



Illinoisans Buying 2012 IECC Homes Will Save Thousands

An Analysis of Cumulative Homeowner Profit *After* Paying Incremental Construction Costs for New Single Family Homes Meeting Historic New Building Energy Code

Summary

Illinoisans buying new single family homes meeting the 2012 International Energy Conservation Code (IECC) will pocket between \$9,780 and \$11,100 in net energy savings over the mortgage term, according to an analysis of energy savings and incremental construction costs by the Building Codes Assistance Project and ICF, International. *The differences in energy bill savings and added construction costs depend on where the home is located (Climate Zone 4 is in southern Illinois; Climate Zone 5 is in northern Illinois) and on the type of insulation used for the walls.*

The energy savings over added mortgage costs are enough to pay back the buyer's additional down-payment in as little as 7 months and no more than 1 year and 1 month (sooner if the loan allows less than 20% down payment). **After that date, the owner continues to pocket between \$326 and \$370 in estimated savings annually until the mortgage is paid off, when savings increase to between \$396** (given R-13+5 exterior walls in northern Illinois) **and \$424** (given R 13+5 exterior walls in southern Illinois) **per year.** Obviously, the savings are even greater if energy costs rise over the next 30 years.

Specifically, this analysis finds an average new home meeting the 2012 IECC will cost an additional \$1,513 in Climate Zone 5 and between \$958 to \$1,775 in Climate Zone 4 (depending on wall insulation type) over the construction costs of meeting the state's current energy code. Estimated energy cost savings range from \$396 to \$424 per year depending on climate zone and wall type.

Stated differently, **monthly utility bill savings to the homeowner are more than four times as much as the additional mortgage payment needed to cover the added first-cost of energy saving features required by the 2012 code.**

This analysis calculates the energy savings and incremental construction costs of new, 2,400 square foot single family homes in Illinois that meet the latest energy code, the 2012 IECC, compared to the state's current code, the 2009 IECC.

Energy Savings and Construction Cost Methodology

To calculate energy savings and incremental construction costs, this analysis defined a "typical" single family house to represent new residential development in Illinois. The home modeled is two stories in height, with exterior dimensions of 30 by 40 feet with wood-framed walls and a basement foundation. This size and foundation type is based on regional construction practices. In Illinois (as nationally) the average new home is approximately 2,400 square feet—which is the size used in this analysis.

For the purposes of this analysis we assume a baseline home that meets the requirements of the 2009 IECC, which is the state's current code. Although some leading builders in Illinois are already building to a higher standard than the 2012 IECC, for purposes of this analysis we assume a baseline home that exactly meets the requirements of the 2009 IECC. We also err on the side of good building practice, which is why

we also assume builders are installing return air ducts, although some builders may currently be using floor joist cavities in lieu of conventional return ducts.¹

Using this model home as a baseline, we identified the building components that would have to be upgraded from the current 2009 IECC code, according to the prescriptive requirements in the 2012 IECC. These changes differed by climate zone, but in both climate zones code changes include increased ceiling insulation from R-38 to R-49 blown-in insulation, an increase from 50 to 75 percent compact florescent bulbs in hard-wired fixtures, R-3 insulation on hot water pipes from the hot water heater to kitchen, improved house air sealing and testing, bathroom and kitchen vent fan upgrades, and increased sealing around air handlers and furnaces. Additionally, meeting the latest code houses in climate zone 4 will require an upgrade from R-13 to R-20 or R13 + 5 exterior walls while houses in climate zone 5 will require an upgrade of basement wall insulation from R10 to R15.²

Energy savings were modeled by ICF International (ICFI), an international energy consulting firm with extensive experience in the use of hourly building energy simulation software to estimate energy performance and energy savings of alternative building codes and design concepts. Although the values included in the analysis represent a careful, independent technical judgment by ICFI staff, it should be kept in mind that – like any such analysis – the results depend on a number of assumptions about the physical features of a typical new home, operating practices, energy prices, and other factors.

Both the existing 2009 IECC code and the new 2012 IECC code allow a builder to choose among a number of alternatives to comply with the code. In this case, ICFI conservatively chose to compare the results from the prescriptive path of each version of the code. ICF uses Beacon™, an hourly simulation model that utilizes DOE-2 or EnergyPlus, and summarizes building performance in terms of estimated annual energy costs, based on long-term average weather conditions in a given climate zone (city), DOE/EIA state level energy costs. ICF also estimates energy consumption by end-use, fuel type, electricity peak demand, and air conditioner size in each prototype home. More details of the modeling assumptions used in this analysis are available on request.

Incremental Costs

To estimate incremental costs, we rely on construction costs from the well-regarded *2011 RS Means Contractor's Pricing Guide* to approximate actual costs of new home construction. While this resource is known to be conservative, it is useful for this analysis as RS Means estimated construction costs are inclusive of material costs, labor, and contractor overhead and profit.³ For this analysis many of these costs were also confirmed with local building experts in Illinois.

¹ As a result of this assumption, some builders currently using floor joists as ducts (“panned ducts”) may incur incremental costs under the 2012 IECC, which will require them to install conventional return ducts.

² For the purposes of this analysis, we chose to model a two story house with a basement. By contrast, house with a slab foundation would have a lower incremental cost.

³ RS Means also includes a location factor, which indicates an estimate of local costs as a percentage of RS Means national average estimates. In an effort to be conservative, for this analysis we have chosen the highest location factor available in RS Means in each climate zone: 121% of the national average in Climate Zone 5 (Chicago) and 101% of the national average in Climate Zone 4 (East St. Louis).

Costs Shared by New Homes in Climate Zones 4 and 5:

Among other changes, the 2012 IECC requires builders to upgrade ceiling (attic) insulation from R-38 to R-49, which is estimated by RS Means to range from an additional \$497 to \$595 per new home. As well, we estimate that the additional required air sealing in the 2012 IECC and the required whole house “blower door” testing will add about \$350 per new home.⁴ To improve ventilation, an additional \$100 is estimated for upgrading two bathroom vent fans to units with an Energy Star rating. Finally, builders will have to install high-efficiency lights in 75 percent of hard-wired fixtures, up from 50 percent in the 2009 IECC. Usually, this requirement is met with compact florescent lights (CFLs). Our analysis estimates that the upgrade of 25 percent of fixtures will cost \$25. An additional 2012 IECC code change will require builders to insulate hot water distribution lines to kitchens. We believe the cost impact of this change is small, as R-3 insulation costs less than 50 cents per linear foot and most insulation products can be “clipped” around supply pipes after the plumbing rough-in.⁵ As a result, this cost is estimated at \$100 per new home. Finally, due to additional language in the 2012 IECC requiring sealing around air handlers and furnaces, we have added an additional \$100 for sealing.

Incremental Costs Unique to Climate Zones 4

To meet the 2012 IECC in Climate Zone 4 (which takes up the lower third of the state), builders will have flexibility in the type of exterior wall assembly they chose to build. At present, the 2009 IECC requires R-13 walls, while the 2012 IECC mandates an insulation upgrade to R-13 + 5 or R-20. To build an R-13 + 5 wood frame wall, builders retain 2 x 4 framing with R-13 fiberglass batts as cavity insulation, but replace the conventional wood sheathing for with an insulated sheathing—an engineered product that combines structural reinforcement with insulation equivalent to R-5 to create an R-13 + 5 wall. Alternately, if builders choose to meet the R-20 requirement, 2 x 4 walls are upgraded to 2 x 6 wall construction. The larger framing allows for R-21 fiberglass batts to be placed between studs instead of the R-13 batts required in the 2009 IECC. Additionally, because of the superior strength of 2 x 6 construction, builders can introduce a cost-saving variant of the R-20 wall that increases the space between studs from 16 inches apart to 24 inches—thus saving lumber and dramatically reducing incremental cost. Many builders prefer to retain 16 inch spacing however, and thus all three wall framing alternatives are presented in **Table 1**, which summarizes incremental costs for Climate Zone 4.

⁴ \$350 is a commonly used as an expected air sealing and testing cost for new single-family detached homes nationwide. By following the air sealing visual checklist already required by the 2009 IECC, builders should be able to reduce air changes to the required three air changes per hour required in the 2012 IECC.

⁵ It is difficult to determine what combination of redesign, resizing, and/or partial insulation of hot water lines would be done in a typical new home. Insulating distribution lines to the kitchen and very long runs would add costs while downsizing lines would reduce costs; in any case we believe the net effect would be small.

| Table 1: Climate Zone 4 Incremental Costs | | | | | |
|--|------------|-----------------------------|------------|-----------------|-------------------------|
| Building Component | Total Area | Incremental Cost/ Square Ft | Total | Location Factor | Adjusted Total |
| Wall Option 1: R-13 + 5 | 2,380 | \$0.34 | \$ 809.20 | 101% | \$817 |
| Wall Option 2: R-20 Walls with Studs Spaced 16" on Center | 2,380 | \$0.59 | \$1,404.20 | 101% | \$1,418 |
| Wall Option 3: R-20 Walls with Studs Spaced 24" on Center | 2,380 | \$0.25 | \$ 595.00 | 101% | \$601 |
| Upgrade Ceiling insulation to R-49 | 1,200 | \$0.41 | \$ 492.00 | 121% | \$497 |
| Increased Air Sealing and Testing | N/A | N/A | N/A | N/A | \$350 |
| Insulating Hot Water Pipes | N/A | N/A | N/A | N/A | \$100 |
| 75% CFLs in hardwired fixtures (from 50% in 2009 IECC) | N/A | N/A | N/A | N/A | \$25 |
| Bathroom Vent Fan Upgrade | N/A | N/A | N/A | N/A | \$100 |
| Increased Sealing at Air Handlers and Furnaces | N/A | N/A | N/A | N/A | \$100 |
| HVAC System Savings (downsizing 1 ton) | N/A | N/A | N/A | N/A | -\$815 |
| Total Incremental Costs (Varies Based on Wall Type Above) | | | | | \$958 to \$1,775 |

While complying with the 2012 IECC increases first-cost in some areas, the new code also presents opportunities to **reduce** costs for HVAC equipment as a result of an improved building envelope. Among other possible savings, builders will be able to reduce the size of costly mechanical equipment. For the prototype house in Climate Zone 4, builders are able to reduce the cooling system capacity from 61,500 kBtuh to 49,500 kBtuh or from 5.125 to 4.125 tons. This reduction in air conditioner capacity can result in first-cost savings of one ton, which is expected to save approximately \$815 for each new house.⁶

Taking into account both incremental costs and savings, **this study estimates that net incremental costs for Climate Zone 4 will range from \$958 to \$1,775, depending on which wall construction type is selected by builders.** These options are \$1,174 (R-13 + 5 wall), \$1,775 (R-20 wall with 16" spacing between studs), and \$958 (R-20 wall with 24" spacing between studs).

Incremental Costs Unique to Climate Zones 5

Unlike Climate Zone 4, to meet the 2012 in climate zone 5, no change is required for exterior walls. However, basement walls insulation will have to be upgraded from R-10 continuous insulation to R15 insulation. Assuming a basement with eight foot ceilings and 140 feet in exterior perimeter, the difference in price for extruded polystyrene is estimated by RS Means at \$0.48 per square foot, for a total of \$651 per

⁶ EPA conservatively estimates for their Energy Star Homes Version 3 that first-cost savings for downsizing a 13 SEER air conditioner are \$815 per ton. It should be noted that because HVAC systems are usually sold in half-ton increments, to meet the 5.125 tons of needed cooling capacity estimated for the baseline home, builders would have to install the next size up, a 5.5 ton unit and a 4.5 ton unit for a 2012 home. By "right-sizing" the HVAC equipment, building occupants will also benefit from a reduction in equipment short-cycling (i.e., where equipment is too large for the cooling load and cycles on and off frequently, thus wasting energy and losing some of its ability to dehumidify indoor air). Please note that additional cost savings could be obtainable from downsizing heating equipment, but this study does not attempt to calculate those savings. Estimated heating requirements decline from 80,000 to 70,000 kBtuh in Climate Zone 4 and from 78,000 to 70,000 kBtuh in Climate Zone 5.

new home. The cooling system is also reduced from an estimated 54,000 kBtuh to 44,400 kBtuh (from 4.5 to 3.7 tons) allowing a one-half ton reduction in system size. **In total, the incremental costs for new homes built in Climate Zone 5 are estimated at \$1,513 per new home.** A summary of incremental costs for Climate Zone 5 is displayed below in **Table 2**.

| Table 2: Climate Zone 5 Incremental Costs | | | | | |
|--|------------|-----------------------------|-----------|-----------------|----------------|
| Building Component | Total Area | Incremental Cost/ Square Ft | Total | Location Factor | Adjusted Total |
| Increase Basement Insulation from R-10 to R-15 | 1,120 | \$0.48 | \$ 537.60 | 121% | \$651 |
| Upgrade Ceiling insulation to R-49 | 1,200 | \$0.41 | \$ 492.00 | 121% | \$595 |
| Increased Air Sealing and Testing | N/A | N/A | N/A | N/A | \$350 |
| Insulating Hot Water Pipes | N/A | N/A | N/A | N/A | \$100 |
| 75% CFLs in hardwired fixtures (from 50% in 2009 IECC) | N/A | N/A | N/A | N/A | \$25 |
| Bathroom Vent Fan Upgrade | N/A | N/A | N/A | N/A | \$100 |
| Increased Sealing at Air Handlers and Furnaces | N/A | N/A | N/A | N/A | \$100 |
| HVAC System Savings (Downsizing 1/2 ton) | N/A | N/A | N/A | N/A | -\$407.50 |
| Total Incremental Costs | | | | | \$1,513 |

Energy Cost Savings

According to the model used in this analysis, **upgrading to the 2012 IECC will result in significant energy cost savings for homeowners in Illinois, ranging from \$397 per year in Climate Zone 5 to \$416 in Climate Zone 4.**⁷ Annual energy savings for each climate zone (and wall type) is presented in Table 3, below. It is noteworthy that these savings assume constant energy prices; if energy prices continue to rise consistent with historical trends, savings will be greater in future years.

| Table 3: 2012 IECC Energy Savings by Climate Zone and Wall Type for Two Story Houses | |
|---|-----------------------|
| House Type | Annual Energy Savings |
| Climate Zone 4: Houses with R-20 Walls | \$407 |
| Climate Zone 4: Houses with R-13+5 Walls | \$424 |
| Climate Zone 5: Houses with R-20 Walls | \$398 |
| Climate Zone 5: Houses with R-13+5 Walls | \$396 |

Mortgage Payback for Homeowners

Homebuyers will be able to include in their mortgage the incremental first-costs of meeting the 2012 IECC, while benefiting from lower utility bills starting on day one. With estimated energy cost savings ranging from \$397 to \$416 per year, monthly utility bill savings are at least 4 times as much as the additional mortgage payment needed to cover the added first-cost of energy saving features required by the 2012 code.

⁷ Note that the estimated ranges represent an average within each Climate Zone of the two different wall types: R-20 and R-13+5.

This cash-flow difference is enough to pay back the buyer’s added down-payment in no more than one year, one month and as little as seven months (or sooner if the loan allows a down payment below 20%). After that date, the owner continues to save at least \$326 annually in lower utility bills – and even more if energy prices increase.

This payback analysis assumes that homebuyers purchase a new home with 20% down at the current nationwide interest rate of 4.01 percent. This scenario would result in an increased down payment of \$325 with additional monthly mortgage cost of \$4 to \$7. Taking into account energy savings and lower utility bills, a cash flow analysis indicates that the homebuyer would break even within as little as seven months. After that break-even date, **home owners would continue to save between \$326 and \$370 in annual energy costs.** Homebuyers with a lower down payment—such as 5 or 10 percent—will realize payback much more quickly. Mortgage payback to homeowners is presented below in **Table 4.**

| Table 4: Mortgage Payback for Homebuyers by Exterior Wall Type | | | | | |
|---|-------------------|--------------------------------|---|------------------------|---|
| Climate Zone and Wall Type | Incremental Costs | Energy Savings/ Month per home | Down Payment Increase (and Mortgage Increase per Month) | Breakeven Point | Annual Profit for Homeowner after Breakeven Point |
| Climate Zone 4: R-13+5 Walls | \$1,174 | \$35 | \$235 (plus \$4/month) | 8 months | \$370 |
| Climate Zone 4: R-20 Walls, Studs 16" on center | \$1,775 | \$34 | \$355 (plus \$7/month) | 1 year, 1 month | \$326 |
| Climate Zone 4: R-20 Walls, Studs 24" on center | \$958 | \$34 | \$192 (plus \$4/month) | 7 months | \$363 |
| Climate Zone 5: R-20 Walls | \$1,513 | \$33 | \$302 (plus \$6/month) | 11 months | \$336 |
| Climate Zone 5: R-13+5 Walls | \$1,513 | \$33 | \$302 (plus \$6/month) | 11 months | \$329 |

Conclusions

- As estimated in this analysis, incremental costs for new 2,400 square foot homes built to the 2012 IECC in Illinois range from \$958 to \$1,775 per new home.
- Annual energy savings for Illinois homeowners attributable to the 2012 IECC range from \$396 to \$424 per new home.
- Assuming a conservative 20% down payment, new home buyers will break even on their initial investment in as few as seven months and no more than one year and one month after purchase.

About BCAP

As an independent judge of the efficacy of energy codes, BCAP strives to use data to address energy code barriers, including the real or perceived construction costs incurred by code changes. To address concern in the building community that upgrading to the latest version of the residential energy code, the 2009 IECC, will result in cost prohibitive increases in construction cost for new single-family homes, BCAP has completed a nationwide incremental cost analysis as well as analysis for states on demand. Funding for this work is provided by the Environmental Protection Agency, the Department of Energy, and the National Association of State Energy Officials.

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