

## Costs

### Price Quotes

**Methodology:** Price quotes provided by current Utah homebuilders, suppliers and industry specialists

Discussion: Nexant worked with its network of trade allies and industry contacts to quantify the cost impact of residential construction under IECC 2012 compared to IECC 2009. This evaluation consisted of asking vendors and contractors to establish the difference in building costs. Takeoffs of the building were provided by Nexant and approved by the Ad Hoc committee. Local builders were then asked to fill in costs using the takeoff. Nexant received data from builders for Climate Zones 5 and 6 but did not receive any from Climate Zone 3. Takeoffs, however, were provided on a cost per square foot basis and it is assumed that material costs do not vary significantly between climate zones. The takeoff used can be seen in Figure 7 and Figure 8 in the Appendix.

Two measures - reduced infiltration and duct sealing - were not included in the takeoff. Prices for these measures were taken from "ENERGY STAR Qualified Homes, Version 3 Thermal Enclosure System Rater Checklist Savings & Cost Estimate."<sup>1</sup> Costs were scaled based on square footage, and applied to the prototypical homes.

Cooling and heating equipment sizing and associated costs were accounted for in both modeling and pricing. Cost reductions due to sizing downgrades were deducted from final costs in applicable climate zones and housing models. Table 7 and Table 8 list price reductions for each of the homes. Cost was not reduced for the townhouse model because there was no difference in cost below 1.5 tons nor were there heating equipment reductions.

**Table 7 - Cooling Equipment Cost Reductions**

	Climate Zone		
	3	5	6
<b>Single Family Slab</b>	\$ 154	\$ 68	\$ -
<b>Single Family Basement</b>	\$ 312	\$ 86	\$ 154
<b>Townhouse</b>	\$ -	\$ -	\$ -

**Table 8 - Heating Equipment Cost Reductions**

	Climate Zone		
	3	5	6
<b>Single Family Slab</b>	\$ 16.50	\$ 16.50	\$ 16.50
<b>Single Family Basement</b>	\$ 16.50	\$ 16.50	\$ 16.50
<b>Townhouse</b>	-	\$ -	-

<sup>1</sup>[http://www.energystar.gov/ia/partners/bldrs\\_lenders\\_raters/downloads/EstimatedCostandSavings.pdf](http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/EstimatedCostandSavings.pdf)

Because mark-up costs are arbitrary and vary between builders, the Ad Hoc group agreed to use wholesale prices which do not include any mark-up costs.

Historically, when new codes are adopted, prices on the equipment required by the new code tend to fall. Once a code is adopted, the reduction in price is driven by market forces. The magnitude of the reduction is difficult to estimate in advance and has not been factored into this analysis.

## Savings

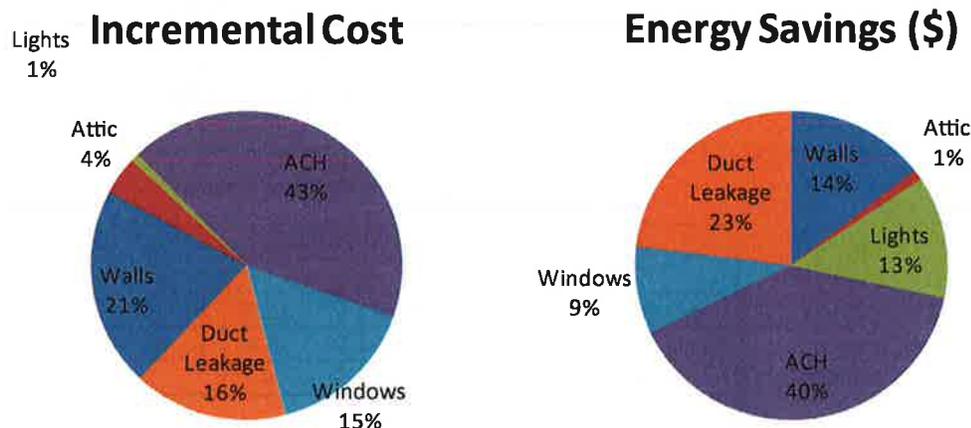
### Energy Cost Savings for Single-Family Housing

The following tables present the results of compiled costs and energy cost savings determined using REMRate software. Both types of single family dwelling units were simulated. Table 9 includes the cost results by measure for the slab-on-grade configuration. Table 10 provides results for the heated basement configuration.

**Table 9- Energy Cost Savings Summary for Single-Family Housing Plan with Slab-on-Grade Foundation**

Measure	Climate Zone 3			Climate Zone 5			Climate Zone 6		
	Incremental Cost	Energy Cost Savings	Simple Payback	Incremental Cost	Energy Cost Savings	Simple Payback	Incremental Cost	Energy Cost Savings	Simple Payback
Walls	\$ 828.12	\$ 58.96	14.0	\$ -	\$ -	-	\$ 351.90	\$ 56.19	6.3
Attic	\$ 86.70	\$ 3.95	21.9	\$ 141.70	\$ 5.25	27.0	\$ -	\$ -	-
Lights	\$ 16.00	\$ 34.12	0.5	\$ 16.00	\$ 31.48	0.5	\$ 16.00	\$ 36.37	0.4
ACH	\$ 803.00	\$ 64.54	12.4	\$ 803.00	\$ 103.25	7.8	\$ 803.00	\$ 147.50	5.4
Windows	\$ 421.99	\$ 41.81	10.1	\$ 227.42	\$ 10.76	21.1	\$ 227.42	\$ 20.12	11.3
Duct Leakage	\$ 301.13	\$ 49.73	6.1	\$ 301.13	\$ 55.64	5.4	\$ 301.13	\$ 78.35	3.8
Eqp Sizing	\$ (170.50)	\$ -	0.0	\$ (84.70)	\$ -	0.0	\$ (16.50)	\$ -	0.0
Total	\$ 2,286.43	\$ 253.11	9.0	\$ 1,404.55	\$ 206.38	6.8	\$ 1,682.95	\$ 338.52	5.0

**Figure 1- Incremental Cost and Cost Savings Distribution by Measure for Single-Family Home with Slab-On-Grade Foundation**

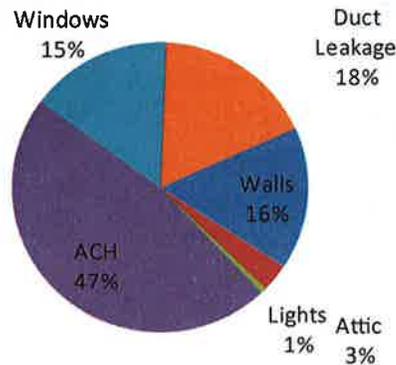


**Table 10- Energy Cost Savings Summary for Single-Family Housing Plan with Heated Basement**

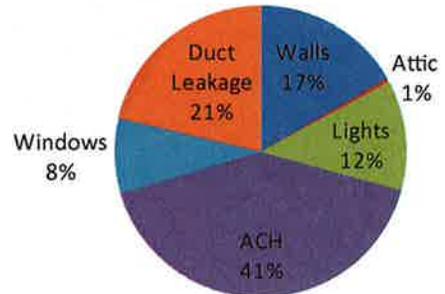
Measure	Climate Zone 3			Climate Zone 5			Climate Zone 6		
	Incremental Cost	Energy Cost Savings	Simple Payback	Incremental Cost	Energy Cost Savings	Simple Payback	Incremental Cost	Energy Cost Savings	Simple Payback
Walls	\$ 828.12	\$ 126.50	6.5	\$ -	\$ -	-	\$ 351.90	\$ 51.37	6.8
Attic	\$ 86.70	\$ 3.77	23.0	\$ 141.70	\$ 1.67	85.1	\$ -	\$ -	-
Lights	\$ 16.00	\$ 46.45	0.3	\$ 16.00	\$ 43.28	0.4	\$ 16.00	\$ 41.26	0.4
ACH	\$ 1,174.00	\$ 90.54	13.0	\$ 1,174.00	\$ 146.03	8.0	\$ 1,174.00	\$ 203.40	5.8
Windows	\$ 568.30	\$ 56.40	10.1	\$ 296.31	\$ 14.17	20.9	\$ 296.31	\$ 19.42	15.3
Duct Leakage	\$ 440.25	\$ 60.64	7.3	\$ 440.25	\$ 72.05	6.1	\$ 440.25	\$ 95.21	4.6
Eqp Sizing	\$ (328.90)	\$ -	0.0	\$ (102.30)	\$ -	0.0	\$ (170.50)	\$ -	0.0
Total	\$ 2,784.47	\$ 384.30	7.2	\$ 1,965.97	\$ 277.19	7.1	\$ 2,107.97	\$ 410.65	5.1

**Figure 2- Incremental Cost & Cost Savings Dist. by Measure for Single-Family Home with Basement**

**Incremental Cost**



**Energy Savings (\$)**



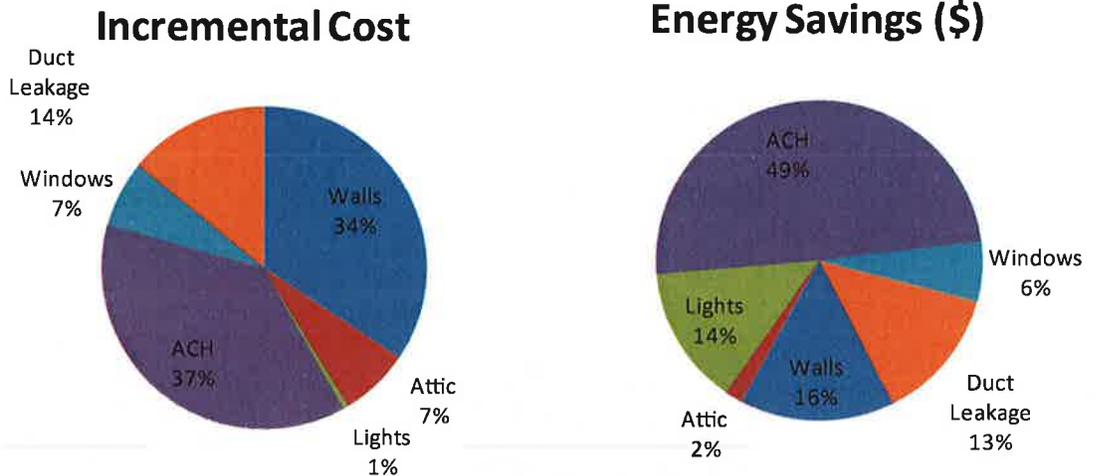
## Energy Cost Savings for Multi-Family Housing

Energy cost savings for the multi-family configuration were determined using REMRate Software as well. The results were compiled by measure for each climate zone. Cost savings are most attractive in climate zone 6 which has a payback of less than 10 years.

**Table 11-Energy Cost Savings Summary for Multi-Family Home**

Measure	Climate Zone 3			Climate Zone 5			Climate Zone 6		
	Incremental Cost	Energy Cost Savings	Simple Payback	Incremental Cost	Energy Cost Savings	Simple Payback	Incremental Cost	Energy Cost Savings	Simple Payback
Walls	\$ 1,400.97	\$ 45.80	\$ 30.59	\$ -	\$ -	-	\$ 219.60	\$ 37.20	5.9
Attic	\$ 113.53	\$ 4.66	24.4	\$ 214.38	\$ 4.30	49.9	\$ -	\$ -	-
Lights	\$ 8.00	\$ 26.24	0.3	\$ 8.00	\$ 25.53	0.3	\$ 8.00	\$ 23.69	0.3
ACH	\$ 589.33	\$ 54.82	10.8	\$ 589.33	\$ 89.27	6.6	\$ 589.33	\$ 121.55	4.8
Windows	\$ 57.49	\$ 20.11	2.9	\$ 127.21	\$ 5.60	22.7	\$ 127.21	\$ 6.82	18.6
Duct Leakage	\$ 221.00	\$ 18.21	12.1	\$ 221.00	\$ 23.36	9.5	\$ 221.00	\$ 30.62	7.2
Eqp Sizing	\$ -	\$ -	0.0	\$ -	\$ -	0.0	\$ -	\$ -	0.0
Total	\$ 2,390.32	\$ 169.82	14.1	\$ 1,159.93	\$ 148.06	7.8	\$ 1,165.14	\$ 219.88	5.3

**Figure 3- Incremental Cost and Cost Savings Distribution by Measure for Multi-Family**



## Energy Savings by Climate Zone

This section displays results of energy savings by climate zones and broken down by energy type. Energy savings for the individual measures as well as a simulation including all measures was calculated. The energy savings contribution to an entire building built to IECC 2012 standards is also broken down in the figures.

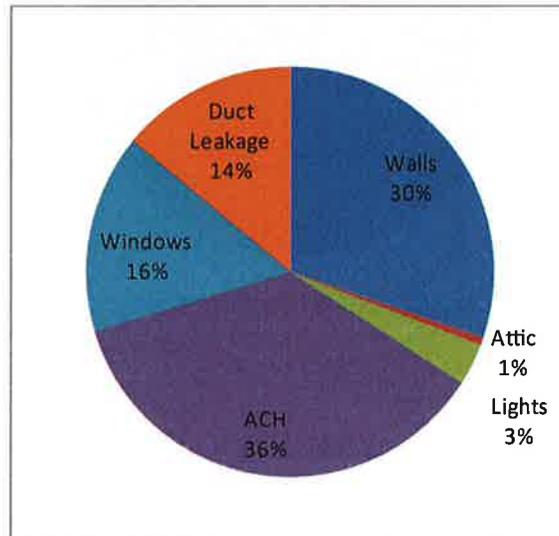
Climate Zone 3 includes southwest Utah and is considerably warmer than climate zones 5 and 6. It has a higher cooling load and a shorter heating season. Table 12 is a summary of the energy savings achieved by each measure individually, as well as an overall code compliant home in climate zone 3.

Figure 4 is the averaged energy savings contribution for each measure when combined into an overall IECC 2012 code compliant building.

**Table 12- Energy Savings Summary for Climate Zone 3**

Measure	Multi-Family			Single-Family Slab-on-Grade			Single-Family Heated Basement		
	Elect Savings (kWh)	Gas Savings (Therms)	% Energy Change	Elect Savings (kWh)	Gas Savings (Therms)	% Energy Change	Elect Savings (kWh)	Gas Savings (Therms)	% Energy Change
Walls	122	50	-7%	160	64	-6%	670	96	-9%
Attic	21	4	-1%	13	4	1%	11	4	0%
Lights	336	-5	-1%	433	-6	-1%	596	-9	-1%
ACH	42	73	-9%	49	86	-8%	66	121	-10%
Windows	69	20	-3%	164	39	-4%	226	52	-5%
Duct Leakage	95	14	-2%	293	34	-4%	353	42	-4%
<b>Total</b>	<b>680</b>	<b>159</b>	<b>-22%</b>	<b>1113</b>	<b>220</b>	<b>-23%</b>	<b>1423</b>	<b>270</b>	<b>-25%</b>

**Figure 4-Energy Savings Distribution by Measure for Climate Zone 3**

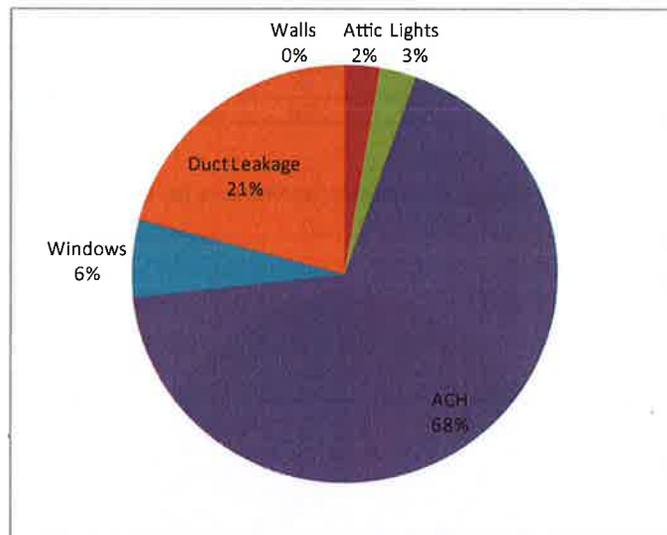


Climate zone 5 is the largest zone in the state and includes major metropolitan areas such as Salt Lake City and Orem. Table 13 is a summary of the energy savings achieved by each type of equipment individually, as well as an overall code compliant home in climate zone 5. Figure 5 displays the averaged energy savings contribution for each measure when combined into an overall IECC 2012 code compliant building. Please note that the wall insulation requirements in climate zone 5 do not change from IECC 2009 to IECC 2012.

**Table 13- Energy Savings Summary for Climate Zone 5**

Measure	Multi-Family			Single-Family Slab-on-Grade			Single-Family Heated Basement		
	Elect Savings (kWh)	Gas Savings (Therms)	% Energy Change	Elect Savings (kWh)	Gas Savings (Therms)	% Energy Change	Elect Savings (kWh)	Gas Savings (Therms)	% Energy Change
Walls	0	0	0%	0	0	0%	0	0	0%
Attic	9	5	-1%	4	7	-1%	3	2	0%
Lights	328	-5	-1%	419	-8	-1%	576	-11	-1%
ACH	20	125	-14%	-4	148	-13%	-11	210	-15%
Windows	0	8	-1%	-5	16	-1%	-6	21	-1%
Duct Leakage	90	22	-3%	249	48	-5%	300	65	-5%
<b>Total</b>	<b>449</b>	<b>150</b>	<b>-18%</b>	<b>638</b>	<b>208</b>	<b>-20%</b>	<b>860</b>	<b>280</b>	<b>-21%</b>

**Figure 5 - Energy Savings Distribution by Measure for Zone 5**



Climate zone 6 is located in northern Utah and is the coldest of the three climate zones. Table 14 is a summary of the energy savings achieved by individual measures as well as an overall IECC 2012 code compliant building in climate zone 6. Figure 6 displays the averaged energy savings contribution for each individual measure when combined in an overall IECC 2012 code compliant building. Please note that roof insulation requirements do not change in climate zone 6 between IECC 2009 and IECC 2012.

**Table 14- Energy Savings Summary for Climate Zone 6**

Measure	Multi-Family			Single-Family Slab-on-Grade			Single-Family Heated Basement		
	Elect Savings (kWh)	Gas Savings (Therms)	% Energy Change	Elect Savings (kWh)	Gas Savings (Therms)	% Energy Change	Elect Savings (kWh)	Gas Savings (Therms)	% Energy Change
Walls	9	52	-5%	10	79	-5%	11	72	-4%
Attic	0	0	0%	0	0	0%	0	0	0%
Lights	323	-7	0%	411	0	0%	569	-13	0%
ACH	13	172	-16%	-26	214	-14%	-35	295	-16%
Windows	-2	10	-1%	-10	30	-2%	-10	29	-2%
Duct Leakage	85	33	-3%	213	85	-6%	269	102	-6%
Total	438	255	-25%	564	356	-25%	806	461	-27%

**Figure 6 - Energy Savings Distribution by Measure for Zone 6**

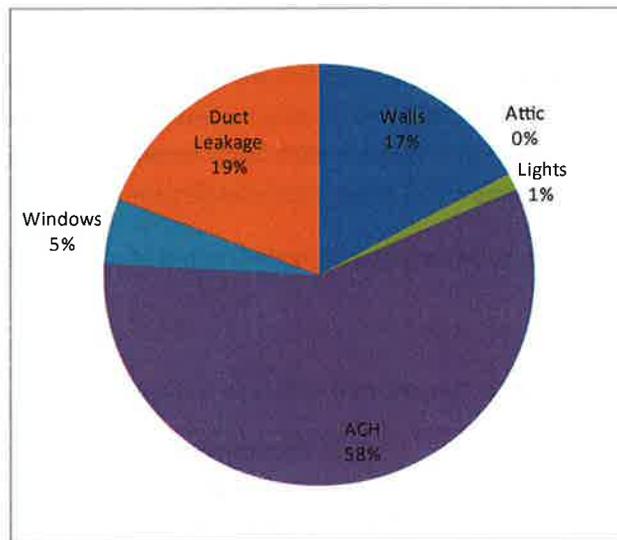


Table 15 is a summary of the energy savings as they relate to measure cost for each individual measure by zone. The overall energy reduction is given in kbtus, the incremental cost is the additional cost to go from IECC 2009 to IECC 2012 compliance and the ratio of the two is provided to show the value. A higher ratio of energy savings per dollar indicates a greater measure value. In all zones the measure that produced the greatest energy savings with the lowest cost was increasing high-efficacy lighting from 50% to 75%. Attic insulation provided the lowest energy savings per dollar spent in climate zones 3 and 5.

**Table 15- Energy Savings and Cost Comparison by Climate Zone**

Measure	Zone 3			Zone 5			Zone 6		
	Energy Savings (kbtu)	Incremental Cost	kbtu/\$	Energy Savings (kbtu)	Incremental Cost	kbtu/\$	Energy Savings (kbtu)	Incremental Cost	kbtu/\$
Walls	8100	\$ 1,019.07	7.9	-	-	-	6467	\$ 307.80	21.0
Attic	167	\$ 95.65	1.7	467	\$ 165.93	2.8	-	-	-
Lights	933	\$ 13.33	70.0	633	\$ 13.33	47.5	533	\$ 13.33	40.0
ACH	9567	\$ 855.44	11.2	16067	\$ 855.44	18.8	22367	\$ 855.44	26.1
Windows	4300	\$ 349.26	12.3	1500	\$ 216.98	6.9	2000	\$ 216.98	9.2
Duct Leakage	3900	\$ 320.79	12.2	5167	\$ 320.79	16.1	7433	\$ 320.79	23.2
Eqp Sizing		\$ (166.47)			\$ (62.33)			\$ (62.33)	
Total	25300	\$ 2,487.07	10.2	23400	\$ 1,510.15	15.5	37467	\$ 1,652.02	22.7

### Weighting factors

Simulations were conducted in one weather location per climate zone. Simulation results from individual climate zones were weighted based on new residential building permit data for the years 2008-2009<sup>2</sup>. Table 16 shows the shares of state-wide construction listed by IECC climate zone. Notice climate zone five claims 70% of new construction for the state.

Table 17 lists weighting factors by percentage of single family and multi-family homes built in Utah<sup>3</sup>.

**Table 16- Housing Start Shares by Climate Zone**

Climate Zone	Percentage of Building Permits
3	9.13%
5	70.5%
6	20.33%

<sup>2</sup> Most recent available building permit information was gathered from the state sample generator at [www.energycode.pnl.gov](http://www.energycode.pnl.gov). Data is averaged for the years 2008 and 2009.

<sup>3</sup> Data from <http://www.realestatenewsutah.com/news/utahs-improving-home-building-sector-26128> for the year of 2009.

**Table 17- Building Type Shares (percent)**

<b>Building Type</b>	<b>Weighting Factor (percent)</b>
Single Family	73%
Multifamily	27%

## Appendix

Table 18 - Final Results Summary by SQFT

	Zone 3	Zone 5	Zone 6
Incremental Cost/ SqFt	\$ 1.13	\$ 0.69	\$ 0.75
Savings/ SqFt	\$ 0.12	\$ 0.10	\$ 0.15
Simple Payback	9.25	7.17	5.13
<b>Total Simple Payback (Weighted)</b>	<b>6.88</b>		

Table 19 - Single Family Housing Incremental Cost/SQFT

	Zone 3	Zone 5	Zone 6
Inc Cost	\$ 1.05	\$ 0.70	\$ 0.79
Savings	\$ 0.13	\$ 0.10	\$ 0.16
Weight	0.09	0.71	0.2
Wtd Cost	\$ 0.09	\$ 0.50	\$ 0.16
Wtd Savings	\$ 0.01	\$ 0.07	\$ 0.03
Payback	6.56		

Table 20 – Multi-Family Housing Incremental Cost/SQFT

	Zone 3	Zone 5	Zone 6
Inc Cost	\$ 1.35	\$ 0.66	\$ 0.66
Savings	\$ 0.10	\$ 0.08	\$ 0.12
Weight	0.09	0.71	0.2
Wtd Cost	\$ 0.12	\$ 0.47	\$ 0.13
Wtd Savings	\$ 0.01	\$ 0.06	\$ 0.02
Payback	7.74		