding sources of the need for this information.

Conclusion

The non-energy benefits identified in this paper and included in the TecMRKT Works non-energy benefits database have important implications for public policy, for program designers and implementors and for weatherization participants. While these programs are typically designed to maximize the energy savings benefits to the participant, there are a significant number of non-energy benefits that can be identified along with an energy impact evaluation. The non-energy benefits database provides program managers and evaluators with a method of identifying a more complete range of benefits associated with these programs and places a wide range of non-energy benefits at the finger tips of program analysts, without costly literature searches and document reviews. As policy makers and legislators become more aware of the total benefits of energy efficiency programs and learn that effective environmental and greenhouse gas reduction efforts often begin with energy efficiency improvements, the value that these individuals attribute to energy efficiency programs will be enhanced. This paper serves as a tool to help identify the range of benefits from weatherization and low-income energy programs.

Selected references

There were 91 publications accessed and used in writing this paper. Due to ACEEE page limitations, only 23 key selected references are included. A complete list of references is available from TecMRKT Works. The references displayed below contain a "DB" number (database ID) for cross-referencing back into the annotated references in the database.

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