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Kansas City Residents Buying 2012 IECC Homes Will Save Thousands

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

Summary

Kansas City Residents buying new single family homes meeting the 2012 International Energy Conservation Code (IECC) will pocket between $15,033 to $16,338 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 energy savings from the 2012 code are enough to pay back the buyer's additional down-payment in as little as 7 months and no more than 11 months (sooner if the loan allows less than 20% down payment). **After that date, the owner continues to pocket between $516 and $544 in estimated savings annually.** These savings will be even greater if energy costs rise over the next 30 years.

This analysis assesses energy savings and incremental construction costs of new, 2,400 square foot single family homes in Kansas City that meet the latest energy code, the 2012 IECC, compared to the city's current code, the 2006 IECC. Specifically, this analysis finds an average new home meeting the 2012 IECC will cost between $1,460 to $2,293 over current homes (depending on wall insulation and construction type) over the construction costs of meeting the current energy code. Energy cost savings are estimated at $621 per year.

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

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 Kansas City, Missouri. The home modeled is two stories in height, with exterior dimensions of 30 by 40 feet with wood-framed walls and a full basement foundation. This size and foundation type is based on regional construction practices. The home size modeled is 2,400 square feet—which is also the approximate size of the average new home built nationwide.

For the purposes of this analysis we assume a baseline home that meets the requirements of the 2006 IECC, which is the city's current code. Although some leading builders are already meeting or exceeding many elements of the 2012 IECC already, for purposes of this analysis we assume a baseline home that exactly meets the requirements of the 2006 IECC. Also, although we err on the side of good building practice, in an effort to be conservative we have included some incremental costs that may not be necessary. For instance, although it is a good building practice for builders install conventional "hard ducted" return air ducts, some builders may be using joist cavities (panned floor or enclosed interior wall cavities) in lieu of conventional "hard ducted," metal or other return ducts. In an effort to anticipate this possible cost (and others) for some builders, we include the incremental costs of upgrading to hard ducted return ducts, which are required in the 2012 IECC.

Using the 2,400 square foot model home as a baseline, we calculated incremental costs by identifying the building components that would have to be upgraded from the current 2006 IECC, according to the prescriptive requirements in the 2012 IECC. These changes include increased ceiling insulation from R-38 to R-49 blown-in insulation, an window upgrade to meet a lower U-factor, adding programmable thermostats, improved house air sealing and testing, insulating hot water pipes, increasing the percentage of compact florescent bulbs in hard-wired fixtures from 0 to 75 percent, bathroom vent fan upgrades, sealing and insulating the attic hatch or door, and upgrading from panned to "hard ducted" return ducts. Additionally, meeting the latest code will require an upgrade from R-13 to R-20 or R13 + 5 exterior walls.

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 2006 IECC and the new 2012 IECC codes 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 BeaconTM, 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. This resource is known to be conservative and is useful for this analysis because all estimated construction costs are inclusive of material costs, labor, and contractor overhead and profit.[1]

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 cost an additional $507 per new home. Builders will also need to make window upgrades to meet the 2012 IECC. To meet the improved U- and SHGC factors for the 2012 IECC (.35 and .40, respectively) our analysis expects that insulating gas between window frames will have to be upgraded to argon. This added cost is conservatively estimated by the Efficient Windows Collaborative (EWC) as $0.50 per square foot of window area. It is important to note that some builders may already install windows that meet 2012 IECC requirements, but in an effort to be conservative (and strictly compare the two codes) this analysis assumes that builders are currently using the least-cost window to meet existing code requirements, which we assume to be a vinyl frame double paned window.[2]

[1] RS Means also includes a location factor, which indicates an estimate of local costs as a percentage of RS Means national average estimates. For this analysis, the location factor is 103%, indicating that construction costs in Kansas City are approximately 3% higher than the national average.

[2] As a result, many builders will be able to reduce or avoid incremental costs for better windows.

Additionally, builders must install programmable thermostats, a cost we have estimated at $50. As well, we estimate that the additional required air sealing in the 2012 IECC and the required whole house air leakage (commonly known as "blower door") and duct leakage testing will add about $350 per new home.[3] Because the resulting home will have fewer air and duct leaks to the outside, ventilation will have to be improved, a cost we estimate at $150 for upgrading two bathroom vent fans to units with an Energy Star rating.

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.[4] As a result, this cost is estimated at $100 per new home. Builders will also have to install high-efficiency lights in 75 percent of hard-wired fixtures, up from 0 percent in the 2006 IECC. Usually, this requirement is met with compact florescent lights (CFLs). Our analysis estimates that the upgrade of 75 percent of fixtures will cost no more than $50.

To meet the 2012 IECC we also estimate an additional $100 to seal and insulate the attic hatch. This cost varies by home, and depends on whether or not attic access is achieved through a wall opening (such as a door) or via an overhead pull-down stair, or simple hatch. For wall openings, cost is expected to be much lower, as builders can simply adhere surplus insulation to the unconditioned side of the door. For attic pull-down stairs, a variety of kits can be placed over the stairs by builders, but costs are higher. Prior analysis for pull-down stair insulation and sealing completed in conjunction with the Home Builders Association (HBA) of South Carolina estimated this cost to be $100—an estimate which has also been used in this analysis in an effort to default to the most conservative option.

For builders that are currently using "panned" floor joists as return ducts, meeting the 2012 IECC will require an upgrade to conventional "hard ducted" returns in basement ceilings. Many builders already use conventional ducts as returns, but this cost has been included in this analysis regardless. Calculating the cost change between panned and conventional ducts is challenging, as panned ducts are not priced in RS Means and many construction cost sources. After consulting with HVAC contractors, who indicated the cost of panned ducts was roughly half of conventional ducts, incremental costs are estimated in this analysis as one-half of cost of conventional return ducts. We believe this cost is reasonable due to the significant amount of labor required for panned ducts, as contractors must screw sheet metal between two adjacent joists and seal the edges with mastic. RS Means estimates the installed cost of flexible, non-insulated, 6" diameter ducts at $4.58 per linear foot.[5] As such, the cost to upgrade ducts is estimated at $2.29 per linear foot, or $177 for the estimated 75 feet of return duct which some builders will have to upgrade under the 2012 IECC.

Finally, to meet the 2012 IECC, builders will have to upgrade the r-value of exterior walls from the current R-13 to R-13+5 or R-20. Fortunately, builders will also have flexibility in the type of exterior wall assembly they choose to build. To build an R-13 + 5 wood frame wall, builders retain 2 x 4 framing, typically with R-13 fiberglass batts as cavity insulation, but replace the conventional wood sheathing with insulated sheathing—an engineered product that combines structural reinforcement with the insulation equivalent

[3] $350 is a commonly used as an expected air sealing and testing cost for new single-family detached homes nationwide.

[4] 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.

[5] Less expensive duct options are available, but this product matches the modeling assumptions used by ICFI.

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 cavity allows for R-21 fiberglass batts or other insulation equivalent to R-20 to be placed between studs instead of the R-13 batts required in the 2006 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. This advanced framing approach, sometimes designated "O.V.E.," has been supported by NAHB and the Residential Code and eliminates unnecessary headers and doubled framing members by "stacking" building loads and using modern fasteners. Many builders prefer to retain 16 inch spacing however, and as such all three wall framing alternatives are presented in **Table 1**, which summarizes incremental costs for Climate Zone 4.

In addition to wall framing savings, the 2012 IECC will also introduce cost savings for builders. 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 57,000 kBtuh to 45,000 kBtuh or from 4.75 to 3.75 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]

Table 1: Kansas City Missouri 2012 IECC 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	103%	$833
Wall Option 2: R-20 Walls with Studs Spaced 16" on Center	2,380	$0.59	$1,404.20	103%	$1,446
Wall Option 3: R-20 Walls with Studs Spaced 24" on Center	2,380	$0.25	$ 595.00	103%	$613
Ceiling insulation Upgrade to R-49	1,200	$0.41	$ 492.00	103%	$507
1st Floor Panned Return Ducts Upgraded to Flexible Ducts	75 linear ft	$2.29/lf	$ 171.75	103%	$177
Upgrade Windows to Argon Fill	357	$0.50	$ 178.50	N/A	$179
Programmable Thermostat Upgrade	N/A	N/A	N/A	N/A	$ 50
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	N/A	N/A	N/A	N/A	$ 50
Bathroom Vent Fan Upgrades	N/A	N/A	N/A	N/A	$150
Sealing/Insulating Attic Hatch	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)					**$1,460 to $2,293**

[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 4.75 tons of needed cooling capacity estimated for the baseline home, builders would have to install the next size up, a 5 ton unit, and likewise a 4 ton unit for meeting the 2012 IECC. 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 90,000 to 70,000 kBtuh.

Taking into account both incremental costs and savings, **this study estimates that *net* incremental costs for new homes in Kansas City, Missouri will range from $1,460 to $2,293, depending on which wall construction type is selected by builders.** These options are $1,460 (R20 OVE Wall, with 24" spacing between studs), $1,681 (R-13+5), and $2,293 (R-20 wall with 16" spacing between studs).

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 Kansas City, resulting in savings of $620.76 per year.** 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.

Mortgage Payback for Homeowners

Homebuyers will be able to include the incremental first-costs of meeting the 2012 IECC in their mortgage, while benefiting from lower utility bills starting on day one. With estimated energy cost savings of $621 per year, monthly utility bill savings are at least 5 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 cash-flow difference is enough to pay back the buyer's added down-payment in no more than eleven months and as few as seven months (or sooner if the loan allows a down payment below 20%). After that date, the owner continues to save at least $516 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 3.96 percent. This scenario would result in an increased down payment of between $292 and $459 with additional monthly mortgage cost of $5.55 to $8.72. 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, **homeowners would continue to save between $516 and $544 in annual energy costs**. Homebuyers with a lower down payment—such as 5 or 10 percent—will realize payback more quickly. Mortgage payback to homeowners is presented below in **Table 2.**

Table 2: Mortgage Payback for Homebuyers by Exterior Wall Type

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
R-13+5 Walls	$1,681	$52	$336 (plus $6/month)	**8 months**	**$544**
R-20 Walls, Studs 16" on center	$2,293	$52	$459 (plus $9/month)	**11 months**	**$516**
R-20 OVE Walls, Studs 24" on center	$1,460	$52	$292 (plus $6/month)	**7 months**	**$554**

Conclusions

- As estimated in this analysis, incremental costs for new 2,400 square foot homes built to the 2012 IECC in Kansas City range from $1,460 to $2,293 per new home.
- Annual energy savings for Kansas City homeowners attributable to the 2012 IECC are $620 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 eleven months 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 2012 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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