U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BUILDING TECHNOLOGIES PROGRAM

Evaluation of Northern Illinois Residential Retrofit Delivery Practices

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Partnership for Advanced Residential Retrofit

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Evaluation of Northern Illinois Residential Retrofit Delivery Practices

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On behalf of the U.S. Department of Energy's Building America Program

Office of Energy Efficiency and Renewable Energy

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Definitions

AFUE	Annual fuel utilization efficiency, a thermal efficiency measure of combustion equipment like furnaces, boilers, and water heaters
BPI BA+E	BPI Building Analyst and Envelope, certification by the Building Performance Institute
BPI	Building Performance Institute
CNT	Center for Neighborhood Technology; CNT Energy is a subsidiary of CNT and a PARR research team member
CO	Carbon monoxide
EA-QUIP	Energy Audit using the Queens Information Package tool
EF	Energy factor, a measure of efficiency for residential water heaters when tested according to the U.S. Department of Energy standard
gpm	Gallons per minute
HPwES	Home Performance with ENERGY STAR
IHP	Illinois Home Performance, state program of the national HPwES program
kWh	Kilowatt-hour
MEEA	Midwest Energy Efficiency Alliance, a PARR research team member
MLS	multiple listing service
PARR	Partnership for Advanced Residential Retrofit
QA	Quality assurance
pCi/L	picocuries/liter
SEER	Seasonal energy efficiency ratio, measure of efficiency for air-conditioning systems
TREAT	Targeted Retrofit Energy Analysis Tool

Executive Summary

The Partnership for Advanced Residential Retrofit (PARR) team reviewed current northern Illinois energy efficiency retrofit programs. The review's goals were to identify practices, tools, and approaches that can be used to streamline and reduce costs of comprehensive retrofits, and to improve the consistency of audit and retrofit delivery practices across different programs. This task focused on four cold-climate comprehensive retrofit programs. Their audit and retrofit delivery processes are described in detail in this report. Best practices or lessons learned were determined based on feedback from program administrators, contractors, and customers. Key findings and recommendations follow:

- The application and prescreening process must be user-friendly and streamlined. Because this is the initial contact with the customer, it should focus on customer engagement and education, require minimal data input, and clearly identify eligible measures and rebate requirements to prevent delayed or denied applications. Information should be targeted to the average nontechnical individual. Online tools for energy efficiency programs have been developed to provide an easy-to-use interface for the customer and the contractor; to share information between the customer, contractors, and program administrators; and to reduce redundant and incomplete information.
- Auditors and contractors or individuals overseeing the delivery of the audit were required to be Building Performance Institute (BPI) Building Analyst and Envelope certified and use approved BPI Technical Standards[1] when performing diagnostic testing. Auditor and contractor companies should be approved by the program, which involves checking certifications, insurance information, and references. A strong, expert pool of contractors is crucial to ensuring long-term savings and reducing program operation costs.
- Northern Illinois retrofit program personnel should consider developing consistent site condition assessment protocols and mitigation strategies appropriate to conditions commonly found in Chicago housing stock (e.g., radon). Some diagnostic tests, such as pre- and post-retrofit blower door testing, are costly and have been found to be unreliable in some cases.
- Quality assurance is important to program success for maintaining a strong brand and gaining customer trust. It can even be used as a successful marketing tool for contractors. Programs use different quality assurance protocols, ranging from performing file reviews of documents, to conducting post-installation inspections, to repeating blower door tests to verify contractor results.
- Measures of success for comprehensive retrofit programs can vary depending on the program goal. Most programs track energy savings and completion rates, and evaluate customer satisfaction through surveys. Other measures of success are simply based on the number of retrofits completed using prescriptive measures or certificates granted.

By incorporating lessons learned from early programs along with common protocols, standard requirements for testing, and data collection, audit procedures can become more streamlined and consistent. Improving audit procedures and reducing program costs will allow comprehensive retrofit programs to reach more homes, increasing total energy savings.

[1] Building Performance Institute, Inc., Technical Standards, http://www.bpi.org/standards.aspx

1 Introduction

1.1 Background

The Building America Program is part of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program. Building America focuses on conducting the systems research required to improve the efficiency of new and existing homes. Building America research accelerates the development of reliable and effective whole-house efficiency measures to maximize energy savings. The program's overall goal is to develop integrated systems solutions that can take advantage of economies of scale. Residential efficiency solutions are tailored for each major U.S. climate region and can be widely implemented. At the same time, these solutions reduce risks, increase durability, and yield a reasonable return on investment. The Partnership for Advanced Residential Retrofit (PARR) is a Building America team based in Chicago with a focus on cold-climate retrofits in the Midwest.

Over the past 3 years, PARR's research team members and industry team partners have led large, comprehensive residential retrofit programs that serve as an excellent foundation for residential retrofit research in cold climates. Table 1 summarizes the northern Illinois retrofit programs and initiatives conducted over the past 3 years.

Table 1. Summary of Northern Illinois Retrofit Programs and Pilots From 2008 to 2011

Name	Retrofit Number	Savings
ComEd Showcase of Homes	12 homes	30%–59% electric savings 20%–38% gas savings
Center for Neighborhood Technology (CNT) Energy Savers Program	7,500 multifamily units	487,500 kWh electric savings 1,800,000 therms gas savings
Community and Economic Development Association of Cook County, Inc.	12,500 homes	12%–15%
Delta Institute Low and Moderate Income Weatherization Program	220 homes	10%–35% gas savings (depending on measure package)
Bungalow Energy Savers Program	135 homes	Billing analysis to be conducted
Chicagoland[a] Natural Gas Savings Program Comprehensive Residential Retrofit Pilot	81 homes	>30% gas savings (estimate); billing analysis to be conducted
Chicagoland Illinois Residential Retrofit Rebate Program	>10,000 measures	Varies by measure
Nicor Gas Rider 29 Residential High Efficiency Furnace Program	19,908 furnaces	Billing analysis to be conducted

[a] The metropolitan Chicago area is commonly called "Chicagoland" .

1.2 Research Needs

As Table 1 shows, northern Illinois has several residential retrofit pilots and programs and strong collaborative processes that provide a wealth of information, research opportunities, and coordinated, community-based scale-up opportunities. Current audit programs, though, have been inconsistent in their reporting, site assessments, diagnostics, and work orders. The PARR team reviewed the results of the current retrofit pilots and programs, as well as tools, practices, and approaches that can streamline and reduce costs of comprehensive retrofit programs for cold climates. This work, in part, was meant as an important foundational task to engage with existing stakeholders, understand existing programs, and develop research plans and results that most efficiently target the needs of the retrofit community in the Midwest. Based on an initial review of current retrofit efforts, the following research needs were identified by the PARR team:

- **Improved, standardized audit reports for homeowners and contractors.** Current audit reports contain detailed information on home condition and structure, plus energy efficiency measure recommendations. These reports, however, need to be transformed into consistent, streamlined, actionable audit reports that contain reliable cost and savings estimates and consistent measure pricing.
- **Consistent site assessment reports and recommendations.** Some homes have preexisting conditions that should be mitigated or preclude a home from a comprehensive retrofit. Current northern Illinois retrofit pilots and programs do not have consistent site condition assessment protocols and mitigation recommendations. PARR recognizes the need to develop common, agreed-on assessment protocols, along with mitigation strategies covering at least the conditions that are commonly found in Chicago housing stock: carbon monoxide (CO), radon, mold, water damage, knob and tub wiring/aluminum wiring, asbestos (particularly through vermiculite insulation), lead, and damaged/poor condition roofs and thermal envelopes (including windows/doors).
- **Standards for diagnostic testing (how, when, why).** Current residential retrofit pilots and programs have different requirements for diagnostic testing. PARR recognizes a need to develop common protocols for diagnostic testing. These protocols should state when to conduct various diagnostic tests, whether the tests should be conducted by independent auditors or could be done by the installation contractors, and how the tests should be conducted.
- **Common contractor work orders.** Contractors need consistent, clear guidance on measure installation requirements and standards.

2 Objectives and Approach

This task was designed to study whole-home retrofits in the Chicagoland area. The goal of this task was to evaluate audit and retrofit delivery practices including site assessments, in-home audits, contractor work orders, and quality assurance (QA) programs. The project identified local best practices and protocols that can be used to streamline and reduce costs associated with comprehensive retrofits. This report focuses on the following six components of a comprehensive retrofit program:

- **Prescreening/application process.** This process typically includes customer engagement and informal screening to target homes with high potential energy savings or exclude homes because of existing safety issues such as leaky roofs. Best practices identify the key aspects of the prescreening and application process based on feedback from customers and contractors. Online tools used by current programs are included.
- **Audit procedures.** The majority of comprehensive whole-home programs require, at minimum, an in-home energy audit before any energy efficiency measures are installed. This section reviews the different audit delivery models of current programs including whether the tests should be conducted by independent auditors or installation contractors. Assessment protocols and mitigation strategies are identified for conditions commonly found in Chicago housing stock. Methods and models used to determine potential energy savings are also included.
- **Standard audit report.** Audit reports need to be consistent, streamlined documents that include key information about the pre- and post-retrofit house condition and equipment. These data are required for accurate assessments of individual measures, packages of measures, and overall program achievements. Only necessary information should be required, however, to reduce the burden on auditors and contractors and improve compliance.
- **Contractor work scope.** Contractors need consistent, clear guidance on measure installation requirements and standards. Some programs have developed standard work orders for all jobs within a program; other programs rely on the auditor to develop the appropriate work order. A detailed work order example for a cold-climate air sealing program is presented.
- **Quality assurance.** All programs included some level of QA, ranging from conducting file reviews,[2] to performing post-installation home inspections to verify work completed, to repeating blower door tests to verify contractor results. Different QA methods are discussed.
- **Measures of success.** Depending on the program goal, measures of success can include deemed or actual energy savings, cost-to-benefit ratio, customer satisfaction, or number of retrofits completed.

[2] In a file review, participating contractors are required to submit a report detailing their improvement work for each house. The program then reviews each report.

This task examined retrofit programs in the Chicagoland area during the past 3 years and included feedback from program stakeholders to identify local best practices and protocols for the delivery of retrofit programs for northern Illinois. This approach consisted of three elements:

1. Describe audit and retrofit delivery processes used in local whole-house retrofit programs. Identify consistent protocols, processes, or tools developed for use in current retrofit programs.
2. Interview program administrators for input on protocols and processes that help foster comprehensive retrofits.
3. Use feedback from program administrators and other stakeholders to identify lessons learned and best practices in retrofit program delivery practices, focusing on audits, site assessment criteria, diagnostics testing, contractor work orders, QA, and measures of success.

3 Results

PARR reviewed whole-home retrofit delivery practices from the four northern Illinois programs in the list that follows. Some aspects of the audit and retrofit delivery practices could be applied to any retrofit program regardless of region or climate. Building type, construction, and equipment installation practices do vary from region to region, however. As a result, some practices, such as site assessment protocols, address safety issues or concerns specific to cold-climate buildings as compared to buildings in a hot, humid climate.

- Under the **Chicagoland Air Sealing Pilot Program,** the program objective was to develop and evaluate best practices for air sealing and attic insulation in single-family and two-unit residential homes. The Air Sealing Pilot Program included an initial energy assessment; optional installation of low-flow showerheads, faucet aerators, and energy efficient lightbulbs; a post-work energy assessment to ensure results; and radon testing before and after work was complete. Participants paid a $125 deposit to cover the energy audit and initial radon test. This deposit was refunded when the air sealing work and all follow-up assessments were complete. The rebate for air sealing work covered 85% of the cost up to $1,000 per unit. The rebate for insulation covered 75% of the cost up to $850 per unit.

  The administration of the Air Sealing Pilot Program involved a partnership between the Center for Neighborhood Technology (CNT Energy),[3] the Delta Institute, and Thermo-Scan Inspections. The program was open to all Chicago residents regardless of income and participants were selected on a first-come, first-served basis. CNT Energy sought to enroll participants broadly representative of Chicago housing styles. The information presented in this report represents processes and data collected by CNT Energy and is not representative of information collected by the Delta Institute or Thermo-Scan Inspections partners.

- The **Energy Savers Program** is a recognized and award-winning program offering a one-stop energy efficiency shop for multifamily building owners. The Energy Savers Program, which was launched in 2007 for owners of multifamily residential buildings, offers affordable rents in the seven-county Chicagoland region and in Rockford, Illinois. This program offers services including free energy audits, cost-effective energy saving recommendations, retrofit financing, construction oversight, and ongoing monitoring of building performance to ensure savings.

  This program is administered by CNT Energy. To date Energy Savers has retrofitted approximately 7,500 units, resulting in 1,800,000 therms and 487,500 kWh saved.

- **Illinois Home Performance** (IHP)[4] is Illinois' local program of the national Home Performance with ENERGY STAR (HPwES) Program.[5] HPwES programs are currently available in more than 25 states. HPwES incorporates a whole-house approach to improving the comfort and energy efficiency of existing homes. Qualified contractors

[3] CNT Energy is an independent nonprofit organization that solicits bids from expert qualified contractors to implement energy conservation measures. See http://www.cntenergy.org/buildings/energysavers/ for more information on CNT Energy and the Energy Savers Program.
[4] See http://www.illinoishomeperformance.org/welcome for more information.
[5] See http://www.energystar.gov/ for more information.

conduct a complete home assessment and recommend measures to improve energy efficiency. Contractor work scope includes insulation, air sealing, and diagnostic testing to verify that heating and cooling equipment is operating safely and efficiently. Contractors also replace heating and cooling equipment if necessary. HPwES uses a network of independent home improvement contractors accredited by BPI.

IHP provides participants with an Illinois HPwES Certificate of Completion, verified by a third party and detailing improvements and energy savings. This certificate is recognized on the Chicagoland multiple listing service (MLS) as a third-party green and sustainable home designation. Midwest Energy Efficiency Alliance (MEEA), the statewide coordinator of the program, manages program development, coordination, and support services including contractor training and homeowner education.

- The **Nicor Gas Rider 29 Residential Rebate Program for High-Efficiency Furnaces** offered education and cash incentives (rebates) to Nicor Gas residential customers to encourage customer purchases of high-efficiency space heating and water heating equipment for existing buildings. Both rental and owner-occupied dwellings were eligible. Rebates were offered for natural gas furnaces (annual fuel utilization efficiency [AFUE] 92, 95), boilers (AFUE 90, 95), and water heaters (energy factor [EF] 0.62, 0.67). The Nicor Gas Rider 29 Program was administered from 2010 to 2011. Participants received 19,908 gas furnace upgrades.

For this project, these four northern Illinois programs were reviewed in detail, and best practices and lessons learned were identified based on feedback from program administrators, contractors, and customers. This report addresses the following six components of a comprehensive retrofit program and describes the protocols and practices used in local cold-climate programs. At the end of each section that follows, best practices or lessons learned are summarized in a text box.

- Prescreening/application process
- Audit procedures
- Standard audit report
- Contractor work scope
- QA
- Measures of success.

3.1 Prescreening and Application Process

The initial application and prescreening process for a comprehensive whole-home retrofit program may have several goals. Most programs use the application process to engage customers as they learn about the current energy use of their homes and the potential for energy and cost savings. The application typically includes an informal screening to eliminate homes with existing or potential safety issues. Prescreening can also be used to target homes with the highest potential energy savings. Whole-house retrofit programs that require an audit have high fixed costs compared to traditional rebate programs. By targeting high energy users, programs can reduce the overall cost per unit energy saved. Some targeting strategies include identifying high energy use customers and older homes, excluding newer homes built after energy efficiency

codes were established (e.g., after 1978), or excluding homes that already have air sealing or attic insulation. Some programs target a limited geographic area to reduce travel time and to ensure that a pool of trained auditors and contractors is available to complete comprehensive retrofits. Whole-home programs require trained auditors and contractors who are able to work together and install multiple measures instead of the single measures on which most utility rebate programs have focused.

During the application process, initial data are collected such as electric and gas utility account numbers, building information, and heating type. After the information is submitted, the program notifies the customers by phone or email if they qualify for the program. Once customers are qualified, program representatives schedule an energy audit or supply contact information for participating contractors in their area, or both.

3.1.1 Customer Focus

The prescreening and application process, whether an online tool or a written application, is the initial contact the customer has with the program. Most programs consider completion rate and customer satisfaction to be key measures of a successful program. Completion rate is the percentage of enrolled participants that proceed with an energy audit and complete the installation of recommended energy efficiency measures. Programs with high customer satisfaction reported increased personal referrals over time. Personal referrals can contribute significantly to advertising and community outreach efforts, potentially reducing program marketing costs.

Surveys indicate that the initial customer contact is critical to customer satisfaction. Customer satisfaction with most programs was very high and most participants would recommend the program to others. Surveys did, however, identify several areas of improvement for the application and the whole-house retrofit process. Customers wanted marketing information and websites that were easier to understand, along with prompt responses to questions. Eligibility and rebate requirements must be clearly identified to prevent rebates from being delayed or denied because of returned applications.

Several program administrators also emphasized the importance of customer involvement and education. Although rebates provided a solid foundation for gaining interest in the program, there are many levels of customer involvement. Some homeowners were excited about the air leakage reduction, some wanted to take advantage of the rebates, and some saw the investment value of the energy efficiency measures. Although energy savings may be the goal of the program, customers receive other benefits in terms of working with qualified contractors and increasing the comfort of their homes. A program administrator needs to communicate all these advantages while responding to the customer's interests.

Homeowner education is vital to success. Program administrators and contractors need to work together to educate homeowners about home energy efficiency measures and how they can solve their homes' ailments, including drafts, improper heating or cooling, HVAC reliability, and moisture problems, among others. The need for education is so great that it could almost be described as consciousness-raising. The public is not only unaware that HPwES can offer solutions to their homes' problems; they do not even know that these types of problems can be fixed.

3.1.2 Contractors and Trade Allies

Equipment suppliers are an important source of program information because equipment failure is a significant driver for many participants to contact a contractor who introduces the homeowner to the program. In some cases, though, customers made trade allies aware of the program. One online application program (Energy Savvy) tracks whether a customer is referred to the prescreening and application website by a specific contractor. In this case, the customer will only be given information about that company, instead of several contractor referrals. This makes contractors willing to refer potential clients to the program because they will likely retain the lead.

Based on surveys of contractors and trade allies, the lowest rated aspect of the process was the application form. Some contractors find the application submission process to be too rigid. Several stated that many applications were returned for not following detailed directions they considered tedious and unnecessary. Trade allies also reported that rebate processing problems, including returned forms and refused eligibility, were a major source of customer complaints. Trade allies identified three areas for improvement: rebate application, contractor marketing and outreach, and website improvement (to make the website more user-friendly). Contractors found some applications to be tedious and time consuming with redundant data entry, such as requirements to reenter information that might be on the invoice.

3.1.3 Online Tools

Some programs use paper applications, but more and more programs are incorporating online tools to engage customers and collect and manage information. Online tools can simplify and streamline the application process by furnishing a central location where all program information resides, whether entered by the customer, the contractor, or the program administrator. This can reduce redundant and incomplete information and give customers up-to-date status information. Because some tools are being used in several energy efficiency programs, they allow for quick deployment and permit newer programs to use standard protocols developed by existing programs. Most software tools can be customized for specific program needs or to interface with existing websites or databases.

IHP selected Energy Savvy as the homeowner engagement tool on the IHP website.[6] Energy Savvy is also being used in several energy efficiency programs including Clean Energy Works Oregon, Utah HPwES, and the City of San Francisco. Energy Savvy offers two online products, Program Optix and Online Audit. Program Optix, which is designed for residential energy efficiency programs, tracks customer activity from initial engagement to project completion. It features a user-friendly interface for customer engagement and claims to improve completion rates for several programs. It also includes a portal for communication and coordination with auditors, contractors, and other partners while managing and optimizing all the activities of an energy efficiency program. Figure 1 shows an example of an action plan generated by Energy Savvy.

[6] See http://www.energysavvy.com for more information.

Figure 1. Energy Savvy online audit tool

Source: http://www.energysavvy.com. Accessed March 2012.

Online Audit is a companion product that allows users to determine energy and cost savings for different energy efficiency upgrades. The final step in the tool's process allows users to take action and submit their information to the program. The program administrator then follows up with these individuals, lets them know if IHP is active in their part of the state, and provides contact information for three IHP participating contractors that service their area. The Energy Savvy website reports that Online Audit has an 80% completion rate, although this is difficult to verify.

Other programs use proprietary or other software packages. CNT Energy utilized SalesForce, a web-based customer relationship management service, to support its program management tasks. This online tool helped manage intake, schedule appointments, track progress, and record data collected at site visits.

Lessons Learned/Best Practices

Improved communication and a streamlined application process were found to increase both customer and contractor satisfaction. High customer satisfaction leads to higher completion rates and increased overall energy savings, reducing program costs per amount of energy saved. Programs with high customer satisfaction also reported increased personal referrals over time, potentially reducing program marketing costs. Contractors and trade allies are an important source of program marketing because equipment failure is a significant driver for many participants. Streamlining data input can also minimize errors that might cause rebates to be denied.

- The application process must be simple and streamlined for both customers and trade allies, requiring minimal data input. Marketing and informational material should be targeted to the average nontechnical individual. Eligible measures and rebate requirements should be clearly identified for the customer to prevent delay or denial of rebates because of returned applications. Phone-in applications should be available for those uncomfortable with or without computer access, such as elderly homeowners.
- A user-friendly website is important to both homeowners and contractors. Online tools can also simplify and streamline the application process by providing a central location for all program information, reducing redundant and incomplete information, and giving customers up-to-date status.
- A one-stop shop that targets practical energy savings and supplies both technical services and low-interest financing is a key to removing barriers that result from lack of information, services, and financing.
- It takes numerous conversations and consistent communications to demystify energy efficiency work and to overcome the barrier of perceived risk.
- Equipment suppliers are influential in introducing a customer or contractors to a program, providing equipment suppliers and contractors with program information and brochures to give to customers. Also, program referrals by contractors should be tracked to protect their relationship with their customers.
- The importance of data collection for evaluation, measurement, and verification programs (e.g., the existing furnace model or capacity) should be explained clearly to contractors to improve compliance.
- Systematic surveys of customers and contractors should be conducted and analyzed to improve program design.

3.2 Energy Audit Procedures

The majority of comprehensive whole-home energy efficiency programs require completing an in-home energy audit before any measures are installed. The audit can be split into two segments or completed by a single company all at once. The purpose of the audit is four-fold: (1) to engage homeowners and educate them about the need and the protocol for the upgrade; (2) to identify any immediate safety concerns that would affect the upgrade; (3) to develop a scope of work for the upgrade based on a documented baseline specific to the house; and (4) to establish a baseline against which the program can measure improvements.

3.2.1 Site Assessment and Diagnostic Tests

The purpose of the energy audit is to identify any safety issues in the home that might be affected by installing any energy efficiency measures and to identify the most effective energy efficiency measure(s) for a given home. Energy audits typically include discussions with homeowners about their issues and needs. Auditors conduct a comprehensive visual site assessment of major home attributes and deficiencies (e.g., HVAC, distribution systems, insulation type and condition, moisture issues, and lighting, among others). Digital and infrared photography is used to document building conditions. Comprehensive combustion safety testing following BPI Building Analyst standards must be conducted pre- and post-installation. Blower door testing is performed if envelope improvements are recommended. When the energy audit is complete, a prioritized list of improvements is developed (based on need and estimated cost effectiveness) following BPI Envelope standards. This list includes an energy savings estimate.

3.2.1.1 Safety Issues

Because air sealing can alter the air pressure in a home, diagnostic tests are performed as part of energy audits to ensure that the building is eligible for air sealing. Several safety and indoor air quality issues are addressed including combustion safety, moisture, or asbestos. Testing is performed to identify any existing issues that may be amplified within a tighter building. If mold or high levels of CO are present, reducing air infiltration will increase these concentrations, potentially endangering the occupants. The homeowner is usually asked to fix the problems identified before reapplying to the program. Diagnostic testing is typically performed before and after air sealing work to verify that no safety issues were created by the installation of energy efficiency measures.

Some criteria that can result in disqualification for home retrofit programs follow:

- Building in poor condition
- Structural issues
- Missing or nonoperational smoke or CO detectors
- Elevated levels of radon
- Active knob and tube wiring in areas to be air sealed
- Water damage or leaks
- Mold covering 5 ft^2 or more in the home
- Vermiculite present in the attic

3.2.1.2 Safety Diagnostic Testing, Assessment Protocols, and Mitigation

All local programs conduct combustion appliance safety testing. Some programs also perform additional diagnostics such as radon testing. PARR recognizes that radon is an issue of concern in many northern Illinois counties and must be appropriately addressed. The best way to do so, however, needs further research, as the simple testing approach is not universally endorsed. Other safety protocols include inspection for mold, moisture problems, lead, or asbestos (normally found with vermiculite insulation). Audit programs that do not perform these tests do give the homeowner information about these safety issues and recommend that testing be conducted as part of a home inspection according to American Society of Home Inspectors Standards of Practice.[7]

3.2.1.2.1 Carbon Monoxide Diagnostic Testing and Mitigation

Before the retrofit, combustion appliance safety testing is conducted to ensure that the home does not have a preexisting CO issue. Gas leak testing is performed if the auditor or the customer has noticed natural gas odors.

- Diagnostic Test Procedures: Combustion appliance zone(s) are inspected and tested per BPI standards (including combustion safety testing, gas leak detection, and ambient CO level monitoring). If CO detectors are missing, it is recommended that they be installed before air sealing work is performed.
- Mitigation Recommendations: If the results of combustion safety testing do not meet BPI standards, recommendations are made stating that combustion appliances (or the CO safety hazard) must be fixed before moving forward with the air sealing project.

3.2.1.2.2 Radon Diagnostic Testing and Mitigation

Radon is a radioactive gas that can cause lung cancer. Radon, which comes from the natural breakdown of uranium in soil, rock, and water, gets into the air we breathe. Although any home can have a radon problem, the U.S. Environmental Protection Agency (2009) has identified several counties in Illinois with high or moderate potential for elevated indoor radon levels. Radon testing is conducted before air sealing to ensure that levels do not exceed 2.5 picocuries/liter (pCi/L).

- Diagnostic Test Procedures: Some local programs include short-term radon tests as part of their audit. Testing is conducted by certified radon measurement professionals in accordance with Illinois Emergency Management Agency guidelines. Tests are set with tamper tape and inspectors collect results after 48 h. If radon levels are higher than 2.5 pCi/L, a second test is recommended.
- Mitigation Recommendations: If both tests confirm that radon levels are higher than 2.5 pCi/L, radon mitigation equipment is recommended for installation before moving forward with the air sealing project. The homeowner is given a list of Illinois licensed mitigation professionals. Homeowners are required to pay for the remediation before moving ahead with the installation of air sealing and insulation.

[7] See http://www.ashi.org/inspectors/standards/standards.asp for more information.

3.2.1.2.3 HVAC and Water Heaters Site Assessment Protocols

Data are collected on the overall condition, age, and efficiency of the equipment, controls, and distribution systems.

3.2.1.2.4 Damaged or Poor Condition Roof Site Assessment Protocols

If the roof is found to be damaged or in poor condition during the site assessment, the home will be disqualified from participating in the air sealing program (the homeowner can reapply once the issue has been addressed).

3.2.1.2.5 Damaged Thermal Envelope Site Assessment Protocols

If the building envelope—including windows and doors—is found to be damaged or in poor condition during the site assessment, the home will be disqualified from participating in the air sealing program (the homeowner can reapply once the issue has been addressed).

3.2.1.2.6 Asbestos Site Assessment Protocols

During preparation for diagnostic testing, the attic is checked for vermiculite (see Figure 2). If vermiculite is found, the building cannot be depressurized with a blower door. Pressurization can only be performed if there is no danger of asbestos becoming airborne within the dwelling. The contractor must also be informed if vermiculite was found.

Figure 2. Vermiculite insulation between joists

Source: http://www.epa.gov/asbestos/pubs/verm.html. Accessed March 2012.

3.2.1.2.7 Lighting and Appliance Site Assessment Protocols

Fixture and lamp types, controls, and other information on existing lighting systems are assessed. Information on typical age and condition of typical appliances is collected including window air conditioners, refrigerators, and washers and dryers.

3.2.1.2.8 Knob or Aluminum Wiring Site Assessment Protocols

If active knob and tube wiring is present in areas to be air sealed, the home will be disqualified from participating in the air sealing program (the homeowner can reapply once the issue has been addressed).

3.2.1.2.9 Water Damage Site Assessment Protocols

If water or roof leaks are found in the home during the site assessment, the home will be disqualified from participating in the air sealing program (the homeowner can reapply once the issue has been addressed).

3.2.1.2.10 Mold Site Assessment Protocols

Mold testing is typically not performed, but if mold is found to be covering 5 ft^2 or more during the site assessment, the home is disqualified from participating in the air sealing program (the homeowner can reapply once issue has been addressed).

3.2.1.2.11 Lead Site Assessment Protocols

Lead testing is not typically included in the audit.

3.2.1.3 Performance Diagnostic Testing

Diagnostic testing is used to identify energy savings opportunities as well as safety issues. Blower door tests and infrared camera imaging are common whole-home program features that quantify or locate air infiltration (i.e., the "leakiness" of a house). Some programs conduct one or more of these tests as part of the audit process, as well as following up with another test after weatherization measures are installed. Some programs require blower door tests and/or infrared imaging for every house; others do it less frequently. The diagnostic tests are used to visually demonstrate leakiness and educate customers. They are also used to evaluate whether contractors effectively reduced air infiltration through air sealing. Some programs require a predetermined reduction (e.g., 30%) in air infiltration as part of the measure installation.

Data from one program, however, questioned the validity of contractor-performed blower door tests to assess contractor performance. In this program, independent blower door tests were performed on all homes, before and after measure installation. In addition, contractors also performed before and after blower door tests. In all cases, the contractor blower door test results (reduction in home leakiness before and after air sealing) showed a greater reduction in leakiness compared to the independent blower door tests.

For the Energy Savers program, blower door tests are used for qualitative purposes and for educational purposes. In an effort to make the program cost effective, blower door tests are not often used to provide quantitative building analysis.

3.2.1.4 Energy Savings Estimates

Estimates of energy savings for a given house following an audit are determined by several different methods. Many audit tools use a software package or built-in algorithm to calculate

deemed energy savings based on input from a specific house. Other programs use prescriptive deemed savings based on modeling conducted before any changes are made under the program.

Most audit tools that estimate energy savings have been found to overpredict savings (Polly et al. 2011). As a result, programs must validate deemed savings through end-use billing analysis, and adjust savings estimates and program goal claims that are presented to customers as necessary. To date, very few programs have used billing data as a means to compare actual energy savings to deemed savings. Several programs in the northern Illinois area have expressed interest in analyzing billing data or are in the process of doing so. Some programs are considering the use of a prescriptive track of measures that will lead to different levels of savings so that customers can select measure packages without time-consuming, expensive audits.

3.2.1.4.1 Energy Modeling Tools

Online audit tools such as Energy Savvy often have their own algorithm for estimating energy savings. Energy Savvy uses the SIMPLE algorithm, which requires minimal screening criteria (e.g., year built, drafty or tight, insulation levels, HVAC, appliances, and lights, among others) to assess the house's energy efficiency (or lack thereof) and produce an estimate of potential energy savings. The Energy Savers Program has employed other modeling tools including the Targeted Retrofit Energy Analysis Tool (TREAT) and the Energy Audit using the Queens Information Package tool (EA-QUIP). In addition, Energy Savers has developed a proprietary spreadsheet tool.

Initially, IHP required energy savings predictions to be modeled. Recently, however, program administrators have found that this hinders contractor participation. Energy modeling software often has a steep learning curve and can be time intensive to use properly. Furthermore, a growing body of research suggests that the accuracy is lower than desired. The national HPwES program is considering moving away from a percentage energy savings requirement and requiring base-measure installations instead. In light of these changes, MEEA has begun a discussion with IHP current and future program providers to collectively determine a series of retrofit packages that would qualify for a deemed 15% or more savings value. Essentially, this would be a prescriptive path to achieving the Silver Certificate (see Section 4.5.5). If this path is agreed on, IHP would still require the audit to include a prioritized list of recommended measures with predicted energy savings, but the energy savings could be determined using either energy modeling software or the deemed list.

3.2.1.4.2 Prescriptive Deemed Savings

Prescriptive deemed savings were used in the Chicagoland Air Sealing Pilot Program. Estimated energy savings were based on a work order with a contractor goal of a 30% air leakage reduction based on pre- and post-blower door test readings. Prescriptive deemed savings were calculated by data modeled in the TREAT software program using data collected from homes retrofitted before the air sealing program started. The program administrator established prescriptive deemed savings, which were included in the final report to the customer. Gas and electric utility billing data are currently being analyzed to determine actual savings for this program and to validate deemed savings.

Table 2. Prescriptive Deemed Savings for Northern Illinois Air Sealing Program
Based on 30% Air Leakage Reduction

Measure	Prescriptive Deemed Savings
Direct-Install Measures	50 therms
Air Sealing	243 therms
Attic Insulation	367 therms

Lessons Learned/Best Practices

Using diagnostic tests only when needed can reduce costs. Prescriptive measures with deemed savings are being implemented to streamline the audit process, improve consistency, and reduce audit costs.

- Pre- and post-blower door testing should be evaluated to determine whether it is essential to achieve effective air sealing. These tests are costly, and in some cases, contractor-performed blower door test results have been shown to be unreliable. Programs should consider spot checking contractor results.
- Infrared camera imaging is increasing, and is likely to be an effective tool in educating customers simply and graphically about the leakiness of their homes.
- Radon testing adds another level of work including auditor and homeowner education, equipment costs, and reporting. To avoid potentially exposing residents to unsafe levels of radon, program managers should carefully consider whether to require or at least inform residents about radon testing before building envelope measures that reduce air infiltration are installed.
- Better validation of audit tools using utility billing data is essential, so that predicted savings can be correlated to real savings.
- Programs are moving toward prescriptive measures with deemed savings to streamline the audit process and reduce costs.

3.2.2 Standard Audit Report

Audit reports and audit tools are used to collect all relevant data from homeowners, auditors, program administrators, and contractors. These data are important not only for program administration, but also for evaluating the energy savings and cost effectiveness of each measure and each package of measures, as well as the overall program, through actual cost and utility billing data. These data are critical for improving energy savings, reducing the costs of future programs, and identifying best practices. Although auditors and contractors may find data entry to be time consuming and tedious, it is imperative for program administrators to educate all trade allies about the purpose and importance of complete and accurate data collection. At the same

time, online tools must be clear, easy to use, and streamlined to collect only necessary information. This will reduce redundancy and support accurate data input.

Table 3. Key Data Collection for Comprehensive Retrofit Programs

Customer/Auditor	Contractor
Address	Contractor name
Age of Home	Install date
Construction (Brick, Frame, Stucco, Brick and Frame)	Insulation installed attic/walls/basement
Number of Stories	Added ventilation?
Number of Occupants	Gas and electric utility account numbers
Square Footage	Replacement furnace or boiler make/model no./capacity/AFUE/cost
Existing Furnace Or Boiler Make/Model No./Capacity/AFUE/Functional?	Replacement water heater make/model no./capacity/EF/cost
Existing Water Heater Make/Model No./Capacity/EF/Functional?	Replacement air conditioner make/model no./capacity/SEER/cost
Existing Air Conditioner Make/Model No./Capacity/SEER/Functional?	
Existing Insulation Attic/Walls/Basement	
Gas And Electric Utility Account Numbers	

3.2.3 Audit Delivery Models

Energy audits can be completed in one or two parts. For the Chicagoland Air Sealing Pilot Program, the energy audit was split between two visits. The goal of the first visit was to engage the customer, install direct-install energy conservation measures, and begin a radon test. Direct-install measures typically include small energy saving devices such as compact fluorescent lights and high-efficiency showerheads, which result in some energy savings to offset the audit costs. In the second visit, the radon tests were retrieved and evaluated. Diagnostic tests were also conducted, including combustion safety and blower door testing. If radon levels were found to be higher than 2.5 pCi/L, the customer was referred to remediation and determined ineligible until this issue was corrected.

For most programs, each individual responsible for delivering or overseeing the delivery of an audit component must be BPI Building Analyst and Envelope (BPI BA+E) certified. Auditor and contractor companies must be approved, which involves checking certifications, insurance information, and references. Current programs in the Midwest recognize the importance of BPI certification and the Technical Standards to ensure that whole-home retrofits are not performed if

there are preexisting unsafe conditions, such as gas leaks or elevated CO. Requiring BPI certification and diagnostic testing is sound and safe practice.

In the Chicagoland Air Sealing Pilot Program, CNT Energy auditors verified 100% of jobs. CNT Energy auditors performed both pre-air sealing audits with blower doors and combustion safety testing. Post-air sealing was done in two ways: (1) CNT Energy auditors were on site with an air sealing contractor to confirm blower door numbers at test-out and perform combustion safety testing, or (2) CNT Energy auditors performed a final post-air sealing audit with blower doors and combustion safety testing.

For the Energy Savers Program, all auditors work directly for CNT Energy and are BPI-certified Building Analysts or certified Home Energy Rating System Raters. The auditor acts as the point of contact for the building owners throughout the retrofit process, from audit to construction to project closeout and verification.

The IHP program allows for several different models of audit delivery, involving one to two of the following parties: a qualified representative from the local program provider (the local utility or its implementation contractor), an independent auditor company, and a single-source/integrated home performance company (qualified to do audits and improvement work). Each individual responsible for delivering or overseeing delivery of a component of the audit must be BPI BA+E certified. Auditor and contractor companies must be approved by IHP, which involves checking certifications, insurance information, and references.

In some instances, the local IHP program provider completes the visual assessment and develops a work scope. In these cases, the provider representative includes the remaining audit segments (specifically blower door and combustion air zone testing) in the work scope. These tasks are completed by an approved contractor of the homeowner's choosing. This approach allows the utility to install direct-install measures and also to ensure that its relevant rebate offerings are presented to the homeowner.

In other cases, the program provider does not play such a direct role. In these cases, independent auditors and integrated home performance companies sell the audit to the homeowner and perform 100% of the audit components. IHP allows either company to do the audit, as long as the individual performing the audit is BPI BA+E certified and the company has been vetted and approved through IHP.

In a third delivery model, other program providers, most likely those not required by Illinois law to meet rigid cost-benefit tests, may be directly involved in delivering the entire audit. This is the approach favored by membership-based cooperative utilities who highly value the audit as an important opportunity to make contact with customers.

This flexible program design has been valuable in enabling IHP to secure support from a range of program partners, each with unique requirements and goals. IHP has focused on keeping a limited number of items that MEEA expects to have the greatest impact on market acceptance and understanding of home performance consistent across the state. Specifically, these items are base auditor and contractor participation requirements, specific BPI standards to be followed,

linkages with the national HPwES program, homeowner messaging, and requirements to earn the IHP Silver and Gold certificates of completion.

Lessons Learned/Best Practices

Contractor communication and management can be challenging but building these relationships is valuable to the program. Minimizing site visits can reduce costs.

- Auditors and contractors or individuals who oversee the audit should be required to be BPI BA+E certified and to use approved BPI Technical Standards when performing diagnostic testing. BPI Technical Standards help set expectations that facilitate oversight and quality control.
- Auditor and contractor companies must be approved, which involves checking certifications, insurance information, and references.
- Splitting site assessments in separate visits allowed for better prescreening, organized data collection, and a robust set of data around blower door test numbers, health and safety issues, and other parameters. Multiple site visits, however, are time consuming and costly. To control costs, the audit-to-retrofit process needs to be a low-touch customer model with a minimal number of visits to the job site by auditors and contractors.
- A strong, expert pool of contractors is crucial to ensuring long-term savings and reducing program operation costs.
- Working with fewer contractors per site (i.e., one or two) reduces communication efforts and oversight costs for the program administrators.

3.3 Contractor Work Orders

Contractors need consistent, clear guidance on measure installation requirements and standards. One of the local programs issued a standard work order for all jobs following a successful energy audit. An email was sent to the contractor (and homeowner) with blower door test results and a target 30% air leakage reduction number (in cubic feet per minute). Contractors were also given photos, a building type description, and a work order with recommended installation of the air sealing and insulation measures listed in Table 4. Fixed pricing was agreed on with contractors before the program was launched.

Energy Savers solicits bids on behalf of owners for measures requiring contractor installation. All contractors working with the program undergo an approval process before entering the bid pool, although owners do solicit bids on their own as well. Energy Savers construction management staff assists the customer in soliciting competitive proposals, which are reviewed with the owner for price, thoroughness and accuracy of approach, and projected cost effectiveness. CNT Energy works with the owner to select the contractor team that is right for the specific project. In addition, CNT Energy aligns available utility rebates with the recommended energy conservation measures, and applies for the rebate or assists the contractor in applying. As part of the one-stop shop, CNT Energy partners with the Community Investment Corporation, a lender that specializes in multifamily buildings, to offer a low-interest loan, currently 3%, for approved energy conservation measures.

Table 4. Air Sealing Program Standard Work Order

Measure	Detail
Air Seal Attic (Required)	• Seal with two-part foam • Box out recessed lights • Seal and weather-strip attic access hatch
Air Seal Rim/Band Joist	• Seal with two-part foam
Air Seal Basement or Crawl Space	• Vapor barrier • Rigid foam board
Guided Air Sealing	• Baseboards • Seal around windows and doors • Weather-stripping, caulking • Door sweeps • Seal penetrations
Insulate to R-38 Continuous, Blown Cellulose (Optional)	

3.4 Quality Assurance

All programs included QA such as conducting a file review of all documents, performing an in-home inspection for all or a portion of homes after measures were installed, or repeating blower door tests to verify contractor results.

In the Chicagoland Air Sealing Pilot Program, CNT Energy auditors verified 100% of jobs following completion of air sealing work. CNT Energy's construction manager was present to verify the quality of work for each contractor's first job (or jobs, as warranted by contractor performance). Contractors performed post-work blower door tests with auditors looking on to ensure that procedures are consistent with those used for the pre-work audit. Contractors were expected to comply with BPI standards. In addition, auditors performed a follow-up radon test and post-combustion safety testing. During the post-work audit, auditors also completed a QA/quality control final inspection checklist verifying direct-install, air sealing, and insulation measures that were completed.

QA is an important part of IHP and the national HPwES program. It allows a program to use private-home performance auditors and contractors and stand by their work. QA is also important for maintaining a strong brand and has been successfully used as a sales tool by participating contractors. The program's QA activities help make homeowners more comfortable with purchasing a home energy upgrade, which is often a new concept for them. IHP has adopted the national HPwES QA requirements[8], which include a 100% file review, followed by an in-home inspection of a specific percentage of jobs, tracked per contractor company. The minimum in-home inspection percentages are 100% of a contractor's first 3 to 5 jobs, 20% of the next 20, and 5% of all subsequent jobs. If issues are uncovered, the QA inspection sampling rate is increased until the contractor shows marked improvement on a consistent basis. Participating contractors sign an agreement before entering the program that explains the QA process and

[8] Home Performance with ENERGY STAR® Sponsor Guide, Section 5. http://www.energystar.gov/ia/home_improvement/HPwES_Sponsor_Guide.pdf,

states that the contractor is financially responsible for any repairs or further improvements that may be identified through QA. IHP program providers are responsible for the QA, with MEEA overseeing all providers.

As part of the Energy Savers Program, all deliverables and calculations are reviewed by senior analysts before they are sent to customers. The engineering department accompanies the staff and reviews the field data and reports for a subset of all projects. CNT Energy conducts field visits to provide oversight and verify the quality of the work during and after retrofit activities. The QA measures include verifications that contracted work was performed to specifications, along with best work practices. CNT Energy monitors and reports on fuel and electrical savings data for each property to ensure that savings targets are met. If the building does not perform as well as expected, CNT Energy intervenes to resolve whatever issues exist.

Lessons Learned/Best Practices

Quality assurance is a key strategy to ensure customer satisfaction and identify areas to reduce costs.

- Quality assurance is important for maintaining a strong brand and has been successfully used as a sales tool by participating contractors.
- Oversight (retesting and/or inspection) of air sealing and insulation work gained customer trust during the program.
- Contractor-performed blower door test results have been shown to be unreliable, so programs should consider spot checking contractor results.

3.5 Measures of Success

Although each program defines its own goals, some common measures of success for a comprehensive energy efficiency program include the following:

- Energy savings
- Completion rate
- Customer satisfaction
- Costs and benefits
- Number of retrofits or certificates
- Job creation.

3.5.1 Energy Savings

Most programs report energy savings based on deemed savings, engineering estimates, or estimates from on-site audit tools that can significantly over-report savings. Post-retrofit end-use billing analysis must be performed to determine actual savings from whole-home retrofits. To date, very few programs have used billing data as a means for comparing actual energy savings to deemed savings. Several whole-home retrofit administrators, however, have expressed interest

in performing end-use billing analysis on completed retrofits. Other programs are planning to incorporate end-use billing analysis in the future.

Energy Savers has retrofitted approximately 7,500 units, resulting in 1,800,000 therms and 487,500 kWh in deemed savings. A typical project results in 240 therms and 650 kWh saved per unit. Program staff members choose the appropriate modeling tool depending on the scope and type of building. Analysts can also refer to completed retrofits and proposals from similar Energy Savers buildings to fine-tune savings and pricing estimates.

Energy Savers will begin monitoring fuel and electrical usage data for a property 6 months after the work is substantially complete. Energy Savers applications require the customer to submit utility account numbers and permission to access data. The local gas utility, Peoples Gas, will supply 3 years of billing data on request. The electric utility (ComEd) makes electricity billing data available online. Energy Savers will do comparative analyses of billing data 1 year after retrofit measures are complete and issue savings statements to owners at that time.

For the Chicagoland Air Sealing Pilot Program, initial energy savings were based on prescriptive deemed savings for each measure as calculated by data modeled in the TREAT software program. TREAT used data collected from homes that had been retrofitted before the air sealing program began. Deemed savings will be compared to actual savings based on gas and electric utility billing data. Energy savings reported at the end of the pilot program in prescriptive deemed savings was 12,636 therms from air sealing and 11,744 therms from attic insulation.

3.5.2 Completion Rate

Completion rates can be used as a measure of success for the complete audit process or as a means to evaluate customer engagement during individual steps in the process, such as prescreening or application. Completion rates can help identify steps in the audit/retrofit process where customers are successfully engaged or identify barriers in the process.

For the Chicagoland Air Sealing Pilot Program, CNT Energy received 304 applications. Of these, 143 participants completed the first site assessment (including radon testing and direct-install measures); 116 of those homes completed the second site assessment (including diagnostic testing and direct-install measures). This represents a full completion rate of 38% (116 of 304 applicants) for the audit process. The overall completion rate for the program was approximately 20% because 60 homes of the original 304 applicants received air sealing or insulation, or both. The Energy Savers Program is able to convert one of every three units audited into the retrofit phase.

3.5.3 Customer Satisfaction

Most program representatives consider customer satisfaction a key measure of a successful program. Programs with high customer satisfaction reported increased personal referrals over time. Referrals contribute to community outreach efforts and potentially reduce program costs required for advertising and marketing. Most programs use surveys to obtain feedback from both customers and contractors to continuously improve the program process.

Customer satisfaction with the Chicagoland Air Sealing Pilot Program was evaluated using two surveys: one focused on the audit and direct-install measures, and the other focused on the work

performed by the contractor. Customer satisfaction was high for those participants who completed all of the program steps. An overwhelming majority of the respondents reported that both the auditor and the contractor were "timely, flexible, helpful, and responsive" to their needs. Homeowners successfully submitted 40 surveys. Any complaints or issues between homeowner and contractor were documented using SalesForce software and have been resolved since the pilot program ended. The Energy Savers Program also measures customer satisfaction and consistently rates in the top 10 percentile with respect to customer satisfaction.

3.5.4 Costs and Benefits

For the Chicagoland Air Sealing Pilot Program, the costs and benefits varied by home depending on the amount of service received, how much the installed work cost, and whether it was a single-family or two-unit home. Program costs for a typical home that received all program services was $743.60, excluding marketing and outreach. Program services included: an initial energy assessment; optional installation of low-flow showerheads, faucet aerators, and energy efficient light bulbs; a post-work energy assessment; results and radon testing before and after measures were installed**.** Contractor costs were paid by the homeowner. Deemed savings per unit (deemed) were 50 therms for low-cost direct-install measures per dwelling, 243 therms for air sealing, and 367 therms for attic insulation.

The Energy Savers Program creates packages of measures based on savings to investment ratio to assist owners in prioritizing savings by payback over the lifetime of the retrofit. Table 5 gives typical measures that may be included in a package.

Table 5. Example of an Energy Savers Package of Measures

Recommendation	Cost ($)	Savings (therms/ year)	Savings ($/year)	Simple Payback (years)	Retrofit Lifetime (years)	Savings to Investment Ratio
Air seal and insulate roof cavity to R-49 using spray foam and blown-in cellulose	6,000	1,178	1,178	5.1	25	4.9
Install weather-stripping and door sweeps on all exterior doors	525	210	210	2.5	10	4.0
Insulate domestic hot water piping to R-4.5	1,200	150	150	8.0	25	3.1
Install new boiler controls with indoor and outdoor sensors and replace radiator vents	10,000	1,550	1,550	6.5	10	1.6
Install low-flow showerhead (1.5 gpm) and faucet aerators (1.0 gpm)	500	80	80	6.3	10	1.6
Total	18,225	3,168	3,168	5.8	–	–

3.5.5 Number of Retrofits or Certificates

IHP's metric of success is simply the number of homes that achieve the Silver or Gold certificates. Investor-owned utilities that act as IHP program providers will also need to demonstrate measureable kilowatt-hour or therm savings, or both. These demonstrated savings must balance the cost of their involvement per the Illinois Energy Efficiency Portfolio Standard, which requires the entire portfolio to meet the total resource cost test. As an adopted best practice, the utilities generally try to have each measure or program meet the total resource cost test (or at least come close). MEEA and the Illinois Energy Office, MEEA's funder for the IHP work, assist the utilities in meeting these requirements by performing infrastructure development activities across the state, such as homeowner education and contractor training. If each utility conducted these programs separately, program costs would rise significantly.

One of the lessons learned in the IHP is the weight carried by a third-party administered HPwES Certificate of Completion. Recent work by a team of experts working on the valuation issue and greening America's MLS indicated that a certificate administered by a third party is vital for energy investments to translate on the MLS. In response, MEEA led a team to create IHP's own certificates (see Figure 3 and Figure 4). These certificates have proven to be a powerful way to motivate homeowners to take action (they want that certificate!) as well as a useful sales tool for participating contractors. The certificate gives the homeowner a way to tout his investment and more easily document an often invisible and difficult-to-explain home improvement project (e.g., air sealing). Furthermore, the certificate translates building improvements into terms valuable to homeowners (dollar and energy savings) and elevates the project by providing a direct link with the local and national HPwES programs.

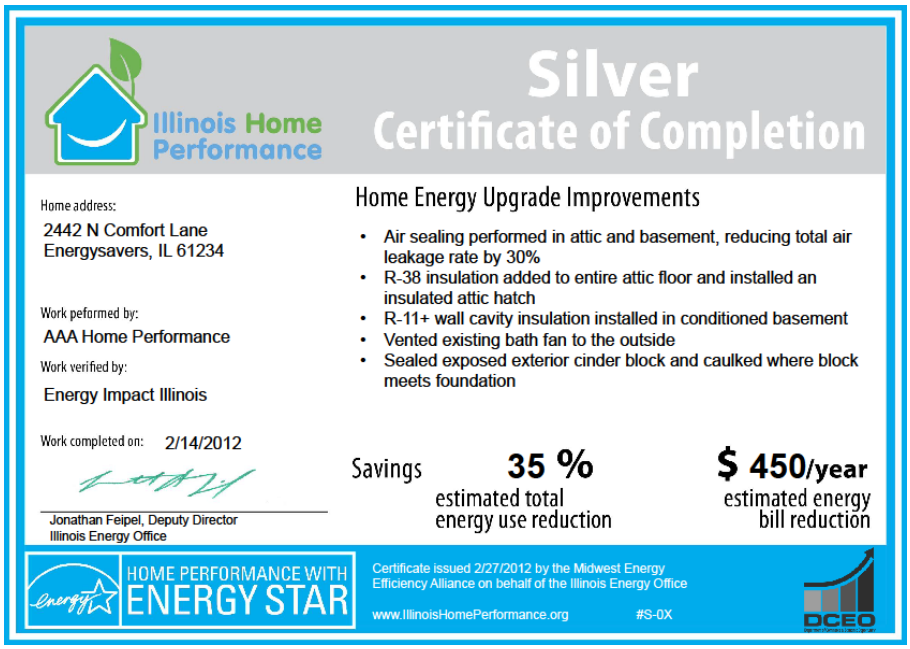

Figure 3. IHP Silver Certificate of Completion

Source: Midwest Energy Efficiency Alliance (MEEA)

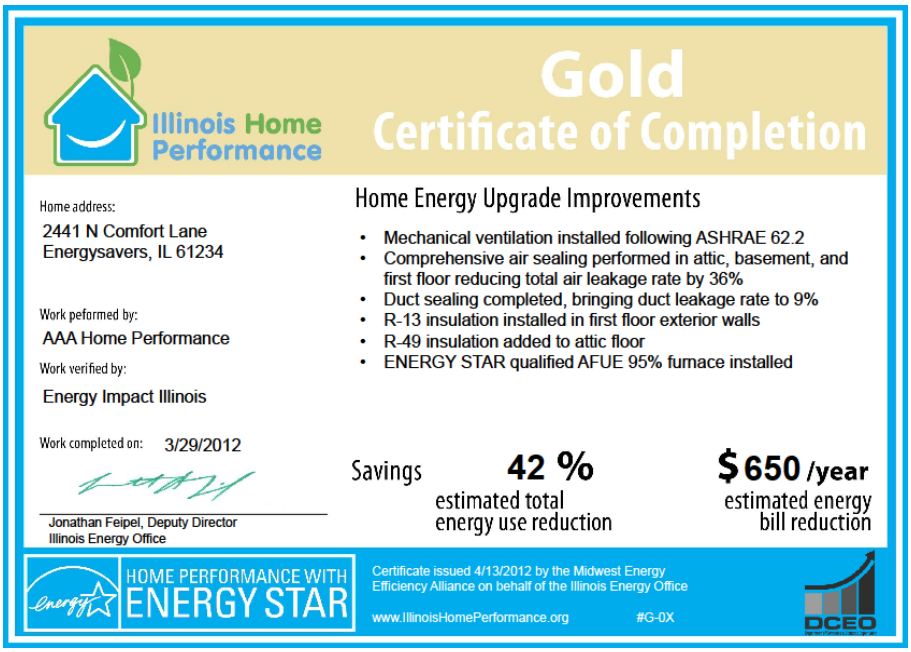

Figure 4. IHP Gold Certificate of Completion

Source: Midwest Energy Efficiency Alliance (MEEA)

The requirements for an IHP Silver or Gold Certificate of Completion follow:

- A home energy assessment (energy audit) must be completed by a BPI BA+E certified individual employed by an IHP participating contractor or the local IHP program provider. The energy assessment must follow BPI BA+E standards. The BPI Home Energy Auditing standard will be reviewed for possible inclusion as well. The homeowner receives a copy of the home energy assessment summary report, which contains details on the home's baseline conditions, along with a prioritized list of recommended improvements and accompanying predicted energy savings.
- Home energy upgrades (or retrofits) must be overseen by a BPI BA+E certified individual employed by an IHP participating contractor. In all applicable instances, the upgrade must follow BPI BA+E standards. In each instance, air sealing is performed before insulation is installed. Depending on the performance metrics met, the upgrade will be awarded an IHP Silver or Gold Certificate.
- A verification of work (or test-out) must be completed by a BPI BA+E certified individual overseen by an IHP participating contractor. This includes blower door and combustion safety testing and visual inspection of completed work. The findings and results are documented. The homeowner receives a copy of the performance improvement report, which the program also uses to determine which certificate might be issued.
- The homeowner must agree to participate in third-party QA inspection program. The QA program must be completed by a BPI BA+E certified representative from a local program provider. It serves as an additional verification point and added (free) benefit to the homeowner. Only a specified percentage of homes will receive the QA inspection depending

3.5.5.1 IHP Silver Certificate

To earn an IHP Silver Certificate, the home retrofit must complete all these requirements and also achieve a minimum of 15% predicted (modeled or deemed) total energy savings as compared to the baseline determined during the home energy assessment. Note that when pursuing this certification track, the post-retrofit predicted total energy use figure must be clearly stated in the test-out report, which will be compared to the pre-retrofit figure to determine if requirements for the IHP Silver Certificate have been met.

3.5.5.2 IHP Gold Certificate

To earn an IHP Gold Certificate, the home retrofit must satisfy the same requirements for the IHP Silver Certificate including achieving a minimum of 15% predicted total energy savings. In addition, the following criteria must be met:

- The ventilation requirements set forth in ASHRAE 62.2 2007 must be achieved.
- The building infiltration rate must be 4 air changes per hour at a pressure difference of 50 Pascals (ACH50) or a 30% reduction below baseline.
- In addition, four out of five performance metrics must be achieved:
    - Duct leakage rate (when ducts are partially or fully outside the conditioned space): Sum of supply and return leakage to the outside divided by fan flow ≤10% (see BPI 104 Envelope Professional Standard, pg. 7)
    - Wall insulation = ≥R-13
    - Attic insulation = ≥R-49; not required for cathedral ceilings
    - Basement/crawlspace insulation: If unconditioned, floor insulation = ≥R-30; if conditioned, wall insulation = ≥R-10 continuous or ≥R-13 cavity; in either instance, insulation must be installed with proper air sealing and venting to avoid moisture problems. Not required for exposed masonry
    - Heating and cooling equipment: ENERGY STAR qualified, subject to manufacturer installation specifications.

When pursuing this track, each of the required performance metrics must be clearly documented in the post-retrofit test-out report to determine if the IHP Gold Certificate requirements have been met. If multiple IHP home improvement projects have been undertaken at a single residence, the air leakage rate baseline is determined by the first IHP home energy assessment. This will ensure that a homeowner is not penalized for completing some air sealing to achieve the Silver Certificate, should he later aim to achieve the Gold Certificate.

Lessons Learned/Best Practices

More accurate estimates of energy savings and installed costs are needed to ensure that customers have accurate information. The cost effectiveness of energy efficiency measures can be attractive to some customers; obtaining a certificate may be motivating for others.

- Better validation of audit tools and deemed energy savings is essential, so that predicted savings correlate to real savings.
- Local installed costs tend to be higher than models predict; more accurate cost information needs to be collected.
- Properties with affordable rents often do not have as much cash flow, so a focus on cost effectiveness will make the program more attractive to the customer.
- Recent work by a team of experts working on greening America's MLS indicated that a certificate (administered by a third party) is vital for energy investments to translate on the MLS. The certificate also gives homeowners a way to tout their investments.

4 Conclusion

A detailed review of recent comprehensive retrofit programs in the northern Illinois area has produced a number of recommendations for streamlining, reducing costs, and improving the consistency of the audit process across different programs.

- The **application and prescreening** process must be user-friendly and streamlined. Because this step is the initial contact with the customer, it should focus on customer engagement and education and minimal data input. It should also clearly identify eligible measures and rebate requirements to prevent dissatisfied customers resulting from delayed or denied applications. Information should be targeted to the average nontechnical individual. Several **online tools** have been developed to present user-friendly interfaces for the customer and the contractor. Online tools can simplify and streamline the application process by furnishing a central location for all program information entered by the customer, the contractor, or the program administrator. This can reduce redundant and incomplete information, improve compliance and accuracy in data collection, and give customers up-to-date status information.
- **Homeowner education** is vital to successful energy efficiency programs. The program and participating contractors need to work together to educate homeowners about energy efficiency upgrades and how they can solve their home's ailments, including drafts, improper heating or cooling, or HVAC reliability, among others. The need for education is so great that it could almost be described as consciousness-raising.
- The **prescreening** process presents a marketing opportunity, not only for customer referrals, but also for contractors and equipment suppliers who may introduce customers to the program. Some programs track **referrals by contractors** to protect their relationship with their customers. Contractors will not hesitate to refer potential clients to the program if they feel that they will be able to keep the lead.
- **Auditors** and **contractors** or individuals overseeing the delivery of the audit were required to be **BPI BA+E certified** and use approved **BPI Technical Standards** when performing diagnostic testing. Auditor and contractor companies should be approved, which involves checking certifications, insurance information, and references. A strong, expert pool of contractors is crucial to ensuring long-term savings and reducing program operation costs.
- Better **validation of audit tools** and deemed energy savings is essential to correlate predicted savings to actual savings. End-use **billing analysis** must be performed after the retrofit to determine actual savings. Collecting adequate data at the time of the retrofit is necessary to determine actual energy savings. Some programs are moving toward **prescriptive deemed savings** to streamline the audit process and reduce costs.
- Northern Illinois retrofit programs should consider developing **consistent site condition assessment protocols** and **mitigation strategies** appropriate for conditions commonly found in Chicago housing stock. Some **diagnostic tests**, such as radon testing, are conducted in some programs but not others. Radon testing adds another level of work including auditor and homeowner education, equipment costs, and reporting. Program managers need to carefully consider whether to require or at least inform residents about radon testing before installing retrofit measures to reduce air infiltration. Other diagnostic

tests, such as **pre- and post-blower door testing** should be evaluated to determine whether they are necessary to achieve effective air sealing. Blower door tests are costly and contractor-performed tests have been shown to be unreliable in some cases.

- All programs included **QA protocols,** ranging from conducting a file review of documents, to performing a post-installation inspection of all or a portion of jobs, to repeating blower door tests to verify contractor results. QA is important to program success for maintaining a strong brand and gaining customer trust. Contractors can even use QA as a successful marketing tool.
- A **one-stop shop,** such as the Energy Savers Program, targets practical and significant energy savings. This approach offers both **technical services** and **low-interest financing,** and it can be a way to remove barriers resulting from lack of information, services, and financing.
- **Measures of success** for comprehensive retrofit programs can vary depending on the program goal. Most programs track energy savings and completion rate and evaluate customer satisfaction through surveys. Other measures of success focus simply on the number of retrofits completed or certificates granted. Recent work by a team of experts working on the valuation issue and greening America's MLS indicated that a **certificate administered by a third party** is vital for energy investments to translate on the MLS. The certificate gives homeowners a way to tout their investments. It also aids in communicating about an often invisible and difficult-to-explain home improvement project (e.g., air sealing).

By incorporating best practices, protocols, consistent testing and data requirements, and lessons learned from early comprehensive retrofit programs, audit and retrofit procedures can become more streamlined, consistent, and cost effective. Improving audit and retrofit procedures and reducing program costs will allow programs to reach more houses and improve overall energy savings.

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