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Utah Residents Buying 2012 IECC Homes Will Save Thousands

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

HIGHLIGHTS

- **Energy cost savings for a 2012 IECC home are estimated at between $351 and $629 per year ($29 - $52 per month), when compared to homes meeting the current energy code.**
- **Break-even on investment—the additional down payment and slight mortgage payment increase—occurs in 10 – 21 months.**
- **After the break-even point, homeowners achieve a net profit (energy savings less mortgage costs) of $250 to $532 annually.**
- **2012 IECC home buyers pocket $7,052 - $15,543 in net profits over the length of a 30 year mortgage term.**

SUMMARY

Utah residents buying new single family homes meeting the 2012 International Energy Conservation Code (IECC) will pocket between $7,052 to $15,543 in net energy savings over a 30 year mortgage term, according to an analysis of energy savings and incremental construction costs by the Building Codes Assistance Project and ICF, International.

This report assesses energy savings and incremental construction cost increases of new, 2,400 square foot single family homes in Utah that meet the latest model energy code, the 2012 IECC, compared to the current code in effect, the 2006 IECC. Specifically, this analysis finds an average new home meeting the 2012 IECC will cost an additional $1,926 to $3,081 over the construction costs of meeting the current energy code. **Energy cost savings are significant, however, and are estimated at between $351 and $629 per year, depending on the exterior wall type used by builders.**

The energy savings from the 2012 code are enough to pay back the buyer's additional down payment and slightly increased mortgage cost in approximately 10 to 21 months (*sooner if the homebuyer puts less than 20% down*). **After that date, the owner continues to pocket a profit (energy savings minus mortgage costs) of between $250 and $532 annually—money that would otherwise go to pay higher utility bills.** These net savings will be even greater if energy costs rise over the next 30 years consistent with historical trends.

Stated differently, monthly **utility bill savings to the homeowner are more than three 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 Utah. 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 state's current code. Although some leading builders are 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 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.

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. ICFI 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. ICFI 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

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 costs vary between Utah's climate zones[1], and are higher on average in Climate Zone 6, which occupies the northeastern corner of the state. 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.[2] For this analysis, RS Means data is supplemented by additional calls to local building suppliers and experts.

[1] Due to data availability, this analysis only includes Utah's climate zones 5 and 6, although one county in the southwestern corner of the state falls in climate zone 3.

[2] RS Means also includes a location factor, which provides an estimate of local costs as a percentage of RS Means national average estimates. For this analysis, the location factor for Salt Lake City, 81%, is used for climate zone 5, indicating that construction costs in climate zone 6 are approximately 19% lower than the national average. Likewise,

INCREMENTAL COSTS SHARED BY CLIMATE ZONES 5 AND 6

Windows

Builders in climate zones 5 and 6 will need to make window upgrades to meet the 2012 IECC to meet the improved U- factor in the 2012 IECC (.32 from .35). This added cost is conservatively estimated by the Efficient Windows Collaborative (EWC) as no more than $1.00 per square foot of window area. It is important to note that many builders may already install windows that meet the 2012 IECC's 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.[3] Total window incremental costs are estimated as $357.

Hard Ducted Returns in Basement Ceilings

For builders in both climate zones 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 flexible ducts at $4.58 per linear foot.[4] As such, the cost to upgrade ducts is estimated at $2.29 per linear foot, or $139 for the estimated 75 feet of return duct which some builders will have to upgrade under the 2012 IECC.

Whole House Air Leakage and Ventilation

We estimate that the additional required air sealing in the 2012 IECC and the required testing for whole house air leakage (commonly known as "blower door") and duct leakage will add about $350 per new home.[5] Because the resulting home will have fewer air and duct leaks to the outside, mechanical ventilation will have to be improved, a cost we estimate at $180 for upgrading one bathroom vent fan to a unit with an Energy Star rating along with the installation of a simple controller which is set to automatically exhaust indoor air.[6]

Hot Water Distribution Lines

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

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the location factor used in climate zone 5 is also 81%, which is the highest available location factor for any city in climate zone 6.

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

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

[5] $350 is a commonly used as an expected air sealing and testing cost for new single-family detached homes nationwide.

[6] Ventilation system and costs are described in an August 2005 report from Lawrence Berkeley National Laboratory "Review of Residential Ventilation Technologies." Although the costs of these components have decreased in recent years, the 2005 estimate ($180 per new home) is quoted in this analysis.

linear foot and most insulation products can be "clipped" around supply pipes after the plumbing rough-in.[7] As a result, this cost is estimated at $100 per new home.

Lighting and Programmable Thermostats
Builders will have to install high-efficiency lamps in 75 percent of hard-wired fixtures, up from zero percent in the 2006 IECC. Usually, this requirement is met with compact florescent lights (CFLs). Our analysis estimates that the upgrade of lamps in 75 percent of fixtures will cost no more than $50. Builders will also have to upgrade conventional thermostats to programmable thermostats, a cost which is estimated as $50.

Sealing and Insulating the Attic Hatch
To meet the 2012 IECC we 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 weatherstrip around the opening and adhere surplus insulation to the unconditioned side of the door. For attic pull-down stairs, builders can place a variety of kits over stair hatch, but costs are higher.

Interior Basement Insulation
Additionally, builders will have to upgrade the interior basement insulation in both climate zones. According to local building experts, many builders currently meet the 2009 IECC by installing basement wall 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 for 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.

INCREMENTAL COSTS UNIQUE TO CLIMATE ZONE 5

Exterior Walls
In climate zone 5, which encompasses the lower two thirds of the state and the capital, Salt Lake City, builders may have to make a small upgrade to exterior walls. The 2006 IECC requires new home walls to meet R-19 or R-13+5, while the 2012 IECC requires either R-20 or R-13+5. For builders who already build R13+5 walls, the code does not require a change, and these builders will not incur any additional incremental costs. However, for builders currently meeting the 2006 code with R-19 walls (a 2 x 6 framed wall with R-19 fiberglass batts) they will have to upgrade batt insulation slightly, to an R-20 high density fiberglass batt, a cost which is estimated by RS Means as 15 cents per square foot of wall area. This cost, as well as all other estimated incremental costs are summarized in a Table 1, below.

Attic Insulation
Among other changes, the 2012 IECC also requires builders to upgrade blown-in ceiling (attic) insulation from R-38 to R-49, which is estimated by RS Means to cost an additional $399 per new home.

[7] 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 5 City 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 (both blown-in)	1,200	$0.41	$ 492.00	81%	$399
1st Floor Panned Return Ducts Upgraded to Flexible Ducts	75 linear ft	$2.29/lf	$ 171.75	81%	$139
Basement Wall Insulation Upgrade from R-10 to R-15 (R-19)	1,120	$0.18	$ 201.60	N/A	$202
Upgrade Windows from U-.35 to U-.32	357	$1.00	$ 357.00	N/A	$357
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
Upgrade to Programmable Thermostats	N/A	N/A	N/A	N/A	$ 50
Bathroom Vent Fan Upgrade and Addition of Automatic Timer	N/A	N/A	N/A	N/A	$180
Sealing/Insulating Attic Hatch	N/A	N/A	N/A	N/A	$100
IF APPLICABLE: Upgrade R-19 walls to R-20 with high density fiberglass batts (R-13+5 walls exempted from this cost)	2,380	$0.15	$357	81%	$289
Incremental Cost (R-13+5 Walls)					**$1,926 OR**
Incremental Cost (2 x 6 Walls - includes R-19 to R-20 insulation cost)					**$2,215**

INCREMENTAL COSTS UNIQUE TO CLIMATE ZONE 6

Exterior Walls

The 2012 IECC would require builders in climate zone 6 (which takes up the northeast corner of the state) to make changes to a new home's exterior wall construction. At present, the 2006 IECC requires R-19 or R-13 + 5 walls for exterior walls, while the 2012 IECC mandates an insulation upgrade to R-20 + 5 or R-13+10 walls. For the purposes of this analysis, we assume that most builders will elect to meet the 2012 IECC by using R-20+5 walls. The incremental cost of the optional R13+10 wall, therefore, is not estimated in this analysis, as builders nationwide have shown a preference for the 20+5 wall assembly. Building the R-20+5 wall begins with a 2 x 6 wall and replaces a layer of conventional OSB sheathing with structurally insulated sheathing (SIS)—an engineered product that combines structural reinforcement of oriented strand board (OSB) with insulation equivalent to R-5, thus creating an R-20 + 5 wall.[8]

For builders currently meeting the 2006 IECC by building R-19 walls—which requires 2 x 6 wall construction—builders will have to upgrade cavity insulation from R-19 to R-21 fiberglass batt and replace of conventional OSB with SIS. For builders currently using 13 + 5 wood frame walls, upgrading to 20+5 walls will require builders to use 2 x 6 instead of 2 x 4 framing.[9] The larger framing allows for R-21

[8] Incremental cost for 13+5 walls relies on local building supply estimates for R5 structurally insulated sheathing (SIS). Incremental costs for walls with SIS also take into account savings from eliminating a conventional vapor barrier, a function that is included in SIS panels.

[9] Due to the superior strength of 2 x 6 stud 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 this wall assembly is not included in this analysis for clarity.

fiberglass batts to be placed between studs instead of the R-13 batts required in the 2009 IECC. Fortunately for these builders, they will likely already be familiar with R-5 SIS, as they are already using SIS or a similar product to meet the current R-13+5 wall.

Window Extension Jambs

Those builders in climate zone 6 currently meeting the 2006 IECC with 13+5 wall construction will incur an additional cost for window jamb extensions. These jamb extensions are required because the wall thickness increases with a change from 2 x 4 to 2 x 6 framing. While some window manufacturers offer jamb extensions as a factory-built option, most builders prefer to field-fabricate extension jambs, which are attached to the interior jamb of the window and create a consistent wood or drywall transition between the window and wall. These extensions, essentially four pieces of wood or drywall that "frame" the interior window jamb, are estimated at $300 after a brief survey of installers, who put costs at $10-12 per window. By contrast, the Ohio HBA estimates this cost as somewhat higher, at $390 per new house.

Extension jambs are not assumed to be an added cost for other wall types, as the 2012 IECC does not significantly increase overall wall thickness (SIS vs. OSB). For builders already building R-19 walls, 2006 IECC compliant homes likely require extension jambs already, and will thus be unaffected by the 2012 IECC wall requirements. Instead, this change will only affect cost for the small percentage of builders in climate zone 6 who meet the current code with 2 x 4 framing.

Total Incremental costs for new homes in Utah's climate zone 6 are estimated in Table 2, below:

Table 2: Climate Zone 6 2012 IECC Incremental Costs

Building Component	Total Area	Incremental Cost/Square Ft	Total	Location Factor	Adjusted Total
Upgrade from R-19 walls to 20+5	2,380	$0.30	$ 714.00	81%	$578
OR Upgrade from R13+5 walls to 20+5	2,380	$0.65	$ 1,47.00	81%	**OR** $1,253
1st Floor Panned Return Ducts Upgraded to Flexible Ducts	75 linear ft	$2.29/lf	$ 171.75	81%	$139
Basement Wall Insulation Upgrade from R-10 to R-15 (R-19)	1,120	$0.18	$ 201.60	N/A	$202
Upgrade Windows from U-.35 to U-.32	357	$1.00	$ 357.00	N/A	$357
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
Upgrade to Programmable Thermostats	N/A	N/A	N/A	N/A	$ 50
Bathroom Vent Fan Upgrade and Addition of Automatic Timer	N/A	N/A	N/A	N/A	$180
Sealing/Insulating Attic Hatch	N/A	N/A	N/A	N/A	$100
Window Extension Jambs (only for builders using R-13+5 walls)	N/A	N/A	N/A	N/A	$300
Incremental Cost (Builders Currently Using 2 x 6, R-19 Walls)					**$2,106 OR**
Incremental Cost (Builders Currently Using R-13+5 Walls)					**$3,081**

ENERGY COST SAVINGS

According to the model used in this analysis, **upgrading to the 2012 IECC will result in significant energy cost savings for Utah home buyers, resulting in savings of between $351 and $629 per year,** depending on the type of exterior wall type builders select. 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. These energy savings allow homebuyers to quickly recapture their incremental costs. Annual energy savings are presented in Table 3, below, by climate zone and current exterior wall type.

Table 3: 2012 IECC Energy Savings by Climate Zone and Wall Type

Climate Zone and Wall Types	Annual Energy Savings
Climate Zone 5: Houses with R-13+5 Walls	$364
Climate Zone 5: Houses with R-20 Walls (assuming R-19 current practice)	$351
Climate Zone 6: Houses with R-20+5 Walls (assuming R-19 current practice)	$629
Climate Zone 6: Houses with R-20+5 Walls (assuming R13+5 current practice)	$629

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 $351 and $629 per year, monthly utility bill savings are more than three 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 approximately 10 to 21 months after purchase (or sooner if the loan allows a down payment below 20%). After that date, the owner continues to realize a profit of at least $250 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 between $385 to $616 with an additional monthly mortgage cost of between $7 and $15 per month. Taking into account energy savings and lower utility bills, a cash flow analysis indicates that the homebuyer would break even within as little as 10 months. After that break-even date, **homeowners would continue to realize a profit of $250 and $532 annually,** which is calculated by subtracting additional mortgage costs 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 4, below.

Table 4: Mortgage Payback for Homebuyers by Climate Zone and Exterior Wall Type						
Exterior Wall Type	**Incremental Costs**	**Energy Savings/ Year and Month per home**	**Down Payment Increase (and Mortgage Increase per Month)**	**Breakeven Point**	**Annual Profit for Homeowner after Breakeven Point**	**Gross Profit over Mortgage Term (Energy Savings Minus Mortgage Costs)**
Climate Zone 5, R-13+5 Walls (R-13+5 current practice)	$1,926	$364/year ($30/ month)	$385 (plus $7/month)	**17 months**	**$275**	**$7,876**
Climate Zone 5, R-20 Walls (R-19 current practice)	$2,215	$351/year ($29/month)	$443 (plus $8/month)	**21 months**	**$250**	**$7,052**
Climate Zone 6, R-20+5 Walls (R-19 current practice)	$2,106	$629/year ($52/month)	$421 (plus $8/month)	**10 months**	**$532**	**$15,543**
Climate Zone 6, R-20+5 Walls (R-13+5 current practice)	$3,081	$629/year ($52/month)	$616 (plus $15/month)	**16 months**	**$452**	**$12,946**

CONCLUSIONS

- As estimated in this analysis, incremental costs for new 2,400 square foot homes built to the 2012 IECC in Utah total $1,926 to $3,081 per new home.
- Annual energy savings for Utah homeowners attributable to the 2012 IECC range from $351 to $629, 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 10 months and no more than 21 months after purchase.
- Gross profit for Utah home buyers over a 30 year mortgage term ranges from $7,052 to $15,543.

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. BCAP is a project of the Alliance to Save Energy, a nonprofit organization that promotes energy efficiency worldwide through research, education, and advocacy.

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