Illinois Home Performance

Building America Case Study

Whole-House Solutions for Existing Homes

Evaluation of Missed Energy Saving Opportunity

Based on Illinois Home Performance Program Field Data: Homeowner Selected Upgrades vs. Cost-Optimized Solutions

Chicago, Illinois

PROJECT INFORMATION

Construction: Retrofit

Type: Single-family homes

Building Component: Envelope

Location: Chicago, IL

Technical Support Partner: Partnership for Advanced Residential Retrofit, *www.gastechnology.org/PARR*

Year Tested: 2013

Climate Zone: Zone 5 (cold)

PROJECT HOUSING GROUPS

The table below depicts the percent that each housing group represents of total Chicagoland housing stock.

Group	IHP	CCS
1	0.20%	2.50%
2	.020%	1.90%
3	1.00%	4.70%
4	11.20%	17.90%
5	1.40%	6.10%
6	5.00%	4.80%
7	32.20%	11.60%
8	4.00%	4.10%
9	0.00%	1.70%
10	3.00%	2.10%
11	3.60%	1.10%
12	5.60%	23.60%
13	7.40%	3.80%
14	15.20%	11.20%
15	10.00%	2.90%

Building America SM U.S. Department of Energy

In this study, the U.S. Department of Energy Building America team, Partnership for Advanced Residential Retrofit, compared homeowner measure package choices in the Illinois Home Performance with ENERGY STAR® (IHP) program with cost-optimal choices determined through Building Energy Optimization (BEopt) modeling software. This research evaluated actual retrofit measure selection in 800 homes, grouping the homes into one of the 12 single-family housing archetypes identified in the Chicagoland Characterization Study (CCS), and determined the most cost-optimal measure mix for each housing archetype using BEopt. The study provides valuable feedback for the current IHP program and guidance into how similar whole-house retrofit programs can use large datasets to improve the cost effectiveness of installed measure packages.

Comparison between the actual measures installed in IHP homes and BEopt-recommended cost-optimal measures indicates that there is a large difference in measure selection. Findings from the study include:

1. For most housing archetypes in IHP, the homes received more measures than BEopt-recommended cost-optimal measure packages. The exception was in brick homes where fewer measures were installed than BEopt-recommended cost-optimal measure packages.
2. IHP measure packages result in greater EUI reduction in frame houses and older homes.
3. Measure packages installed during an IHP retrofit result in significantly more gas savings than electricity savings (because the IHP houses use gas to heat homes in the cold climate), a finding consistent with BEopt modeling.

One conclusion of this study is that linking home categorization to standardized retrofit measure packages provides an opportunity to streamline the process for single-family home energy retrofits and maximize energy savings and cost effectiveness.

Twelve housing groups—Measure installation frequency: BEopt and IHP measure packages

The table below depicts the frequency with which individual measures were installed in the 12 housing groups analyzed in this study. The first column is representative of IHP measure packages and the second shows BEopt measure packages. One of the primary differences is that BEopt's recommendations favored the installation of mechanical equipment, while IHP measures were primarily focused on the building envelope.

Measures	IHP	BEopt
Air sealing	12	11
Attic insulation	12	8
Exterior wall insulation	4	0
Crawlspace insulation	5	0
Exhaust fans vented to exterior	5	0
Programmable thermostat installed	1	0
Furnace replacement	1	0
Ducts sealed	1	—
Water heater	—	1

For more information, see the Building America report, *Evaluation of Missed Saving Opportunity Based on Illinois Home Performance (IHP) Program Field Data: Homeowner Selected Upgrades vs. Cost-Optimized Solutions,* at *www.buildingamerica.gov*

Image credit: All images were created by the PARR team.

Modeled EUI Reduction Differences Between IHP Measures and BEopt-Recommended Measures

Lessons Learned

- Modeled optimal energy saving for each housing type varies from what is typically installed during IHP retrofits.
- The retrofit characteristics currently implemented under the IHP program differ between each housing group; however, the top measures include air sealing, attic insulation, exterior wall insulation, crawlspace insulation, and mechanical ventilation.
- Only four housing groups experienced a greater reduction in energy consumption by installing measures identified as cost optimal. Initial analysis of economic payback indicates that BEopt-recommended measure packages are more cost effective than IHP-installed measure packages; however, further analysis is required to fully assess cost effectiveness.

Looking Ahead

Further work is needed to examine and compare the costs of BEopt-recommended and IHP common measures. If possible, future research should also incorporate real-world rebate levels into the building science modeling software, to control for the cost differences between what is being modeled and what is actually occurring. In-depth cost analysis was not included in this research, and such an analysis would likely yield key lessons for program administrators and BEopt users. The results of this study can also be used to further refine and improve upon the assumptions that were originally made in the CCS. Refinement of the original characterization assumptions is important because it can help ensure that the original characterization and recommended measure packages are accurate and depict actual housing stock characteristics.

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

For more information, visit:
www.buildingamerica.gov

The U.S. Department of Energy's Building America program is engineering the American home for energy performance, durability, quality, affordability, and comfort.

DOE/GO-102014-4426 • July 2014