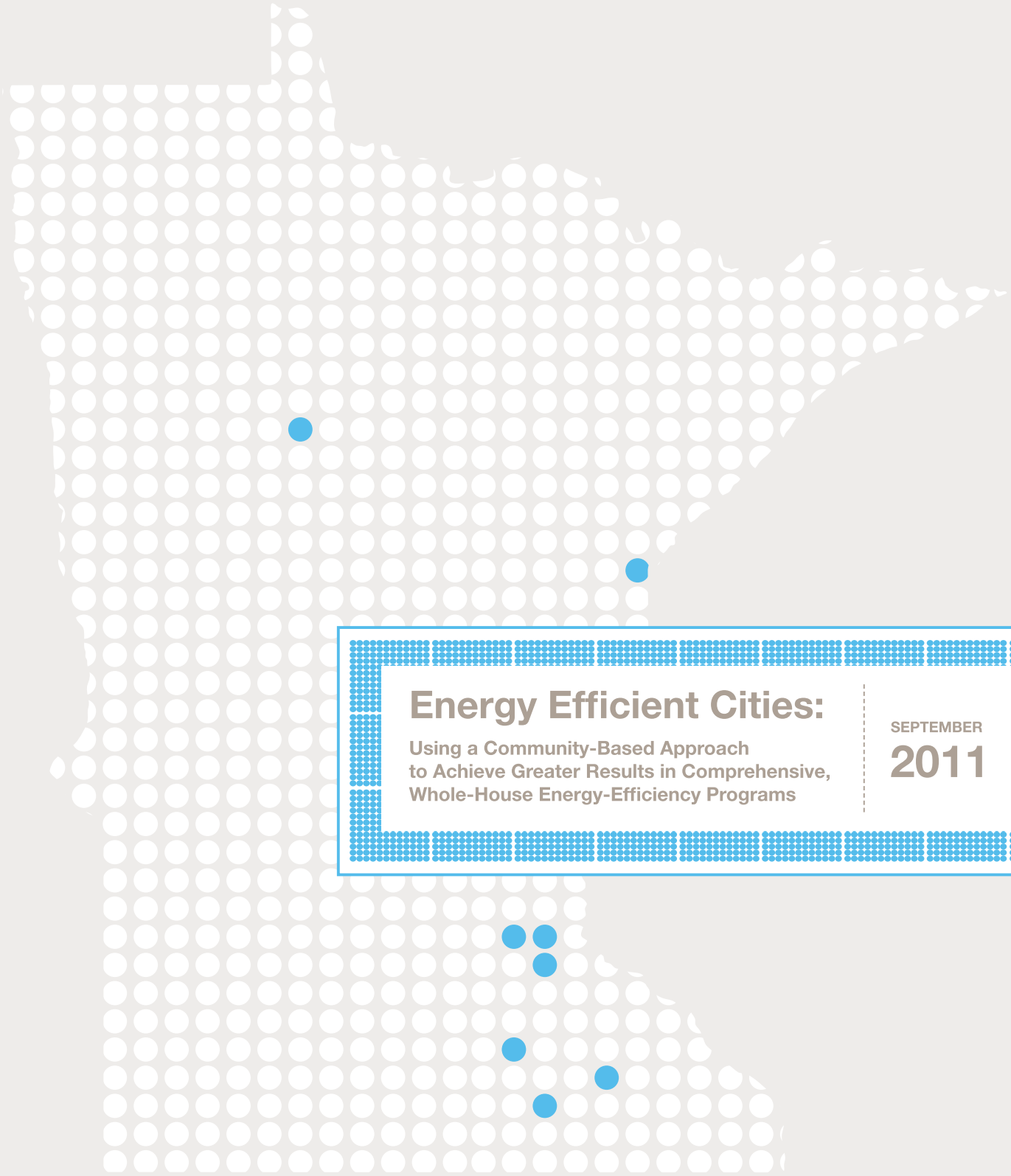

Energy Efficient Cities:

Using a Community-Based Approach to Achieve Greater Results in Comprehensive, Whole-House Energy-Efficiency Programs

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cee
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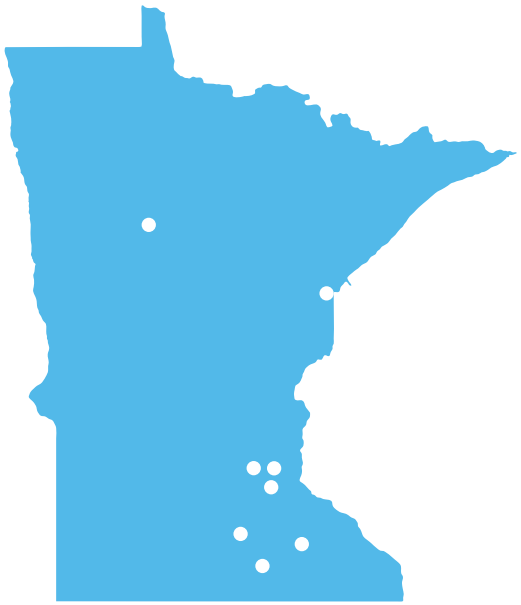
The project exceeded its original goals for participation, with 6,922 households completing a home energy visit and 1,474 of those households completing major energy upgrades, which generated $4.8 million in contractor work and saved homeowners $13.8 million on their energy bills.

Introduction to Energy Efficient Cities

The Energy Efficient Cities project was developed to demonstrate the delivery of innovative residential energy-efficiency programs to reduce energy use and environmental impact in at least 6,000 homes through a community-wide partnership approach, with initial seed funding from Minnesota's Environment and Natural Resources Trust Fund. **With strong and crucial support from local gas and electric utilities, city-specific programs were developed in eight cities: Apple Valley, Austin, Duluth, Minneapolis, Owatonna, Park Rapids, Rochester, and St. Paul.** While each city developed a customized approach, all of the programs were designed to provide a "one-stop shop" whole-house approach that would make it as easy as possible for homeowners to take energy-efficiency actions, while maximizing participation and energy savings. This comprehensive approach involved the following components in every program:



- ***Community-based marketing strategies*** to recruit participants to workshops, for training participants to take low-cost energy actions and to serve as an entry into the program;
- ***Home energy visits*** that include installation of low-cost materials, identify other energy-saving opportunities, and provide a customized energy action plan;
- ***Energy usage feedback reports*** to encourage individual energy-saving actions;
- ***Follow-up assistance***, including providing cost-share for completion of major efficiency upgrades including insulation, air sealing and major mechanicals replacement; and
- ***Training and quality assurance*** for insulation and air sealing contractors.

The project exceeded its original goals for participation, with 8,243 people attending workshops, 6,922 of those households completing a home energy visit, and 1,474 homes completing major energy-efficiency upgrades. Quality-assurance protocols were developed to provide confidence to the homeowner that their upgrade was being done right, as well as to ensure promised energy savings would be realized. Thirty-six contractors were trained in high-performance installation techniques for insulation and air sealing jobs. The upgrades completed under this program generated $4.8 million in work for Minnesota's insulation and heating contractors. The estimated total energy savings from measures installed in these homes is $13.8 million for the homeowners over the life of the measures. The programs will be continued in at least five of the participating cities.

This report provides a summary of the project, as well as lessons learned for implementing similar programs.

Why Was Energy Efficient Cities Started?

Minnesota has a long-standing commitment to improving the energy efficiency of its homes and businesses. In 2007, the legislature reinforced this commitment by requiring both natural gas and electric utilities to increase their efforts to help their customers save energy, sufficient to reduce energy use 1.5% per year from what it otherwise would have been. While utilities have a long history of successfully implementing programs to help customers save energy, the residential sector has been a particularly hard sector to serve, especially for natural gas savings. Achieving significant natural gas savings in the residential sector requires deeper efforts like insulation and heating system upgrades (so-called "whole-house" programs[1]). Major upgrades, such as insulation and air sealing, typically require some kind of home visit to assist with the diagnosis of the problems and design of the upgrades. However, traditional audit programs (the predominate program offering in Minnesota), which simply provide information to help guide consumer action, often do not achieve results on their own. It has long been recognized that providing information is, in itself, insufficient for motivating participant action. New approaches are needed to unleash the potential for energy efficiency in homes.

Traditional audit programs, which simply provide information to help guide consumer action, often do not achieve results on their own.

The Center for Energy and Environment (CEE) set out to design an approach that could address energy efficiency in the residential sector, and jump-start these efforts throughout the state. CEE was awarded a grant from the Minnesota Environment and Natural Resources Trust Fund in 2009 to pilot residential energy-efficiency programs in eight cities throughout Minnesota.

Participating Cities and Partners

Eight cities from across Minnesota participated in the Energy Efficient Cities project: Apple Valley, Austin, Duluth, Minneapolis, Owatonna, Park Rapids, Rochester and St. Paul. Park Rapids participated in the program for only a few months before the city decided to focus instead on another energy-efficiency initiative it had received stimulus funding for. Each city had a broad range of partners that helped make the program possible, summarized below. Utilities from each of the cities were strong supporters and critical to the programs' success, typically funding the home energy visit portion of the program. Cities and community and neighborhood groups were essential to helping garner participation. Program implementers were also different for each city. CEE implemented the programs in Minneapolis and Apple Valley in their entirety; implemented everything except the home energy visit in Austin, Owatonna and Rochester; and conducted the workshops in Park Rapids. In St. Paul, the Metro Clean Energy Resource

Teams (CERTs) did most of the recruitment and workshops, while the Neighborhood Energy Connection conducted the home visits and follow-up work as well as a portion of the recruitment and workshops. Duluth had a large coalition of organizations that resulted in the formation of the Duluth Energy Efficiency Program, which was implemented by Common Ground, a local nonprofit.

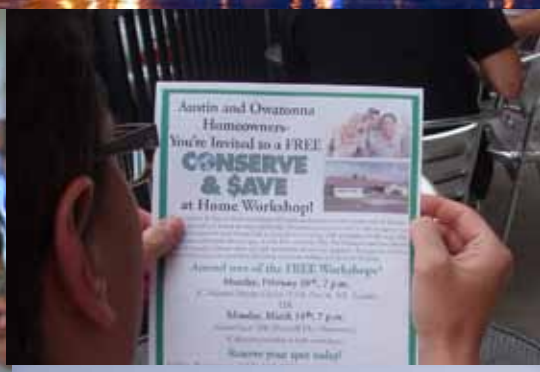
Figure 1: Summary of Energy Efficient Cities Program Partners

City *Program Name*	Utilities	Program Implementers	Other Partners
Apple Valley *be. (better energy) Apple Valley*	Dakota Electric Association *(electric)* CenterPoint Energy *(gas)*	CEE *(everything)*	City of Apple Valley Metro CERTs Great Plains Institute Great River Energy
Austin *Conserve & Save House Call*	Austin Utilities *(electric and gas)*	CEE *(recruitment, workshops, follow-up, quality control)* Greg Ernst and Associates *(home energy visit)*	Owatonna Public Utilities
Duluth *Duluth Energy Efficiency Program (DEEP)*	Minnesota Power *(electric)* Comfort Systems *(gas)*	Common Ground *(everything)*	City of Duluth
Minneapolis *Community Energy Services & Home Energy Squad*	Xcel Energy *(electric)* CenterPoint Energy *(gas)*	CEE *(everything)*	City of Minneapolis Over 50 neighborhood groups
Owatonna *Conserve & Save House Call*	Owatonna Public Utilities *(electric and gas)*	CEE *(recruitment, workshops, follow-up, quality control)* Greg Ernst and Associates *(home energy visit)*	Austin Utlities
Park Rapids *Green Park Rapids*	Minnesota Power *(electric)* MInnesota Energy Resources *(gas)*	HRA of Park Rapids *(recruitment)* CEE *(workshops)* Greg Ernst and Associates *(home energy visit)*	City of Park Rapids Green Park Rapids coalition
Rochester *Neighborhood Energy Challenge*	Rochester Public Utlities *(electric)* MInnesota Energy Resources *(gas)*	CEE *(recruitment, workshops, follow-up, quality control)* Greg Ernst and Associates *(home energy visit)*	City of Rochester R-Neighbors
St. Paul *Neighborhood Energy Service & Home Energy Squad*	Xcel Energy *(electric and gas)*	Neighborhood Energy Connection *(home energy visits, some recruitment, some workshops, follow-up)* Metro CERTs *(recruitment and workshops)*	City of St. Paul District Councils

Challenges for Residential Energy-Efficiency Programs

The benefits of investing in energy-efficiency measures, such as adequate attic and wall insulation, are well documented and can result in a positive economic return for the homeowner. Yet research indicates that homeowners consistently under-invest in energy-saving opportunities. Before starting the project, CEE identified the following challenges that would need to be addressed in developing a successful residential approach.[2]

- ***Information barriers***. It might seem surprising that so few consumers take the sensible step of investing in all conservation opportunities with a payback of 10 years or less, but they can't take advantage of those opportunities if they don't know about them. Giving homeowners information about conservation opportunities is essential, but care must be taken in how that information is presented. Research shows that presenting too many choices can actually increase the likelihood that someone won't choose at all.
- ***Individual consumer behavior plays a large role in household energy consumption.*** It is well established that consumption in identical homes, even those designed to be energy-efficient, can easily differ by a factor of two or more depending on the behavior of the inhabitants. Recent utility studies have established that addressing energy-related behaviors can result in significant reductions in energy consumption.
- ***Logistical barriers and short homeowner attention span***. Even if homeowners know what action to take, they may not take that action unless it is made very convenient for them. Research has shown that homeowners are willing to spend only a limited amount of time dealing with their home's energy issues. Programs must reduce confusion, provide easy steps to action, and deal with logistical barriers such as finding qualified contractors.
- ***Factors other than economics are primary in consumer decision-making.*** Even if a measure can be demonstrated to be a good economic investment, other factors determine homeowner priorities. A kitchen remodel is undeniably a more exciting project to most homeowners than installing insulation. Programs should include persuasion based on non-economic factors, such as creating peer pressure to do the right thing.
- ***Financial barriers.*** Homeowners often do not have access to capital to make needed improvements. It should be noted that in CEE's experience with financing more than $100 million in energy improvements, the importance of this issue is often overstated, but is nonetheless important for program designers to address.
- ***High transaction costs relative to energy savings***. Compared to the commercial or industrial sector, the magnitude of the available energy savings per customer is relatively small. Thus, residential programs that involve a home visit must achieve high efficiencies in program delivery to minimize transaction costs. Minimizing the number of visits to the home (and maximizing the energy savings per visit) is necessary to achieve program cost-effectiveness. To maximize energy savings per customer, each visit must focus on all fuel types present, as well as multiple modes of savings, including direct installation, major retrofits and behavioral changes.



Really happy with the program and happy it was in Apple Valley. That's not something that you really expect in a suburb. I was really proud I could participate in it. I wanted to do my part to help you guys out with any other research with hopes that we can expand the program to other areas and cities.

-Energy Efficient Cities Program Participant

Components of the Energy Efficient Cities Program

Informed by the challenges of serving the residential sector as outlined above, Energy Efficient Cities aimed to create a "one-stop shop" comprehensive approach to make taking energy-efficiency actions as easy as possible for the homeowner, while maximizing participation and energy-savings opportunities. CEE developed five basic program components, discussed below. The intent of this program design was for each of the components to build upon the others to create an integrated whole, creating a "conveyor belt to energy savings."

Community-based marketing strategies including workshops

The Energy Efficient Cities program implementers worked closely with communities on outreach and marketing, for several reasons. First, the programs were able to leverage the interest by cities and community and neighborhood groups in helping their residents save money and energy in their homes. Many cities and neighborhood groups are actively seeking ways to engage their residents in these issues, and the programs provided an outlet for that interest.

Equally important, community-based strategies can provide an additional motivation for homeowners to take action, from taking the first step by enrolling in the program to investing in major upgrades. Insights from behavioral psychologists have shown that people are more strongly influenced by social norms than by economic drivers such as saving money (even though people may say, and believe, that they care more about saving money than they do about what their neighbors think). Showing that a behavior such as insulating your home is a social norm creates a powerful motivator for people to adopt that behavior. Community-based strategies can be important in establishing energy efficiency as a social norm, helping to increase program participation and the number of actions by program participants. This can be particularly true if community leaders are publicly involved with the program.

Energy Efficient Cities used community workshops to reinforce the social norm that energy efficiency is the right thing to do as well as to create a feeling of involvement by the whole community, helping to push individual participants to action. All of the Energy Efficient Cities programs used community workshops as a recruitment technique. It was found that when homeowners could schedule a home energy visit right at the workshop, more homeowners took that next step. This method also has the benefit of having homeowners make a public commitment to energy efficiency in front of their neighbors. Behavioral psychologists have found that public commitments are an effective strategy in driving people to take further actions, in this case making it more likely that homeowners would make investments in major energy-efficiency upgrades down the road.

The workshops also served to prepare the homeowner for the home visit, including setting expectations that doing major upgrades is an important part of a home's energy efficiency. The workshop content was informative, but also engaging for homeowners.

Partnering with neighborhood and other community groups, where such organizations existed, was a successful approach for many cities. Minneapolis has more than 80 neighborhood groups, more than two-thirds of which actively worked with CEE on promoting the program. This varied from helping market the program through community newsletters and email lists to recruiting volunteers for door-knocking efforts.

Many of the other cities also employed volunteer door-knockers to sign people up for the workshops. Minneapolis and St. Paul held volunteer trainings for door-knockers, and hosted door-knocking volunteer events. In Duluth, a "green canvass" talked to more than 2,000 households in their door-knocking efforts.

Home energy visits

The home energy visits provided an opportunity for the homeowner to get personalized assistance and recommendations from energy-efficiency experts. Most cities referred to the home energy visits as "energy audits." This term, however, conjures images of the IRS and tax accounting for many people, making it sound like an unpleasant chore. For this reason, the Energy Efficient Cities project and programs in Minneapolis and Apple Valley used the term "home energy visit."

Procedurally, the home energy visit involved diagnostics to determine the need for insulation and air sealing, typically a blower door test. The heating systems were checked to see if they needed to be upgraded, as well as for safety. To maximize energy savings potential, low-cost materials were installed during the home visit. The exact product mix varied by city, but included compact fluorescent light bulbs, low-flow showerheads, low-flow faucet aerators, programmable thermostats, hot water heater insulation blankets and pipe wrap, refrigerator thermometers and weather-stripping. At the end of the visit, homeowners were presented with any recommendations for major upgrades like insulation, air sealing and heating system replacement. As mentioned above, research has shown that presenting too many options tends to overwhelm people, resulting in no option being selected at all. Because of this, an effort was made in most cities to focus the recommendations on the top two or three most important ones.

“The home visit was great! It was great to learn about all the specific improvements that were being made and how to implement some changes myself. The staff was great about answering questions and involving me in the process.”

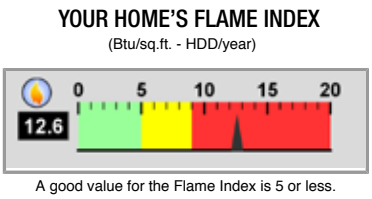
-Energy Efficient Cities Program Participant

Energy use feedback reports

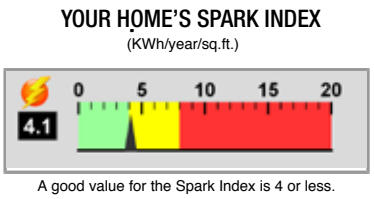
One barrier to people taking energy-efficiency actions is a lack of context for their energy bills. They generally don't know if their energy use is relatively high or low compared to other homes. Providing feedback on homeowners' energy bills can be a step toward their taking actions to reduce their energy use. Many studies have shown that well-designed "feedback reports" can result in people taking small actions to save energy, such as turning down their thermostats in the winter, and make it more likely that they will take larger actions, like buying a new furnace. Feedback reports were an integral part of Energy Efficient Cities. The reports require the participation of gas and electric utilities to acquire the necessary data, and typically require the homeowner to sign a waiver to release the data to a third party like CEE, who then provides it to the homeowner. The data acquisition process was not easy, and was fairly resource-intensive.

Different cities had different approaches to these reports. Duluth used a tool designed by the U.S. Environmental Protection Agency called the "Home Energy Yardstick," which combined natural gas and electric energy use to give a single score. Minneapolis, St. Paul and Apple Valley used a separate score for electric use (the "Spark Index") and natural gas usage (the "Flame Index"). Austin, Owatonna and Rochester, separately from Energy Efficient Cities, contracted with a large national provider of feedback reports (O-POWER). Those cities also worked with O-POWER to help market the program through their feedback reports.

Having a score that provided context for homeowners helped to engage them in conversations about their energy use. Most homeowners found the reports extremely useful. The feedback reports were also very useful in encouraging further actions after the home visit. Homeowners are frequently not ready (financially or otherwise) to immediately do the upgrade work, and it may take many months before they engage a contractor to do the work. The feedback reports provided a reminder to the homeowner of their intention to complete that work.



A good value for the Flame Index is 5 or less.



A good value for the Spark Index is 4 or less.

Having a score that provided context for homeowners helped to engage them in conversations about their energy use.

Follow-up assistance to support implementation of recommendations

After the home visit, homeowners received assistance in following through on the home visit recommendations. This included answering questions about how to select a contractor and what should be included in the scope of the work, assistance with various government and utility incentives, and help with financing if it was needed. With the variety of programs available (including, in Minneapolis, neighborhood-specific financing programs), it can be hard for homeowners to keep track of what they may qualify for, and how they should proceed to maintain eligibility. For example, Duluth homeowners could be eligible for a city-run 4.9% loan program, Minnesota Housing Finance Agency loans available through at least four local lenders, several income-eligible loan programs, rebates from the gas and electric utilities, and a rebate through the DEEP program. A specific rebate was also available from Energy Efficient Cities for all cities, for up to $400 for insulation and up to $250 for heating systems. Often just a simple call to check in with the homeowner helped to keep projects moving along.

In addition to assistance by phone, program implementers created websites and sent emails and letters to homeowners to remind them of rebate offers and any upcoming deadlines for these rebates. As mentioned above, an energy usage feedback report sent out a couple times after the home visit can also serve to trigger action by the homeowner to implement recommendations.

> **We greatly appreciated the follow-up call after the visit because that is where we were beginning to have more questions.**
>
> *-Energy Efficient Cities Program Participant*

Training and quality assurance for contractors

Energy Efficient Cities incorporated contractor training and quality assurance into the program design for two purposes. The first reason was to ensure that the maximum potential energy savings would be realized. Energy savings from insulation in particular is highly dependent upon the quality of the installation. Secondly, program implementers believed that providing homeowners with an assurance that contractor work would be done well and solve their energy problems would make it easier for them to make the decision to invest in upgrades.

Air leaks are a primary cause of ice dam issues.

Generally, there are few issues with installations of heating systems. However, the quality of work done by insulation contractors for existing homes is highly variable. Many contractors are not trained in proper techniques, particularly in sealing air leaks prior to installing insulation. And yet properly sealing air leaks is one of the most critical aspects of insulation work. Air leaks can result in an equal or greater heat loss than through insufficient insulation. Failing to properly seal air leaks can also result in moisture, mold and wood decay issues. This is caused by moisture in the warm, moist air condensing on cool attic spaces in the winter months. In addition, air leaks are a primary cause of ice dam issues, created when warm air reaches the roof deck and melts the snow on the roof. Adding more insulation without sealing air leaks can magnify these moisture issues.

Besides installation issues, contractors must be aware of and ready to deal with indoor air quality issues that may result from their work. Tightening up a home in some situations can result in the potential for combustion gases to leak into the home from combustion appliances (like most older natural gas water heaters) that are not power-vented. Tighter homes may also need mechanical ventilation for supplemental fresh air, and contractors should be ready to help homeowners address this need.

Because the difference between a well-done installation and a badly done installation is not visible to the homeowner, there is little market incentive for a contractor to do the job well, particularly when shortcuts can result in the work being done less expensively. Thus many homeowners experience a wide variation in bids from contractors, because one contractor may be doing more detailed work, while another may be taking shortcuts such as not fully sealing all attic bypasses. Even if homeowners are aware that improper insulation work can cause indoor air quality problems, they may not know the right questions to ask to make sure a contractor will properly deal with this issue. All of these issues create confusion for homeowners, which makes it less likely that they will go forward with doing the work.

To solve this dilemma, Energy Efficient Cities created a quality-assurance process, which was adopted in its entirety by a majority of the programs. The basis of the quality-assurance process is insulation and air sealing standards and a quality-control process to ensure the

standards were followed. The standards were developed by CEE, largely based on CEE's experience overseeing the insulation and/or air sealing of more than 8,000 homes through the Metropolitan Airport Commission's Sound Insulation Program.

The quality-assurance process is under continuous improvement. The current process is different than originally chosen, as initial testing of contractor work showed more quality issues that was deemed acceptable. Additional training and more one-on-one contact between contractors and CEE's experienced staff were added to improve results. The current process involves the following steps:

1. Contractor completes required trainings and/or certifications (including on indoor air quality issues like ventilation and combustion safety), becomes familiar with the insulation and air sealing techniques and standards, and confirms they have required equipment, including a blower door and proper insulation equipment. Contractor also confirms they can properly fill out post-installation report that includes indoor air quality testing as part of program requirements;

2. Contractor is placed on a list of participating contractors that is provided to program participants;

3. Contractor is entered into the program on a probationary basis. Program quality control staff perform on-site "proctoring," or confirmation that the contractor is meeting the standards;

4. Contractor notifies the program administrator as they finish jobs for homeowners, and quality control staff conduct audits on at least 10% of the completed jobs. If deficiencies are found during the quality control audits, contractor corrects deficiencies. Contractors that consistently fail quality control audits are dropped from the program.

Training for contractors involved in Energy Efficient Cities was held to support the quality-assurance process (step 1 above), focusing on air sealing techniques. Toward the end of the project period, the national Building Performance Institute (BPI) developed a certification for insulation installers. A majority of the Energy Efficient Cities programs will be requiring this certification for participating contractors in the future (Duluth already requires contractors to hold another BPI certification for building envelope professionals).

Results

The Energy Efficient Cities project ran for two years, from July 2009 through June 2011. Since the program design and partner relationships had to be created before implementing the individual city programs, most programs didn't start until late 2009 or early 2010, meaning that the results presented here were accomplished in an average of about 18 months.

In total, 8,243 participants attended workshops, resulting in 6,922 home visits. Of the households that had a home visit, 1,474 (21%) completed a major energy-efficiency upgrade, and about 15% of those completed more than one upgrade (resulting in a total of 1,690 upgrades). The breakdown of these results by city is shown below. Of the total major upgrades, 1,348 (80%) were insulation and air sealing jobs, while 342 (20%) were heating system (furnace and boiler) upgrades. These upgrades generated $4.8 million in work for insulation and heating contractors.[3]

Figure 2: Energy Efficient Cities Project Results

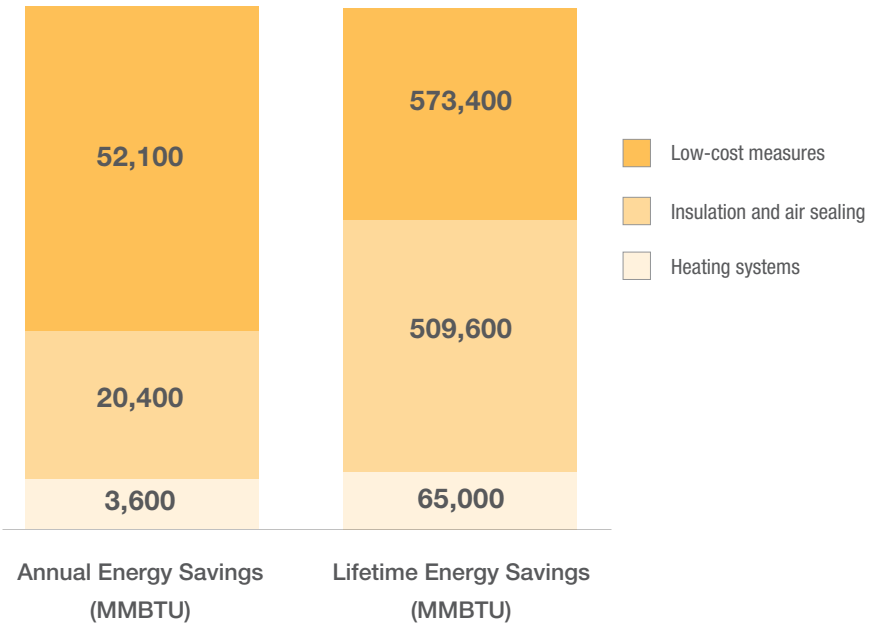
City	Workshop attendees	Home Visits Completed	Households Completing Upgrades	Number of Upgrades Completed
Apple Valley	796	780	147	151
Austin	224	184	64	83
Duluth	789	177	15	15
Minneapolis	4,139	3,886	948	1,063
Owatonna	204	180	43	47
Park Rapids	14	6	0	0
Rochester	302	216	78	110
St. Paul	1,775	1,493	179	221
TOTAL	**8,243**	**6,922**	**1,474**	**1,690**

A comprehensive assessment of energy savings from each program was not available at the time this report was written. Our estimates are based on savings claimed in calendar year 2010 by utilities from the three cities with the largest participation (Minneapolis, St. Paul and Apple Valley), and extrapolated to the remaining program participants.[4] This calculation resulted in the following estimates of energy savings[5] for the 6,922 households participating in the programs:

- 76,120 million BTUs of annual energy savings
- 1,148,000 million BTUs of total savings over the lifetime of the installed measures (35 million kWh of electric savings and 10.2 million therms of gas savings)
- $13.8 million in energy bill savings over the lifetime of the installed measures

The graph below provides a breakdown of energy savings for low-cost and major upgrades, and compares the immediate impact of annual energy savings compared to the long-term impact over the lifetime of the installed measures. As seen below, low-cost measures can provide large energy savings because they can be installed in every house. However, even though insulation and air sealing were installed in less than one-fifth of participating homes, these measures provide a much larger portion of total lifetime energy savings because insulation lasts longer than low-cost measures. And for the homes that installed insulation and air sealing, 80% of lifetime energy savings was attributable to insulation and air sealing. Heating system upgrades resulted in a smaller portion of energy savings, mainly because only 5% of participants installed heating systems. Thus the percentage of homes that actually follow through with insulation upgrades is critically important to the long-term energy savings the program will achieve.

Figure 3: Low-Cost and Major Upgrades: Annual vs. Lifetime Energy Savings



The above savings estimates do not include savings attributable to the program from behavioral changes that participants may make to decrease their energy usage. Although these savings were encouraged by the programs, they are hard to measure without large (more than 10,000 sample size) populations and utility bill information for each participant as well as a control group. Past studies have shown from zero to 12% savings per household from behavioral programs.[6] However, in order to sustain those savings year after year, research suggests that a continued effort (sending feedback reports for at least several years) is necessary.

Insights for Future Program Development

Overall, the Energy Efficient Cities project demonstrated that comprehensive energy-efficiency programs can achieve high participation and energy savings. The experience of many energy-efficiency program administrators is that it can take several years for a successful program design to mature and reach its full potential for cost-effective energy savings. Toward that end, the following reflections and insights are offered for the future development of current Energy Efficient Cities programs and those with similar aspirations.

Community-based marketing combined with traditional marketing can be an effective approach

Engaging local partners, such as cities and community groups, can be an effective method to market a residential energy-efficiency program. In order for it to be a fruitful partnership, the program must have something meaningful to offer all parties that will make it worth their time and effort. For the Energy Efficient Cities program, this was the case. In addition to being popular with participants (based on survey results), the programs helped to improve the local housing stock through home improvement investments and created local jobs for contractors. By being associated with an effective service to their residents, local partners could benefit from the goodwill created by the programs. All of these factors were effective motivators for city and community groups to become involved in the programs.

In addition, community members were willing to volunteer time for program recruitment. While this requires strong volunteer management to use their time effectively (which can be staff-intensive), having neighbors involved in the recruitment can reach people in ways that traditional marketing cannot. It can also increase the effectiveness of other more traditional marketing channels, such as direct mail.

Workshops were found to be a highly effective way to jumpstart participation in residential programs, as well as improve program results. However, it is recognized that those willing to take time away from evening and weekend activities to attend a workshop represent only a segment of the population. To reach deeper participation, future efforts will need to evolve to a program model that goes beyond workshops as a main recruitment method.

I was totally pleased with the whole experience from start to finish. It makes me want to do something with our older appliances in our house, or anything we can do to save energy which will save us money and the environment. It was a good starting point, and now we'll look for other ways to save energy.

-Energy Efficient Cities Program Participant

Combining low-cost measures with insulation measures can increase savings beyond that achieved by separate strategies

All of the programs involved the installation of some low-cost measures in the homes. While homeowners could in theory install some of these materials themselves more cost-effectively, the program significantly increased the penetration of efficient technologies beyond what homeowners would have done on their own. Time and again homeowners said they had done all they could, and yet additional opportunities to install low-cost measures were found. As shown by the savings numbers above, these direct install measures can result in high energy savings on their own. However, combining these direct install measures with an effective pathway for the homeowner to install major upgrades (in particular, insulation and air sealing) increases the overall cost-effectiveness of the program, eliminates the need for multiple visits to the home, and maximizes all opportunities for energy efficiency through a comprehensive approach.

Combining direct install measures with an effective pathway for the homeowner to install major upgrades increases the overall cost-effectiveness of the program.

Further cost reductions in program delivery are possible

While each of the Energy Efficient Cities programs was slightly different, it is estimated that the total cost of this pilot program was between $500 and $700 per participant that completed a home energy visit, including utility funding and rebates, other grant funding, and Environment and Natural Resources Trust Fund dollars. This results in a cost of energy saved of about 3.2 cents/kWh for electricity and 33 cents/therm for natural gas. This is money well spent, as it is less than the cost of procuring new sources of electricity and natural gas. However, a good portion of this cost was start-up costs to get the programs up and running, and the rebates offered were generous (sometimes paying for more than half the cost of the upgrades). These rebates were helpful in motivating people to complete the upgrades, but as the programs become more mature and recognized for the quality they can deliver, the same completion rate should be achievable with smaller rebates.

Quality control and contractor training is important to achieving savings and homeowner confidence

In initial quality-assurance visits, CEE found that even some experienced insulation contractors were not properly completing jobs, particularly air sealing. Insufficient air sealing, as discussed above, not only results in less energy savings, but can create other problems for the homeowner. Incorporating quality assurance into the program design not only forestalls these problems, but serves as a major selling point for the program.

Feedback reports can require significant resources when done on a small scale

Homeowners generally found it very useful to see their home's energy usage compared to some benchmark, as was presented in various forms by the feedback reports of individual city programs. However, producing reports on a relatively small scale (that is, less than 10,000 per year) can be very resource-intensive per participant. The most useful report was the feedback report with utility bill data used at the time of the home energy visit, as this provided a focus for the discussion of energy usage between homeowners and program staff. However, while it is useful to have follow-up reports after the home energy visit, it may not be cost-effective to do this on a small scale for future programs. A better possibility might be to integrate information and messaging from the home energy visit with a larger-scale feedback program if it is being run by a utility already (such as the programs being run by feedback report company O-POWER in more than half of the Energy Efficient Cities territories). For example, homeowners who had a home energy visit could get a special version of a feedback report that would emphasize recommendations made during the home energy visit.

Motivating homeowners to complete upgrades is critical

Because such a high portion of lifetime energy savings come from the major upgrades, it is critical for a program to achieve a high "conversion rate" of participants that complete the recommended upgrades. Energy Efficient Cities programs were generally very successful at this, convincing 21% of participating homeowners to complete upgrades. The most successful programs achieved conversion rates above or well above this average: 24% (Minneapolis and Owatonna), 35% (Austin) and 36% (Rochester). The program design of Energy Efficient Cities lends itself to maximizing the number of households that complete upgrades. This includes an orientation toward homeowner engagement and persuasion from the very beginning of the program, an easy pathway for homeowners to find reliable contractors, and a process for following up with homeowners after the home energy visit. This hand-holding approach is necessary to keep homeowners engaged in the process.

CEE also experimented with using an asset-based energy label to help further persuade homeowners to complete upgrades. This type of label objectively rates the energy performance of a home's building envelope and major energy-using systems independent of building occupant behavior. It is similar to the yellow "EnergyGuide" labels on appliances that tell you how much energy your new appliance will use compared to other appliances for a typical household. CEE was one of 10 participants in piloting the U.S. Department of Energy's "Home Energy Score" label in 154 Minneapolis and Apple Valley homes. An energy label can provide a clear visualization of a home's energy-efficiency deficiencies and a pathway to correcting those deficiencies, which can be useful in the effort to move the homeowner to action. CEE is currently developing a simplified energy asset label that may be useful for future programs.

NOTES

[1] Nationally, many of these "whole-house" programs have been marketed under the name "Home Performance with ENERGY STAR," which is a joint effort of the U.S. Department of Energy and Environmental Protection Agency. These agencies establish criteria for what constitutes Home Performance with ENERGY STAR (HPwES) and are thus allowed to use their brand; the Energy Efficient Cities program design could qualify under existing criteria to be a HPwES program. The HPwES program is currently under review for revisions by the U.S. Department of Energy. As each of the Energy Efficient Cities established a local "brand," the HPwES designation was not deemed necessary, but could be added in the future if it was deemed that it could add value to the individual programs.

[2] Sources for these barriers include CEE's own staff's experience with implementing residential programs, as well as the following sources, among others:

Darby, Sarah, 2006, *The Effectiveness of Feedback on Energy Consumption: A review of the literature on metering, billing and direct displays,* University of Oxford, Environmental Change Institute.

Dougherty, Anne, et al., "Ethnographic Inquiry in Energy: Exploring Meaning-Making and Sociality in Language Use, Program Participation, and Behavioral Choice," Proceedings, ACEEE 2010 Summer Study on Energy Efficiency in Buildings, American Council of an Energy-Efficient Economy (ACEEE), Pacific Grove, California, August 15-20, 2010.

E Source Letter, 2010, *MNCEE inquiry on effectiveness of residential audits regarding major upgrades.* Boulder, CO: E Source, March 25.

Karg, Richard, 1987, "The Soft Audit: A Human Approach to Energy Conservation," *Energy Auditor and Retrofitter,* July/August.

PA Consulting Group, 2010, *Cape Light Compact: Residential Smart Energy Monitoring Pilot Final Report,* Madison, WI: Cape Light Compact, March 31.

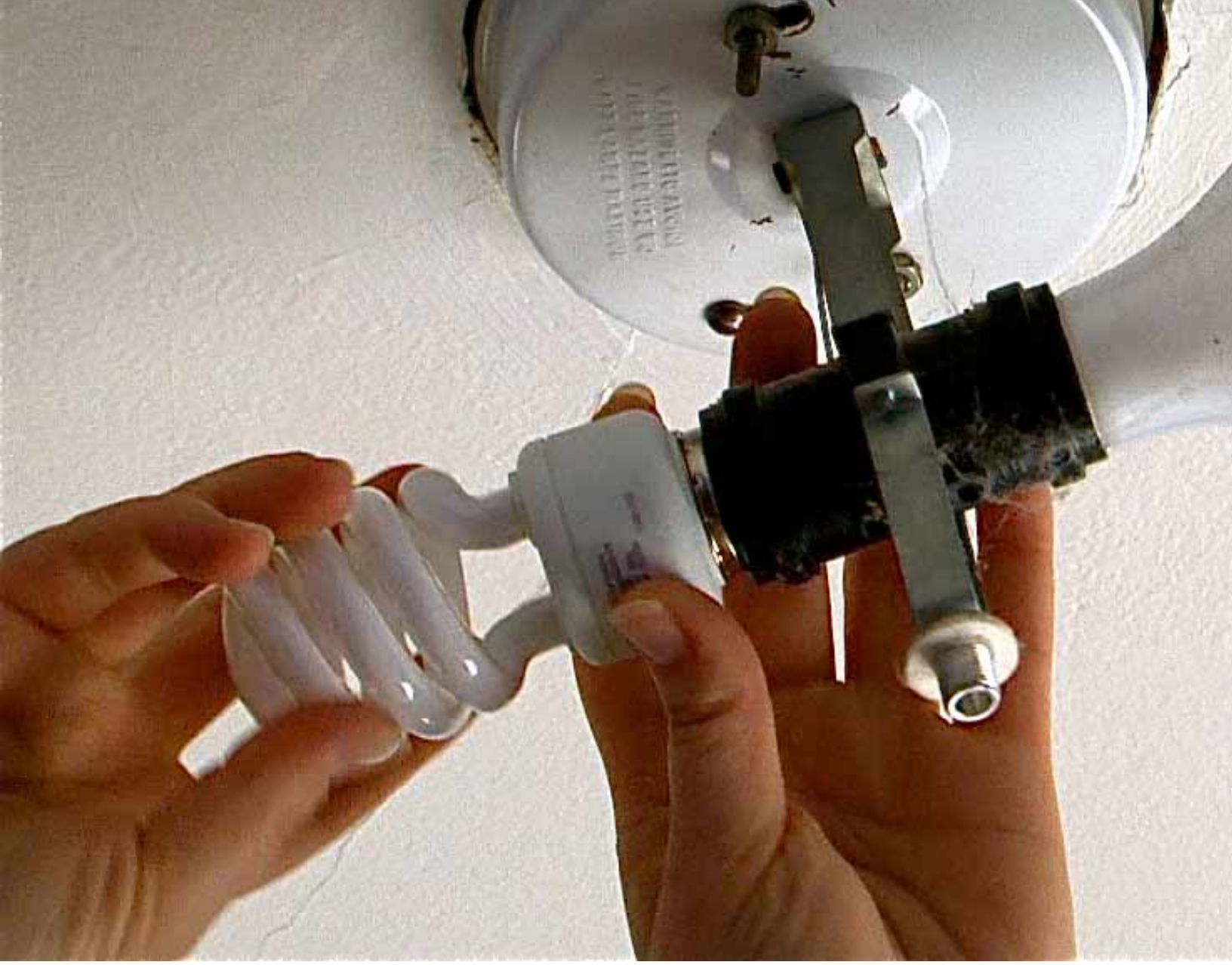
Schwartz, Barry, 2004, *The Paradox of Choice: Why More is Less,* New York: Harper Perennial.

[3] CEE tracked actual contractor costs where the data was available, which was for about 89% of the total reported upgrades (mostly from the paid invoices after the work was completed); the cost of the remainder of the upgrades was assumed to average the same amount as the known costs. About 1% of the upgrades were self-installed by homeowners; these do-it-yourself jobs were not included in the total contractor work estimate.

[4] It should be noted that the programs in these three cities had fairly aggressive installation of low-cost measures; for example, the average number of CFLs installed in Minneapolis was about 13 per household.

[5] Savings from low-cost measures were calculated for an average participant based on claimed savings as filed by CenterPoint Energy and Xcel Energy in their CIP Status Reports for 2010, and then extrapolated to all 6,922 participants. Savings from insulation and air sealing per participant were based on Xcel Energy's average claimed savings of 15.1 dekatherms per house as filed in their 2010 CIP Status Report (note: Xcel's value was used instead of CenterPoint Energy's deemed savings calculation, because Xcel's calculation is more representative of the actual existing R-values in homes in the programs, while CenterPoint Energy's calculations assume existing R-values of R-30, which was rarely the case in the homes treated in the programs). Furnace and boiler savings were calculated based on an average of Xcel Energy's and CenterPoint Energy's claimed savings in their 2010 Status Reports.

[6] See, for example: Ehrhardt-Martinez, Karen, et al., 2010, *Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities,* American Council for an Energy-Efficient Economy, Washington, D.C.



Overall I found the experience very educational, informative, and helpful. I'm very glad I did it. The home visit was great, even the advice was great! I really had a positive experience overall.

-Energy Efficient Cities Program Participant

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