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Denver 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

Denver residents buying new single family homes meeting the 2012 International Energy Conservation Code (IECC) will pocket between $5,886 to $6,354 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 approximately 16 to 17 months (sooner if the loan allows less than 20% down payment). **After that date, the owner continues to pocket between $205 and $221 in estimated profit annually—money that would otherwise go to pay higher utility bills.** These savings will be even greater if energy costs rise over the next 30 years.

This report assesses energy savings and incremental construction costs of new, 2,400 square foot single family homes in Denver that meet the latest model energy code, the 2012 IECC, compared to the city's current code, the 2009 IECC. Specifically, this analysis finds an average new home meeting the 2012 IECC will cost an additional $1,412 over the construction costs of meeting the current energy code. Energy cost savings are estimated at between $270 and $286 per year.

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.**

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 Denver, Colorado. 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 2009 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 2009 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 to 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 2009 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, a window upgrade to meet a lower U-factor, improved house air sealing and testing, insulating hot water pipes, increasing the percentage of compact florescent bulbs in hard-wired fixtures from 50 to 75 percent, bathroom vent fan upgrades, and upgrading from panned to "hard ducted" return ducts. Additionally, meeting the latest code will require an upgrade of basement insulation from R-10 to R-15.

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 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 $453 per new home. Builders will also need to make window upgrades to meet the 2012 IECC. To meet the improved U- factors for the 2012 IECC (.32 from .35). This added cost is conservatively estimated by the Efficient Windows Collaborative (EWC) as no more than $0.50 per square foot of window area. It is important to note that many builders may already install windows that already meet the 2012 IECC slightly-improved 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.[2] Total window incremental costs are estimated as $179.

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[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 92%, indicating that construction costs in Denver are approximately 8% lower than the national average.

[2] As a result, many builders will be able to reduce or avoid incremental costs for better windows. ENERGYSTAR has a comparable estimate for the estimated $0.50 incremental costs per square foot:

Additionally, 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 50 percent in the 2009 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 $25.

For builders that are currently using "panned" floor joists as return air 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 flexible 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 $158 for the estimated 75 feet of return duct which some builders will have to upgrade under the 2012 IECC.

Additionally, many builders will have to upgrade the interior basement insulation. According to local building experts, most builders currently meet the 2009 IECC by installing basement wall or "hanging" fiberglass batt insulation to the inside of basement walls. To meet the 2012 code, these builders will have to upgrade from R-10 to R-15 batts. R-15 Hanging batts are not priced in RS Means and calls to local building suppliers yielded only the cost R-19 hanging insulation, which is priced at an additional $0.18 per square foot. Although the R-15 insulation should be less expensive than the quoted R-19, the $0.18 cost per square foot is used in this analysis, which adds $202 in incremental costs.

Fortunately, 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 5,

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http://www.energystar.gov/ia/partners/prod_development/archives/downloads/windows_doors/WindowsDoorsSkylights_DraftCriteriaAnalysis_CORRECTED.pdf?23b9-4fc2

[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.

builders are able to reduce the cooling system capacity from an average of 19,500 kBtuh to 16,500 kBtuh or from 1.625 to 1.375 tons. This reduction in air conditioner capacity can result in first-cost savings of one quarter ton, which is expected to save approximately $204 for the average new house.[6]

Table 1: Denver 2012 IECC Incremental Costs

Building Component	Total Area	Incremental Cost/Square Ft	Total	Location Factor	Adjusted Total
Ceiling Insulation Upgrade from R-38 to R-49	1,200	$0.41	$ 492.00	92%	$453
1st Floor Panned Return Ducts Upgraded to Flexible Ducts	75 linear ft	$2.29/lf	$ 171.75	92%	$158
Basement Wall Insulation Upgrade from R-10 to R-15 (R-19)	1,120	$0.18	$ 201.60	92%	$202
Upgrade Windows from U-.35 to U-.32	357	$0.50	$ 178.50	N/A	$179
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	$ 25
Bathroom Vent Fan Upgrades	N/A	N/A	N/A	N/A	$150
HVAC System Savings (downsizing 1/4th ton on average per new house)	N/A	N/A	N/A	N/A	-$204
Total Incremental Costs					**$1,412**

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 Denver, resulting in savings of between $270 and $286 per year,** depending on the type of exterior wall type builders select. In energy modeling simulations, R13+5 walls perform slightly better than R-20 walls, saving an additional $16 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 between $270 and $286 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.

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[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, so downsizing by one-quarter ton is not possible. However, for many builders the size and configuration of their 2,400 square foot home will mean they will be able to downsize by as much as a half-ton. Thus, one-quarter ton is expected to be saved on the average new 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 90,000 to 80,000 kBtuh.

This cash-flow difference is enough to pay back the buyer's added down-payment in approximately 16 to 17 months (or sooner if the loan allows a down payment below 20%). After that date, the owner continues to realize a profit of at least $205 annually due to 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 4.03 percent. This scenario would result in an increased down payment of $282 with an additional monthly mortgage cost of $5.41. Taking into account energy savings and lower utility bills, a cash flow analysis indicates that the homebuyer would break even within as little as 16 months. After that break-even date, **homeowners would continue to save between $205 and $221 annually,** after additional mortgage costs are subtracted from energy savings. 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

Exterior 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	$1,412	$24	$282 (plus $5/month)	**16 months**	**$221**
R-20 Walls, Studs 16" on center	$1,412	$23	$282 (plus $5/month)	**17 months**	**$205**

Conclusions

- As estimated in this analysis, incremental costs for new 2,400 square foot homes built to the 2012 IECC in Denver total $1,412 per new home.
- Annual energy savings for Denver homeowners attributable to the 2012 IECC range from $270 to $286, depending on which exterior wall type builders select.
- Assuming a conservative 20% down payment, new home buyers will break even on their initial investment in as few as 16 months and no more than 17 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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