BCAP Dedicated to the adoption, implementation, and advancement of building energy codes

The Building Codes Assistance Project

Incremental Construction Cost Analysis for New Homes

Building to the 2009 IECC

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Executive Summary

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. One major barrier to energy code adoption is the 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.

In an effort to address this concern, BCAP undertook a study to quantify the incremental construction cost of upgrading to the 2009 IECC in each state where such analysis was feasible. BCAP's incremental construction cost analysis indicates that for states to move from their current residential energy code to the 2009 IECC would result in a weighted average incremental cost of $840.77 per new home. On average, the annual energy savings per home are $243.37, meaning the simple payback for homeowners would occur, on average, in 3.45 years. We believe these cost estimates are conservative and represent an upper bound on incremental cost, as they utilize only traditional building techniques, and do not take advantage of technologies or performance tradeoffs that would lower those costs, as well as improve energy performance.

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Introduction

The construction and operation of buildings in the U.S. accounts for over 40% of all energy use. Improving the energy efficiency of the residential building sector therefore represents a unique opportunity to reduce energy use nationally and save money for homeowners. According to a recent estimate, by 2030 new homes – those built between 2005 and 2030 - will make up roughly 30% of all homes in the U.S[1]. These new homes represent an opportunity to make a significant impact on the amount of energy consumed by the residential building energy sector.

Building a foundation for energy-saving improvements across the building stock begins with building energy codes. Applied alongside conventional health and safety codes regulating building construction, building energy codes present an opportunity to ensure that homes are built to the latest energy efficient standards.

While the need for more advanced energy codes is widely acknowledged, the added costs of improving energy codes is often unknown or speculative. To address the debate over what additional costs (if any) are incurred by building to the latest energy code, BCAP has undertaken the following study to uncover the added construction costs (or incremental costs) for each state should it upgrade from current practice to the most efficient building code available, in this case the 2009 IECC.

To complete our analysis, BCAP drew heavily on a Department of Energy (DOE) study, *Impacts of the 2009 IECC for Residential Buildings at State Level*. The DOE study exhaustively documents the specific code changes required in each state. Our analysis leverages the DOE study by pairing the building components identified by DOE with their actual costs – for both building materials and labor. By tabulating the cost changes for each building component identified by DOE, we were able to quantify the incremental cost for each climate zone within a state, and the state as a whole.

The analysis includes 29 of the 50 U.S. states (representing 51.22% of the U.S. population) and the District of Columbia. Among the 31 states and the District of Columbia that were excluded from this study, eleven states (23.98% of population, including Washington D.C.) were excluded by DOE's report as well because they determined the state was already at or above the requirement of the 2009 IECC[2]. For four states (7.07% of population) DOE could find no equivalent energy code as a baseline for analysis. For the remaining seven home rule states (17.73% of population), each lacks a statewide code, and therefore because energy codes vary

[1] EPA White Paper*:* Where Will Everybody Live*? Arthur C. "*Chris*"* Nelson*, Virginia Tech. 2007*
[2] State Population in 2009 (http://www.census.gov/popest/states/tables/NST-EST2009-01.xls)

between municipalities, it is impossible to assess or approximate a statewide code as the basis of an analysis. [3]

[3] See Appendix A for additional details.

Literature Review

BCAP identified a number of studies at the local and national levels that attempt to quantify the incremental construction costs of adopting the 2009 IECC. These studies included work primarily from energy departments and corresponding advocacy groups throughout the country.

The primary resource used throughout this study was the U.S. Department of Energy (DOE) report titled *Impacts of the 2009 IECC for Residential Buildings at State Level*[4]. The Department of Energy report outlines the energy savings available to states if they upgrade from their current energy code to the 2009 IECC. Although the report shows energy savings achieved by moving to the 2009 IECC, it does not show how much this move will cost homeowners and builders. Additionally, while the DOE study estimates energy savings by state, it does not vary energy prices by state. In all states, the model assumes that homes in all states use a combination of a natural gas furnace (with a price of $1.20/therm) and a central electric air conditioning system ($0.12/kWh).

In addition to DOE's nationwide analysis, BCAP's analysis draws on a number of existing studies commissioned by states that attempt to estimate the energy savings and financial costs of moving to a more efficient energy code. Although these reports do not specifically address the 2009 IECC, they do provide BCAP with an established empirical method for conducting cost increment analysis[5][6][7][8].

Lastly, we used the *RS Means Residential Detailed Cost Contractor's Pricing Guide: 2009* as our primary reference material to isolate the cost of building materials and labor for each state. RS Means is one of the most widely used construction cost data sources by builders and contractors working on both new and renovated homes. RS Means outlines both material and labor costs on an average nationwide basis and provides cost adjustments for localities within a state. It is important to note that because RS Means is not product specific, the costs tend to be conservative and do not always represent true costs of materials at building supply stores.

These resources have provided us with a strong case for pursuing the research within this study. Although many studies by various advocacy groups and government agencies focus

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[4] U.S. Department of Energy – Building Energy Codes Program. *Impacts of the 2009 IECC for Residential Buildings at State Level*, September 2009.
[5] Lucas, R.G. *Analysis of Energy Savings Impacts of New Residential Energy Codes for the Gulf Coast.* January 2007.
[6] Musser, Amy Ph.D., P.E. *Energy Impact Study of the 2003 IECC, 2006 IECC, and 2006 IRC Energy Codes for Nebraska.* Vandermusser Design, LLC. September 19, 2006.
[7] Lucas, R.G. *Assessment of Impacts from Updating Iowa's Residential Energy Code to Comply with the 2003 International Energy Conservation Code.* October 2003.
[8] Blumentals, Janis, Moy, James, Hanson, Jeffrey, Wockenfuss, Erick. *Study and Recommendations to Improve the Construction of New Multi-Family Residential Buildings*. September 30, 2005.

greatly on the energy savings that can be achieved by adopting a newer energy code like the 2009 IECC, few cover the costs. Providing this information to the public through this study fulfills a gap in current research and creates a foundation for the assertion that energy savings can be achieved without large incremental cost increases.

Summary of Key Findings

Our analysis indicates that moving from current practice to the 2009 IECC for new residential homes will result in a weighted average incremental cost of $840.77 per new home. Statewide incremental costs range from a weighted average of $556.18 in Wisconsin to $1,873.00 in Minnesota. According to DOE, the weighted average annual energy savings per home are $243.37, which, paired with the incremental cost, means that the simple payback for homeowners would occur, on average, in 3.45 years. For further detail on these two states, see Appendix B and C. For detailed cost data on all states below, please see the attached Excel based model[9].

State	Weighted Average Incremental Cost	Median Energy Savings	Simple Payback
Alabama	$ 668.76	$ 205.00	3.26
Arizona	$ 570.38	$ 217.00	2.63
Colorado	$ 922.73	$ 239.50	3.85
Connecticut	$ 897.42	$ 235.00	3.82
Georgia	$ 675.36	$ 206.00	3.28
Idaho	$ 872.81	$ 235.50	3.71
Iowa	$ 863.69	$ 260.50	3.32
Kansas	$ 1,403.96	$ 468.50	3.00
Kentucky	$ 773.92	$ 336.00	2.30
Louisiana	$ 572.43	$ 188.50	3.04
Massachusetts	$ 910.99	$ 200.50	4.54
Mississippi	$ 699.54	$ 211.50	3.31
Michigan	$ 965.19	$ 274.00	3.52
Minnesota	$ 1,873.00	$ 315.00	5.95
Missouri	$ 1,607.74	$ 459.00	3.50
Nevada	$ 777.15	$ 228.50	3.40
New Mexico	$ 619.18	$ 233.50	2.65
New York	$ 835.82	$ 259.00	3.23
North Carolina	$ 1129.93	$ 221.50	5.10
North Dakota	$ 903.79	$ 343.00	2.63
Ohio	$ 803.04	$ 229.00	3.51

[9] Weighted averages are based on number of single family permits in each climate zone within a state. See Appendix G for further information.

State	Weighted Average Incremental Cost	Median Energy Savings	Simple Payback
Pennsylvania	$ 697.79	$ 240.50	2.90
South Carolina	$ 546.37	$ 207.00	2.64
South Dakota	$ 1,331.27	$ 405.00	3.29
Utah	$ 825.20	$ 242.00	3.41
Virginia	$ 582.07	$ 225.00	2.59
Wisconsin	$ 556.18	$ 220.00	2.53
Wyoming	$ 1,288.23	$ 391.00	3.29

Weighted Incremental Cost	**$ 840.77**	**$ 243.37**	**3.45**

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Methodology

House Model

In order to provide detailed incremental cost estimates for states, BCAP relied on an important study created by the U.S. Department of Energy (DOE) titled *Impacts of the 2009 IECC for Residential Buildings at State Level*. This report was critical to our study, as it documents each building element (windows, insulation, testing requirements, etc.) that would change in a move from the current energy code to the 2009 IECC. In addition to providing a detailed breakdown of construction changes under the 2009 IECC, DOE used a computer model to demonstrate the energy savings that homeowners would achieve under the new code. To do so, the DOE model assumed a 2,400 square foot house with regional modifications to the foundation system to reflect local building practice (For further detail about the model house please see Appendix E). The DOE model house is significant for our study because it provided the building template for our cost increment analysis. For example, when calculating the cost change for upgraded windows from current practice to the 2009 IECC, we assumed the same window area as DOE[10]. By using the DOE model house in our analysis, we are also able to compare our incremental construction cost estimates with DOE-generated energy savings – thus creating a helpful comparison of simple payback for potential homebuyers[11].

Cost Increment Analysis

Using the DOE study, we began our analysis by compiling a list identifying every building element that would change in the move to the 2009 IECC for each climate zone within a state. To determine if there would be any additional construction cost for each building component that was upgraded under the 2009 IECC, we priced out all building components that change from the state's current practice and the 2009 IECC. For each building component, we recorded the cost of the component under current practice and its cost if it was upgraded under the 2009 IECC.

For example, if a builder in a state would be required to upgrade wall insulation under the 2009 IECC, we priced out the insulation and labor costs under current practice and the cost of the insulation and labor costs under the 2009 IECC. If the wall cavity would not accommodate the insulation upgrade under current practice, we also altered the wall thickness, increasing the framing elements from 2 x 4 studs 16" on center to 2 x 6 studs 16" on center, and reflecting the

[10] Windows data was provided by the Efficient Windows Collaborative. Further information can be found on their website: http://www.efficientwindows.org/
[11] Energy savings estimated by the DOE model assume the same pre-2009 IECC baseline that was used in the cost increment analysis.

additional cost and labor as well[12]. By subtracting the costs of the insulation and labor under current practice from the insulation cost and labor mandated by the 2009 IECC, we were able to arrive at the incremental cost for that building component under the new model code. After making a similar calculation for all other code changes required under the 2009 IECC, we were able to produce an incremental cost estimate for a new single-family home for each climate zone within a state.

Construction Cost Data and Location Factors

Construction cost data was drawn from a well-regarded source, *RS Means Residential Detailed Cost Contractor Pricing Guide: 2009*, and included both the construction material cost, labor cost, and contractor overhead and profit. Each material cost is not product specific, and represents an average component cost that contractors use throughout the country. Because standard construction materials and labor rates range widely across the U.S., we modified RS Means' average prices to reflect building costs and labor in each state. To do so, we drew on RS Means' location factors, which are local jurisdiction based estimates that approximate local cost as a percentage of the national average. For instance, construction and labor cost only cost 86% of the national average in Miami, Florida and 109% of the national average in Hartford, Connecticut. Unfortunately, RS Means provides location factors that are only georeferenced to cities and towns, while we sought an average construction cost adjustment factor for each climate zone within a state.

To approximate construction cost for each climate zone, we merged three data sets: 1) the U.S. Census' county-level construction permit data[13], 2) RS Means Construction Cost location factor data and 3) county-level climate zone data defined in the 2009 IECC. By doing so, we were able to identify the jurisdiction within each climate zone that had the most permit activity, i.e. the most new single-family home starts. For the state of Georgia, for example, in climate zone 3 the county with the most construction activity was Fulton County. Fulton County's capital, Atlanta, has a location factor in RS Means of $0.90—10% lower than the national average. Therefore, in our analysis, we modified the national average materials and labor costs in Georgia's climate zone 3 by a factor of 0.90, effectively reducing the anticipated construction cost by 10%.

To approximate a statewide average incremental cost, we used the 2008 U.S. Census county-level construction permit data and the county climate zone data defined by the 2009 IECC to create a weighted average. The weighted average weighs the relative construction level in each climate zone within each state to approximate an average statewide cost per new home.

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[12] Insulation cost, like all other building component prices used in this study, is specific to any brand or product. Costs for insulation and other components are drawn from RS Means' measure of conventional building practice and cost across the country, with modifications for local cost.

[13] Census building permit data from the most recent calendar year, 2008.

To comply with other requirements in the 2009 IECC, we added additional costs that would be incurred. For all states, we added two across the board incremental costs: $350 for duct testing and $50 for energy efficient lighting. HVAC systems are a critical component of an energy efficient home, therefore $350 in duct testing was added to this analysis to improve overall duct sealing and testing in new homes. In addition, because the 2009 IECC requires that 50% of lighting fixtures in a home are high efficiency, $50 was added to this analysis to include the purchase of high efficiency light bulbs within a new home.

Directions for Future Research

While we believe that this study will provide valuable data to the construction community, code officials, policymakers and other groups, we recommend that future research focus on how the use of advanced building techniques can further decrease incremental cost. For example, the use of optimum value engineering (OVE) framing and other building practices can substantially reduce or eliminate the incremental costs identified in this study. While OVE framing and other advanced building practices may not be widespread, these techniques could be easily integrated into states' existing code training work. Likewise, new technologies such as insulative sheathing products are able to integrate insulation within structural elements. These products further reduce the costs of adding exterior insulation board to meet energy code wall insulation requirements. Additionally, future studies could examine the cost savings available by "right-sizing" HVAC equipment to take advantage of envelope improvements and their positive impacts on heating/cooling loads that offers further cost advantages to lowering first cost.

Future research can also address more sophisticated cost benefit analysis. This study only presents a simple payback model, which conservatively estimates how long it will take homebuyers to recoup their investment. The simple payback calculation does not take into consideration that most homebuyers will amortize all incremental costs in their mortgage, effectively lowering their out-of-pocket costs to a few additional dollars per month. Likewise, at the same time they will immediately begin realizing energy savings on a monthly basis through lower utility bills.

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State Pop 2009 (http://www.census.gov/popest/states/tables/NST-EST2009-01.xls).

APPENDIX A: States Not Covered in the 50 State Analysis

Current 2009 IECC States	States with No Energy Code (Unable to assess code)	Home Rule States (unable to assess statewide code)
California	Arkansas	Alaska
Delaware	Indiana	Texas
Maryland	New Jersey	Hawaii
Maine	Oklahoma	Illinois
Montana		Nebraska
New Hampshire		Washington
Rhode Island		Tennessee
Vermont		
West Virginia		
Oregon		
D.C.		
Florida		

Appendix B: Wisconsin Incremental Cost Analysis

Wisconsin Incremental Cost Analysis						
Wisconsin Climate Zone 6A						
Components	Current Practice	2009 IECC	Change Per Sq. Ft.	Sq. Feet	Location Factor	Total Change
Ceiling (R Factor)	49	49	$ -	1,200	$ 0.98	$ -
Window (U Factor/SHGC Factor)	.35/NR	.35/NR	$ -	357	$ 0.98	$ -
Wood Frame Wall (R Factor)	21	20	$ -	2,380	$ 0.98	$ -
Floor (R Factor)	30	30	$ -	1,200	$ 0.98	$ -
Basement (R Factor)	15/19	15/19	$ -	1,120	$ 0.98	$ -
Slab (R Factor)	10, 4 ft	10, 4 ft	$ -	140	$ 0.98	$ -
Crawlspace (R Factor)	10/13	10/13	$ -	1,200	$ 0.98	$ -
Improved Duct Sealing/Testing						$ 350.00
Lighting						$ 50.00
Total						$ 400.00

Wisconsin Incremental Cost Analysis						
Wisconsin Climate Zone 7A						
Components	Current Practice	2009 IECC	Change Per Sq. Ft.	Sq. Feet	Location Factor	Total Change
Ceiling (R Factor)	49	49	$ -	1,200	$ 0.94	$ -
Window (U Factor/SHGC Factor)	.35/NR	.35/NR	$ -	357	$ 0.94	$ -
Wood Frame Wall (R Factor)	21	21	$ -	2,380	$ 0.94	$ -
Floor (R Factor)	30	38	$ 1.05	1,200	$ 0.94	$ 1,184.40
Basement (R Factor)	15/19	15/19	$ -	1,120	$ 0.94	$ -
Slab (R Factor)	10, 4 ft	10, 4 ft	$ -	140	$ 0.94	$ -
Crawlspace (R Factor)	10/13	10/13	$ -	1,200	$ 0.94	$ -
Improved Duct Sealing/Testing						$ 350.00
Lighting						$ 50.00
Total						$ 1,584.40
Weighted Average Incremental Cost						**$ 556.18**
Estimated Energy Payback						$ 220.00

Appendix C: Minnesota Incremental Cost Analysis

Minnesota Incremental Cost Analysis						
Minnesota Climate Zone 6A						
Components	Current Practice	2009 IECC	Change Per Sq. Ft.	Sq. Feet	Location Factor	Total Change
Ceiling (R Factor)	38	49	$ 0.44	1,200	$ 1.15	$ 528.00
Window (U Factor/SHGC Factor)	.35/NR	.35/NR	$ -	357	$ 1.15	$ -
Wood Frame Wall (R Factor)	19	20	$ 0.19	2,380	$ 1.15	$ 520.03
Floor (R Factor)	30	30	$ -	1,200	$ 1.15	$ -
Basement (R Factor)	10/13	15/19	$ 0.40	1,120	$ 1.15	$ 448.00
Slab (R Factor)	10, 3.5 ft	10, 4 ft	$ 0.83	140	$ 1.15	$ 116.20
Crawlspace (R Factor)	10/13	10/13	$ -	1,200	$ 1.15	$ -
Improved Duct Sealing/Testing						$ 350.00
Lighting						$ 50.00
Total						$ 1,896.03

Minnesota Incremental Cost Analysis						
Minnesota Climate Zone 7A						
Components	Current Practice	2009 IECC	Change Per Sq. Ft.	Sq. Feet	Location Factor	Total Change
Ceiling (R Factor)	38	49	$ 0.44	1,200	$ 0.96	$ 528.00
Window (U Factor/SHGC Factor)	.35/NR	.35/NR	$ -	357	$ 0.96	$ -
Wood Frame Wall (R Factor)	19	21	$ 0.19	2,380	$ 0.96	$ 434.11
Floor (R Factor)	30	38	$ 1.05	1,200	$ 0.96	$ 1,260.00
Basement (R Factor)	10/13	15/19	$ 0.40	1,120	$ 0.96	$ 448.00
Slab (R Factor)	10, 5 ft	10, 4 ft	$ (1.66)	140	$ 0.96	$ (232.40)
Crawlspace (R Factor)	10/13	10/13	$ -	1,200	$ 0.96	$ -
Improved Duct Sealing/Testing						$ 350.00
Lighting						$ 50.00
Total						$ 1,810.11
Weighted Average Incremental Cost						**$ 1,873.00**
Estimated Energy Payback						$ 315.00

Appendix D: Incremental Cost Analysis FAQ

Q: Why were advanced building practices not used to further decrease incremental cost?

A: We chose to use the traditional building practices across the country to ensure that this analysis will be an unbiased, upper bound cost estimate for contractors using both standard and advanced building practices. Follow-up research can demonstrate the cost savings accorded by advanced building practices.

Q: Did you use the performance or prescriptive requirements for the 2009 IECC?

A: We used only the prescriptive model in order to provide straightforward cost estimates. The performance model can be utilized with further research.

Q: Why is there a $350 duct testing cost in the house model when duct testing has already been required in previous iterations of the code?

A: Although duct testing has been in previous versions of the IECC, we have found through numerous state contacts that duct testing and duct sealing are not regularly completed as required by code. Due to the fact that a properly tested and sealed HVAC system is critical to achieving energy savings, we believe that adding additional cost to testing the HVAC system is necessary.

Q: Did you use slab, crawlspace or basements as a foundation system?

A: If one of these foundation systems changed between current practice and the 2009 IECC for any particular climate zone, then we used that foundation system, to capture that possible incremental cost. In cases where two building components changed, we selected the most popular building foundation system for that particular area.

Q: How did you account for the difference in component prices and labor costs in each state?

A: Utilizing state permit data from the U.S. Census Bureau, climate zone information from the IECC, and state specific location factor costs from Rs Means, for each climate zone within a state we were able to determine in what county the most permits were issued and the corresponding location factor for that county. For the state of Georgia, for example, in climate zone 3 the county with the most construction activity was Fulton County. Fulton County's capital, Atlanta, has a location factor in RS Means of $0.90—10% lower than the national average. Therefore, in our analysis, we modified the national average materials and labor costs in Georgia's climate zone 3 by a factor of 0.90, effectively reducing anticipated construction cost by 10%.

Q: Are the components specific to a certain type of product?

A: No. Rs. Means utilizes an average cost of products. In addition, we used the most commonly used product to meet prescriptive requirements, i.e. kraft-faced batt is most commonly used for wall insulation.

Q: Does your study incorporate cost-benefit analysis?

A: No. We did include simple payback (incremental costs/energy savings). Cost Benefit analysis and amortization of the incremental costs can be included in future analysis.

Q: Are you concerned that by acknowledging that there can be an added cost associated with the code, you are providing support to energy efficiency opponents?

A: Some authorities have claimed that upgrading the energy code will result in cost increases, per home, in the range of tens of thousands of dollars. Our conservative incremental cost estimates, by contrast, are an order or magnitude lower. Our average costs per state range from $556.18 in Wisconsin to a high of $1,873.00 in Minnesota, with a national average of $840.77. By publishing our Excel based house model, we are hoping to bring additional transparency to the debate over incremental cost.

Appendix E: Model House Specifications

Model House	
Components	Sq. Feet
Ceiling	1,200
Window (U Factor/SHGC Factor)	357
Wood Frame Wall	2,380
Mass Wall	0
Floor	1,200
Basement Wall (If Applicable)	1,120
Slab (In Linear Ft.) (If Applicable)	140
Crawlspace (If Applicable)	1,200
Improved Duct Sealing/Testing	Standard
Lighting	Standard

Appendix F: Window Specifications

State	Zone	Current U-Factor	2009 U-Factor	Current SHGC Factor	2009 SHGC Factor	Assumed Baseline (double paned)	Required technology addition 1	Required technology addition 2	Incremental cost per square foot
Alabama	2	0.75	0.65	0.5	0.3	Aluminum Low-E	Low-E (low solar gain)		$0.50
	3	0.75	0.5	0.5	0.3	Aluminum Low-E	Low-E (low solar gain)	Thermal break	$1.00
Arizona	2b	0.75	0.65	0.4	0.3	Aluminum Low-E	Low-E (low solar gain)		$0.50
	3b	0.65	0.5	0.4	0.3	Aluminum Low-E	Low-E (low solar gain)	Thermal break	$1.00
	4b	0.4	0.35	NR	NR	Vinyl Low-E	Argon gas		$0.50
Colorado	4b	0.4	0.35	NR	NR	Vinyl Low-E	Argon gas		$0.50
Georgia	3a	0.65	0.5	0.4	0.3	Aluminum Low-E	Low-E (low solar gain)	Thermal break	$1.00
	4a	0.4	0.35	NR	NR	Vinyl Low-E	Argon gas		$0.50
Kansas	4	0.5	0.35			Vinyl	Low-E	Argon	$2.00
	5	0.5	0.35			Vinyl	Low-E	Argon	$2.00
Kentucky	4	0.4	0.35	NR	NR	Vinyl Low-E	Argon gas		$0.50
Louisiana	2	0.75	0.65	0.4	0.3	Aluminum Low-E	Low-E (low solar gain)		$0.50
	3	0.65	0.5	0.4	0.3	Aluminum Low-E	Low-E (low solar gain)	Thermal break	$1.00
Mississippi	2	0.75	0.65	0.5	0.3	Aluminum Low-E	Low-E (low solar gain)		$1.00
	3	0.75	0.5	0.5	0.3	Aluminum Low-E	Low-E (low solar gain)	Thermal break	$1.00

State	Zone	Current U-Factor	2009 U-Factor	Current SHGC Factor	2009 SHGC Factor	Assumed Baseline (double paned)	Required technology addition 1	Required technology addition 2	Incremental cost per square foot
Missouri	4	0.5	0.35			Vinyl	Low-E	Argon	$2.00
	5	0.5	0.35			Vinyl	Low-E	Argon	$2.00
Nevada	3b	0.65	0.5	0.4	0.3	Aluminum Low-E	Low-E (low solar gain)	Thermal break	$1.00
New Mexico	3b	0.65	0.5	0.4	0.3	Aluminum Low-E	Low-E (low solar gain)		$0.50
	4b	0.4	0.35	Not listed in chart		Vinyl Low-E	Argon gas		$0.50
New York	4a	0.4	0.35	NR		Vinyl Low-E	Argon gas		$0.50
North Carolina	4a	0.4	0.35	0.4	NR	Vinyl Low-E	Argon gas		$0.50
	5a	0.4	0.35	0.4	NR	Vinyl Low-E	Argon gas		$0.50
North Dakota	6	0.4	0.35	0	0	Vinyl Low-E	Argon gas		$0.50
	7	0.4	0.35	0	0	Vinyl Low-E	Argon gas		$0.50
Ohio	4a	0.4	0.35	NR		Vinyl Low-E	Argon gas		$0.50
Pennsylvania	4a	0.4	0.35	NR		Vinyl Low-E	Argon gas		$0.50
South Carolina	3	0.65	0.5	0.4	0.3	Aluminum Low-E	Low-E (low solar gain)		$0.50
South Dakota	5	0.5	0.35	0	0	Vinyl	Low-E	Argon	$2.00
	6	0.4	0.35	0	0	Vinyl Low-E	Argon gas		$0.50
Utah	3b	0.65	0.5	0.4	0.3	Aluminum Low-E	Low-E (low solar gain)		$0.50
Virginia	4	0.4	0.35	NR		Vinyl Low-E	Argon gas		$0.50
Wyoming	5	0.5	0.35	0	0	Vinyl	Low-E	Argon	$2.00
	6	0.4	0.35	0	0	Vinyl Low-E	Argon gas		$0.50

Appendix G: Housing Permit Data

Single Family Housing New Home Permits by State and Climate Zone								
	Climate Zone							
State	2	3	4	5	6	7	Grand Total	% of Total
Alabama	2,702	9,315					12,017	3.95%
Arizona	16,237	1,407	739	770			19,153	6.29%
Colorado			39	9,157	694	1,067	10,957	3.60%
Connecticut				3,139			3,139	1.03%
Georgia	4,089	17,847	2,943				24,879	8.17%
Idaho				3,956	1,717		5,673	1.86%
Iowa				5,001	1,284		6,285	2.06%
Kansas			5,364	61			5,425	1.78%
Kentucky			6,892				6,892	2.26%
Louisiana	9,919	1,770					11,689	3.84%
Massachusetts				5,368			5,368	1.76%
Mississippi	2,717	4,722					7,439	2.44%
Michigan				6,404	2,233	274	8,911	2.93%
Minnesota					6,520	2,388	8,908	2.93%
Missouri			7,454	323			7,777	2.55%
Nevada		5,840		1,270			7,110	2.34%
New Mexico		1,323	1,629	1,234			4,186	1.38%
New York			2,605	6,670	3,463		12,738	4.18%
North Carolina		17,557	20,499	1,026			39,082	12.84%
North Dakota					734	1,154	1,888	0.62%
Ohio			931	11,942			12,873	4.23%

Single Family Housing New Home Permits by State and Climate Zone								
	Climate Zone							
State	2	3	4	5	6	7	Grand Total	% of Total
Pennsylvania			5,842	13,837	559		20,238	6.65%
South Carolina		19,778					19,778	6.50%
South Dakota				190	2,474		2,664	0.88%
Utah		687		4,738	1,659		7,084	2.33%
Virginia			19,939				19,939	6.55%
Wisconsin					8,789	1,335	10,124	3.33%
Wyoming				32	1,786	360	2,178	0.72%
Grand Total	72,423	125,105	120,299	105,566	37,967	7,031	304,394	100.00%