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National Green Building Standard Analysis

NAHB Research Center

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National Green Building Standard Analysis

Prepared for:

Building America

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U.S. Department of Energy

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Definitions

ANSI/NAHB ICC	National Green Building Standard 700-2008
ANSI	American National Standards Institute
BA	DOE's Building America Research Program
EIA	U.S. Energy Information Administration
IECC	International Energy Conservation Code
NAHB	National Association of Home Builders
NREL	National Renewable Energy Laboratory
SEF	Solar Energy Factor
RESNET	Residential Energy Services Network

Executive Summary

The U.S. Department of Energy's Building America (BA) Program is a research and development program to improve the energy performance of new and existing homes. The ultimate BA goal is to achieve examples of cost-effective, energy-efficient solutions for all U.S. climate zones. This goal will be met using a whole-house system engineering approach and by uniting segments of the industry that traditionally work independently of one another, including architects, engineers, builders, remodelers, trade contractors, manufacturers, material suppliers, community planners, and mortgage lenders.

One example of this type of collaboration is the National Green Building Standard (NGBS) (ANSI/NAHB ICC 700-2008, 2009). ICC 700 was developed by a balanced consensus committee of general interest, producers, and users and approved by the American National Standards Institute (ANSI) as an American National Standard on January 29, 2009. Periodic maintenance of an ANSI standard by review of the entire document and action to revise or reaffirm it on a schedule not to exceed five years is required by ANSI. In compliance, a consensus group has once again been formed and NGBS is currently being reviewed to comply with the periodic maintenance requirement of an ANSI standard.

There are two important considerations for the energy efficiency chapter update process. The first is the methodology for energy savings and the second is the new baseline for energy savings. The updated energy chapter is proposed to use a whole-house energy savings methodology and therefore further align with the BA methodology. In addition, the newly proposed baseline for energy savings is the 2009 International Energy Conservation Code (IECC). Therefore, in order to reach any level of certification, the building's performance must exceed that of a similar building constructed to the 2009 IECC. Effectively, this results in the lowest level of certification, Bronze in the energy efficiency chapter, aligning with the 2012 IECC. The savings for the other three levels, Silver, Gold, and Emerald, are even higher. The recommendations in this report are made with the goal of making the NGBS rating levels consistent with IECC 2012 and BA goals. Actual savings levels will depend on final decisions made by the consensus committee.

This report details the proposed point structure for the prescriptive approach of the energy efficiency chapter of the NGBS update. This proposed point structure was developed with support from the BA house design and simulation protocols. The source energy was calculated for both the reference home and the proposed house in each specific climate. This analysis also compared the simulated energy performance of a home designed to meet the revised NGBS Chapter 7 at the Gold level with reference to the 2010 BA Benchmark using the BA House Simulation Protocols. The results of modeling various houses in multiple climate zones indicate that the range of energy savings for the designs is 40%–50% for the Gold level. This range aligns well with BA program energy savings goals of 30%–50% whole-house energy savings.

1 Background

The U.S. Department of Energy's Building America (BA) Program is a research and development program to improve the energy performance of new and existing homes. The ultimate BA goal is to achieve examples of cost-effective, energy-efficient solutions for all U.S. climate zones. This goal will be met using a whole-house system engineering approach and by uniting segments of the industry that traditionally work independently of one another, including architects, engineers, builders, remodelers, trade contractors, manufacturers, material suppliers, community planners, and mortgage lenders.

One example of this type of collaboration is the National Green Building Standard (NGBS) (ANSI/NAHB ICC 700-2008, 2009, NAHB Research Center, 2009). ICC 700 was developed by a balanced consensus committee of general interest, producers, and users and approved by the American National Standards Institute (ANSI) as an American National Standard on January 29, 2009. Periodic maintenance of an ANSI standard by review of the entire document and action to revise or reaffirm it on a schedule not to exceed five years is required by ANSI. In compliance, a consensus group has once again been formed and the NGBS is currently being reviewed to comply with the periodic maintenance requirement of an ANSI standard.

As part of the periodic maintenance the energy efficiency portion of the ICC 700, Chapter 7 Energy Efficiency, is being updated. There are two important considerations for the energy efficiency chapter update process. The first is the methodology for energy savings and the second is the new baseline for energy savings. The updated energy chapter is proposed to use a whole-house energy savings methodology and therefore further align with the BA methodology. In addition, the newly proposed baseline for energy savings is the 2009 International Energy Conservation Code (IECC) (IECC, 2009). Therefore, in order to reach any level of certification, the building's performance must exceed that of a similar building constructed to the 2009 IECC. Effectively, this results in the lowest level of certification, Bronze in the energy efficiency chapter, aligning with the 2012 IECC (IECC, 2012). The savings for the other three levels, Silver, Gold, and Emerald, are even higher. The recommendations in this report are made with the goal of making the NGBS rating levels consistent with IECC 2012 and BA goals (see Tables 1 and 2). Actual savings levels will depend on final decisions made by the consensus committee.

Table 1. Multiyear Energy Savings* Goals for Existing Homes

Energy Savings	Mixed/Hot-Dry and Marine	Mixed-Humid and Hot-Humid	Cold, Very Cold, and Subarctic
Current "Best in Class" (15% or above)	2011	2011	2011
30%	2012	2013	2014
50%	2015	2016	2017

*Savings based on the IECC 2009

Table 2. Multiyear Energy Savings* Goals for New Homes

Energy Savings	Mixed/Hot-Dry and Marine	Mixed-Humid and Hot-Humid	Cold, Very Cold, and Subarctic
Current "Best in Class" (20% or above)	2010	2011	2011
30%	2011	2012	2013
50%	2014	2015	2016

*Savings based on the IECC 2009

The ICC 700 and BA link building science research and actual energy efficiency improvements implemented by builders and remodelers based on a whole-house systems approach. This relationship demonstrates that homes can be designed and constructed according to the principles developed by BA on a larger scale. The collaboration introduces builders and remodelers to certification programs including Builders Challenge through the dual certification process, and provides materials for the marketing and sales activities of high performance builders.

2 Introduction

NBGS is a system of rating the sustainability of the siting, construction practices and products, and expected performance of a residential building. Point thresholds determine the project's compliance with the criteria that support progressively higher rating levels: Bronze, Silver, Gold and Emerald. By the ICC 700-2008, practices defined in the areas of site development, resource efficiency, energy efficiency, water efficiency, indoor environmental quality, and operation, maintenance, and education earn points toward an overall green rating level.

Chapter 7 of the ICC 700-2008 covers the energy efficiency (EE) of residential buildings. To be useful to a broad spectrum of builders, the ICC 700-2008 allows a choice between a performance and a prescriptive approach to achieve the Energy Efficiency Chapter 7 point thresholds for the Bronze, Silver, and Gold levels. The highest level rating (Emerald), requires use of the performance compliance approach.

The proposed revisions to Chapter 7, Energy Efficiency, of the ICC 700-2008 are the subject of this analysis; specifically, the correlation of the points for individual prescriptive practices relative to the expected energy savings from that practice.

3 ANSI/NAHB ICC 700-2008 Background

Chapter 7 of the 2008 version of the ICC 700 Standard (ANSI/NAHB ICC 700-2008, 2009) contains five sections titled:

701 – Minimum Energy Efficiency Requirements
702 – Performance Path
703 – Prescriptive Path
704 – Additional Practices
705 – Innovative Practices

A standards Consensus Committee was convened in 2011 to update the 2008 version of the ICC 700. As part of this process, task groups were developed to address specific topics and make recommendations to the Consensus Committee. Task Group 5 was assigned to Chapter 7 review. A primary goal of Task Group 5 was to recommend changes to eliminate incongruities between various sections of Chapter 7. In particular, in practice it was recognized that the points available through the Prescriptive Path (Section 703) were often inconsistent with the points available from the Performance Path (Section 702). To avoid redundancies, Task Group 5 proposed that some of Section 704, Additional Practices points, be moved to the Prescriptive Path, Section 703, thereby aligning the chapter's rating system for both compliance path approaches more closely with the effective whole-house energy savings results. A goal of the task group was to align the Prescriptive and Performance Path practices' point values with the practices' actual contribution to a building's energy efficiency.

Furthermore, Task Group 5 proposed to the Consensus Committee (which has since approved it) that a building meet the minimum requirements of the 2009 IECC. Because some of the provisions in the 2009 IECC had previously been awarded points in the ICC 700-2008, these incongruities had to be resolved in the updates to the standard through recommendations to the Consensus Committee. The task group also recommended redefined levels of merit within the ICC 700 Standard as 15%, 30%, 40%, and 50% better "whole-house" energy performance than the 2009 IECC. (ICC 700-2008 levels were 15%–60% over the 2006 IECC.)

Working in parallel with the recommendations proposed by Task Group 5, this report details the effort to review the Prescriptive Path approach (Section 703) of Chapter 7 and recommend a point structure that will support the stated energy savings thresholds that will be ultimately recommended to the Consensus Committee for approval.

4 Measurement of Energy Efficiency

4.1 Baseline Metrics

In order to establish a baseline metric consistent with the 2009 IECC, a standard house design was developed from statistics in annual builder surveys compiled by the NAHB Research Center. The standard house design was used in the energy simulations undertaken to support point recommendations in Section 703 of Chapter 7. This standard house design was modeled on various foundations, again selected from statistical data by region. Climate zones and cities within the zones where each of these designs was modeled, were selected based on BA[1] and other resources.[2] The climate zones extend from 1 through 8 (covering the United States) and the selected locations include moist and dry climates in each zone, as appropriate. Thirteen cities were selected to represent the eight climate zones in the country. Table 3 and Table 4 cover the house design details; Table 5 covers the location information used in the energy simulations.

Table 3. Characteristics of Reference Houses

House Characteristic	Dimension
Above-Grade Conditioned Area	2,401 ft^2
First Floor Area	1,801 ft^2
Second Floor Area	600 ft^2
Slab/Basement Area	1,801 ft^2
Slab/Basement Perimeter	196 ft
First Floor Height	9.0 ft
Second Floor Height	8.5 ft
Basement Height	8.0 ft
Basement Wall Above Grade (2 ft Above Grade)	392 ft^2
Window Area (Slab Foundation)	360 ft^2
Window Area (Basement Foundation)	420 ft^2
Above-Grade Wall Area	2,597 ft^2
Basement Wall Area	1,568 ft^2
Number of Bedrooms	3
Number of Bathrooms	2.5
Roof Overhang	1 ft

Table 4. Foundation Types Attributed to Reference Houses

Climate Zone	1A	2A	2B	3A	3B	4A	4C	5A	5B	6A	6B	7	8
Foundation Type													
Slab	x	x	x	x	x	x							x
Vented Crawlspace				x			x						
Inground Basement						x		x	x	x	x	x	

[1] http://www1.eere.energy.gov/buildings/challenge/technical_resources.html
[2] Technical Support Document: 50% Energy Savings for Small Office Buildings, Liu, B., et. Al. PNNL-19341, April 2010

Table 5. Locations Attributed to Reference Houses

Zone/Description	City, State	HDD (65)	CDD (65)
1A – Hot, Humid	Miami, Florida	149	4,361
2A – Hot, Humid	Houston, Texas	1,525	2,893
2B – Hot, Dry	Phoenix, Arizona	1,125	4,189
3A – Hot, Humid	Atlanta, Georgia	2,827	1,810
3B – Hot, Dry	Las Vegas, Nevada	2,239	3,214
4A – Mixed, Humid	Baltimore, Maryland	4,720	1,147
4C – Marine	Seattle, Washington	4,797	173
5A – Cold, Humid	Chicago, Illinois	6,498	830
5B – Cold, Dry	Denver, Colorado	6,128	696
6A – Cold, Humid	Minneapolis, Minnesota	7,876	699
6B – Cold, Dry	Helena, Montana	7,975	277
7 – Very Cold	Duluth, Minnesota	9,724	189
8 – Extreme Cold	Fairbanks, Alaska	13,980	74

The 2009 IECC is the baseline energy code above which the energy efficiency of the pending version of ICC 700 was gauged based on the anticipated timing of the updated ICC 700 release in 2012. In order to perform representative simulations in BEopt,[3] the energy simulation software used by BA, a reference house was defined. The reference house represents minimum prescriptive compliance with the 2009 IECC, Section 402.1.

The BA and the Residential Energy Services Network (RESNET)[4] guidelines are used as a basis for the analysis (Hendron, R; Engebrecht, C, 2010). Both of these approaches to energy savings, along with the software that is used to model house energy use, are important to provide better, more detailed analysis for the ICC 700, Chapter 7. Both are needed because the point system development for the ICC 700, as well as practical, commercially available modeling tools to verify compliance within the Standard, require use of multiple approaches. Both of these approaches are integrated in this analysis to provide the basis for the development of the point system in the Energy Efficiency chapter of the ICC 700.

BA and RESNET apply different procedures to simulate plug, appliance, and miscellaneous electric loads in houses, and these organizations' simulation protocols back the two predominant residential energy simulation software programs. RESNET procedures for estimates of lighting and appliance energy[5] were reflected in the reference house used in this analysis so that whole-house simulation results might be similar from the two software programs when practices in the

[3] NREL developed the BEopt, version 1.1 (Building Energy Optimization) software to provide capabilities to evaluate residential building designs and identify cost-optimal efficiency packages at various levels of whole-house energy savings along the path to zero net energy. http://beopt.nrel.gov/
[4] Residential Energy Services Network, providers of energy audits and the software, REMRate, software that produces a HERs Index that is used to determine ENERGY STAR compliance.
[5] RESNET Proposed Standards Revision, Date: 01/15/10 (as modified by Aux Energy Sub: 07/16/10) Amendment #2011 - As modified following resolution of public comments: April 11, 2011, *Lighting, Appliance and Miscellaneous Energy Usage Profiles*

ICC 700 are applied.[6] Table 6 and Table 7 highlight the differences between RESNET and BA energy use estimates.

Table 6. Comparison of RESNET and BA Energy Usage Formulas

Appliance/Device	RESNET Estimate[1]	BA Benchmark Estimate[2]	RESNET Use Estimate[10]	Benchmark Use Estimate[10]
Interior Lighting	455+(0.80*CFA[3])		2,376	
Interior Lighting (Hardwired)		0.8*(FFA[4]*0.542+334)		1,308
Interior Plug-In Lighting		0.2*(FFA*0.542+334)		327
Exterior Lighting	100+(0.05*CFA)	FFA*0.145	220	348
Garage Lighting	100	(GA[5]*0.08)+8.0	100	40
Refrigerator	637+(18*N_{br}[6])	434	691	434
Electric Range/Oven	331+(39*N_{br})	250+(83* N_{br})	448	499
Gas Range/Oven (Gas)	22.6+(2.7*N_{br})	14.3+(4.8* N_{br})	31	29
Gas Range/Oven (Electric)	22.6+(2.7*N_{br})	40+(13.3* N_{br})	31	80
Dishwasher	78+(31*N_{br})	87.6+(29.2* N_{br})	171	175
Clothes Washer	38+(10.0*N_{br})	38.8+(12.9* N_{br})	78	68
Electric Clothes Dryer	524+(149*N_{br})	538.2+(179.4*N_{br})	971	1,076
Gas Clothes Dryer (Gas)	18.8+(5.3*N_{br})	19.5+(6.5*N_{br})	35	39
Gas Clothes Dryer (Electric)	41+(11.7*N_{br})	43+(14.3*N_{br})	76	86
Televisions	413+(69*N_{br})		620	0
Miscellaneous (Electric)[7]	0.91*CFA	1703+(266*N_{br})+(0.454* FFA)	2,185	3,591
Miscellaneous (Electric)[8]	0.91*CFA	1595+(248*N_{br})+(0.426* FFA)	2,185	3,362
Miscellaneous (Gas)[8]		3.7+(0.6*N_{br})+(0.001*FF A)	0.0	7.9
Ventilation Fan Energy[9]	(0.03942*CFA) + (29.565*N_{br})	0.5 W/cfm	212	237

[1] Proposed revisions to the 2006 Mortgage Industry National Home Energy Rating System Standards
[2] BA House Simulation Protocols (Hendron, R; Engebrecht, C. (2010)
[3] CFA (conditioned floor area)
[4] FFA (finished floor area)
[5] GA (garage area)
[6] Nbr (number of bedrooms)
[7] All electric home
[8] Gas/electric home
[9] Ventilation fan rate calculated at 54 cfm
[10] Based on a 3 bedroom, 2,401-ft^2 home (CFA = FFA) with a 400-ft^2 garage

[6] At this writing, only REMrate software is available that can provide both a reference 2009 IECC house design and a performance approach that includes federal minimum equipment efficiencies for a whole-house energy savings analysis.

Table 7. Comparison of RESNET and BA Energy Usage

Load	All Electric		Load	Gas/Electric	
	RESNET	BA Benchmark		RESNET	BA Benchmark
Lighting	2,696	2,023	Lighting	2,696	2,023
Refrigerator	691	434	Refrigerator	691	434
			Range (Gas)	31	29
Range	448	499	Range (Electric)	31	80
Dishwasher	171	175	Dishwasher	171	175
Clothes Washer	68	78	Clothes Washer	68	78
			Dryer (Gas)	35	39
Clothes Dryer	971	1,076	Dryer (Electric)	76	86
Miscellaneous	2,805	3,591	Misc. (Electric)	2,805	3,362
			Misc. (Gas)	0	8
Ventilation Fan	212	237	Ventilation Fan	212	237
Total Electricity, Kwh	8,062	8,113	Total Electricity, Kwh	6,750	6,474
			Total Gas, Therms	65	76
Total Site Btu	**27,508,347**	**27,682,255**	**Total Site Btu**	**29,571,120**	**29,650,674**

As shown in the last row of Table 7, there is a minor difference (less than 1%) between the aggregate energy usage estimates underlying each of the software models; however, there are significant differences within categories (some of which are prescriptive practices in the ICC 700). This reinforces the decision that was made for this analysis to create a reference house in addition to the BEopt baseline benchmark house for the point value analyses that follow. The reference house also contains features consistent with the IECC 2009, such as Section 404.1 requiring 50% of the hardwired fixtures in the reference house to be high efficacy. Table 8 covers reference house features specified by the 2009 energy code for an energy simulation.

Table 8. Reference House Features Specified by the 2009 IECC

Feature	Quantity
Duct Leakage	6%–12%[7]
Infiltration (Maximum)	SLA = 0.00036[8]
Interior Shading – Heat	0.85
Interior Shading – Cool	0.70
Lighting, High Efficiency (Minimum)	50%
Set Point, Heating	72°
Set Point, Cooling	75°
Thermostat Heat Set Point	70°
Thermostat Cool Set Point	78°
Window Area	15%
Winter Interior Shade	0.85
Summer Interior Shade	0.70

4.2 Modeling Software and Analysis Methodology

BEopt version 1.1, developed by National Renewable Energy Laboratory (NREL),[9] was used to simulate the reference house and each new design that incorporated one practice from section 703. As an initial step in the analysis, the whole-house energy cost (and savings relative to the reference house) for each individual practice in the ICC 700 was calculated. The whole-house approach to savings was used, as it is deemed most representative of assumptions held by consumers and many builders and is in alignment with the BA and ENERGY STAR approaches to reporting the energy efficiency of homes. The approach allows for a simple and as factual as possible comparison between a defined baseline and the anticipated actual usage that may be observed, e.g., by periodic utility bills in an occupied green certified home.

Where software models did not provide options that match directly with the prescriptive provisions but do result in energy savings, the following methodologies were used:

- REScheck software[10] was used to establish UA percent levels for building envelope features.
- Air and ground source heat pump energy use estimates are based on HVAC performance estimates of energy savings over standard equipment applied to the heating and cooling portion of the whole house estimates.
- Whole-house energy savings estimates for the whole-house fan were based on percent energy savings calculated from REMrate models for that feature.

[7] Maximum acceptable leakage threshold varies by level and timing of testing performed. Reference house set up with 6% leakage.
[8] 7ACH50
[9] NREL developed the BEopt software to provide capabilities to evaluate residential building designs and identify cost-optimal efficiency packages at various levels of whole-house energy savings. http://www.nrel.gov/buildings/energy_analysis.html
[10] REScheck software, refer to www.energycodes.gov, Build Version 4.4.1.6.

- Energy estimates for the ductless heating and cooling systems were based on total energy savings results from BEopt and apportioned based on the heating and cooling energy estimates for the location.
- Whole-house energy savings estimates for the desuperheater were based on percent energy savings calculated from REMrate[11] models for that feature.
- Programmable thermostat savings estimated at 1% of whole-house savings (2%–3% of heating and cooling energy) due to the inconsistent reports on energy savings.[12]
- Energy use estimates for solar water heaters are based on the methodology outlined in the Solar Rating & Certification Corporation (SRCC) documentation for calculating savings based on the fuel and tank backup to the solar hot water system for the stated solar energy factor (SEF) and including locality cost of fuel.

Both the original and the proposed versions of the ICC 700 Standard stipulate an energy cost approach for the performance analysis, thus, that is the simulation approach used in this analysis. Utility costs used in each location were developed through an analysis of the Energy Information Administration (EIA) cost data relative to the climate zone(s) of each state. The first step in the analysis was to determine the EIA 2010 state average cost of the utility without service charges.[13] Next the climate zone or zones for each state were correlated with the EIA cost data. Finally, the average cost was determined for each climate zone, weighting each state and climate zone equally. The result was an average cost for electricity and natural gas for the climate zone. The local average annual costs which were used for the modeling are very close to the national average cost for electricity and natural gas published by EIA. Furthermore, for each climate zone using averaged state utility cost data, the ratio of the electricity cost to the natural gas cost was the same or nearly the same as the ratio of national average cost data. The cost analysis matrix is shown in Appendix A.

The 15 reference houses were simulated as either all electric houses or gas and electric houses, thus, 30 reference house cases were examined in the analysis. Fuel switching was not modeled. In the gas house, all of the equipment that could be fueled with natural gas was modeled with gas. The energy cost difference between the house employing a green practice and the reference house was converted to a percentage (energy) savings for the practice in a matrix.

For the next step, a 40%–50% whole house energy savings case was modeled for each reference house based on the available practices in the prescriptive approach (Section 703). Forty percent marks the threshold (Gold) that can be obtained using the prescriptive practices outlined in Section 703, as the 50% efficiency level of the ICC 700 (Emerald) requires that a performance analysis (Section 702) of the building support the points claimed. Selected 40%–50% cases were also modeled in REM/Rate version 12.96, to provide a test of energy savings attributed to a combination of practices and the results provided through the software. Results from the two

[11] REM/*Rate* software is used by organizations which operate home energy rating systems (HERS). http://www.archenergy.com/products

[12] Refer to EPA (www.energystar.gov/ia/partners/prod_development/revisions/downloads/thermostats/Spec_Suspension_Memo_May2009.pdf) and http://money.msn.com/saving-money-tips/post.aspx?post=1453ea21-3702-4631-9579-858c5e55897c

[13] U.S. Energy Information Administration, www.eia.gov/cneaf/electricity/epa/fig7p5.html http://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PRS_DMcf_m.htm

software programs were similar and the BEopt output was recorded in the matrix for each of the 30 simulations. Again, the maximum cost savings outcomes were interpreted as the percentage of energy savings over the reference house.

The maximum efficiency savings results from the 40%–50% cases compared to the arithmetic sum of individual practices that comprised the cases was however, not equal. This of course is expected, as often system interactions can account for different (and higher) energy use estimates as cumulative efficiency practices are employed, such as the effect of high-efficiency lighting on lower winter heat gain in buildings and higher heat energy demand. The sum of individual savings for each practice was higher than the 40%–50% packages for all of the cases that were analyzed. To compensate for what might otherwise be an overstatement of efficiency gains, a simple ratio between the sum of the individual practices and the combination maximum savings (of the selected efficiency features) was calculated and applied to the efficiency savings estimate for each individual practice in the matrix. This action reduced the individual practice percentage savings estimates by 4%–37%, varying by fuel source, location, and foundation type.

Once the efficiency savings of individual practices on the matrices were normalized for the cumulative effect, individual practices within each climate zone's foundation types were averaged, followed by averaging practices by climate zones and then by fuel type. This postprocessing approach refined the simulated results to one matrix consisting of 8 climate zone columns and 83 practices, each with a recommended point assignment. Each cell of the matrix contains a normalized percentage of energy savings that should be representative of the whole-house efficiency benefit when multiple practices are employed (refer to Appendix B for examples of these matrices).

4.3 Results: Benchmark Source Energy Savings for the 40%–50% Case

Results in the draft normalized energy savings matrix (Appendix B) were also verified by comparing the 40%–50% case to the BA Benchmark. The Benchmark complies with BA simulation protocols (Hendron, R; Engebrecht, C, 2010), whereas the reference and savings cases comply with the 2009 IECC standard reference criteria (Table 405.5.2(1)) (IECC, 2009). Table 9 lists differences in simulation assumptions between the methods.

Table 9. Simulation Protocols

Feature	Benchmark	Reference and Savings Cases
Duct Leakage	10%	6%
Infiltration (Maximum)	SLA = 0.00036	SLA = 0.00036
Interior Shading – Heat	0.70	0.85
Interior Shading – Cool	0.70	0.70
Lighting, High Efficiency (Minimum)	14%	50%
Overhang, Zones 1—3	2 ft	2 ft
Overhang, Zones 4–8	2 ft	1 ft
Set Point, Heating	71°	72°F
Set Point, Cooling	76°F	75°F
Thermostat Heat Set Point		70°F
Thermostat Cool Set Point		77°F
Winter Interior Shade	0.70	0.85
Summer Interior Shade	0.70	0.70

Table 10 and Table 11 indicate the source energy use of the three cases – Benchmark, Reference (2009 IECC), and 40%–50% savings case (with the Benchmark serving as baseline). The comparison of the Benchmark to the 40%–50% case and the Benchmark to the reference indicates results are similar to those derived from the straight comparison of the reference to the 40%–50% savings cases that were analyzed for point value recommendations.

Table 10. Benchmark, Reference, and 40%–50% Source Energy Savings Case for Climate Zones 1–3

Source Energy, Million Btu, Building America Conversion Factors Site-to-Source															
Location Climate Zone Foundation	Reference Simulation	Miscellaneous Electric	Vent Fan Electric	Large Appliance Electric	Lights Electric	HVAC Fan/ Pump Electric	Cooling Electric	Heating Electric	Heating Gas	Hot Water Electric	Hot Water Gas	Large Appliance Gas	Miscellaneous Gas	Total Combined	Change From Building America Benchmark
CZ 1A Electric Slab	BA Benchmark	41.23	3.19	28.68	22.77	8.28	52.06	1.13		26.70				184.03	
	Reference	41.23	2.49	27.04	21.72	7.66	61.09	1.72		22.12				185.08	-0.6%
	40%-50% Case	32.16	2.49	24.46	12.92	2.73	18.04	0.60		1.41				94.81	48.5%
CZ 1A Gas Slab	BA Benchmark	38.60	3.19	12.49	22.77	10.76	51.59		1.09	0.00	15.21	7.42	0.87	163.99	
	Reference	38.60	2.49	11.89	21.72	11.83	56.43		1.53	0.00	13.12	7.24	0.87	165.72	-1.1%
	40%-50% Case	30.10	2.49	9.31	12.92	6.21	28.76		1.09	1.21	1.82	7.24	0.87	102.02	37.8%
CZ 2A Electric Slab	BA Benchmark	41.23	3.19	28.68	22.77	7.22	34.10	29.82		31.36				198.38	
	Reference	41.23	2.49	27.04	21.72	7.28	43.54	37.53		26.15				206.98	-4.3%
	40%-50% Case	32.16	2.49	24.46	12.92	2.43	9.94	10.53		3.32				98.26	50.5%
CZ 2A Gas Slab	BA Benchmark	38.60	3.19	12.49	22.77	5.96	34.10		31.12	0.00	17.15	7.42	0.87	173.68	
	Reference	38.60	2.49	11.89	21.72	7.72	42.06		40.95	0.00	14.73	7.24	0.87	188.27	-8.4%
	40%-50% Case	30.10	2.49	9.31	12.92	2.14	17.59		19.11	1.14	0.77	7.24	0.87	103.68	40.3%
CZ 3A Electric Crawl	BA Benchmark	41.23	3.19	28.68	22.77	8.06	17.87	56.53		36.08				214.42	
	Reference	41.23	2.49	27.04	21.72	8.99	24.68	67.54		30.22				223.92	-4.4%
	40%-50% Case	32.16	2.49	24.46	12.92	2.97	6.29	22.58		4.14				108.01	49.6%
CZ 3A Electric Slab	BA Benchmark	41.23	3.19	28.68	22.77	9.02	18.29	69.60		36.08				228.87	
	Reference	41.23	2.49	27.04	21.72	8.32	23.78	76.95		30.22				231.75	-1.3%
	40%-50% Case	41.23	2.49	24.46	12.92	3.07	6.09	23.21		4.14				117.61	48.6%
CZ 3A Gas Slab	BA Benchmark	38.60	3.19	12.49	22.77	5.59	18.20		69.12	0.00	19.11	7.42	0.87	197.37	
	Reference	38.60	2.49	11.89	21.72	6.96	22.95		79.61	0.00	16.37	7.24	0.87	208.70	-5.7%
	40%-50% Case	30.10	2.49	9.31	12.92	2.01	7.45		30.25	1.16	1.01	7.24	0.87	104.82	46.9%
CZ 3B Electric Slab	BA Benchmark	41.23	3.19	28.68	22.77	10.41	45.33	43.09		32.09				226.80	
	Reference	41.23	2.49	27.04	21.72	9.69	54.19	48.77		26.76				231.90	-2.2%
	40%-50% Case	32.16	2.49	24.46	12.92	3.55	19.61	18.21		1.95				115.35	49.1%
CZ 3B Gas Slab	BA Benchmark	38.60	3.19	12.49	22.77	8.35	43.74		47.07	0.00	17.45	7.42	0.87	201.95	
	Reference	38.60	2.49	11.89	21.72	10.08	50.85		54.93	0.00	14.98	7.24	0.87	213.66	-5.8%
	40%-50% Case	30.10	2.49	9.31	12.92	2.64	22.19		19.44	1.26	0.23	7.24	0.87	108.69	46.2%

Table 11. Benchmark, Reference, and 40%–50% Source Energy Savings Case for Climate Zones 4–8

Source Energy, Million Btu, Building America Conversion Factors Site-to-Source															
Location Climate Zone Foundation	Reference Simulation	Miscellaneous Electric	Vent Fan Electric	Large Appliance Electric	Lights Electric	HVAC Fan/ Pump Electric	Cooling Electric	Heating Electric	Heating Gas	Hot Water Electric	Hot Water Gas	Large Appliance Gas	Miscellaneous Gas	Total Combined	Change From Building America Benchmark
CZ 4A	BA Benchmark	41.23	3.19	28.68	22.77	11.84	11.53	100.60		40.47				260.31	
Electric	Reference	41.23	2.49	27.04	21.72	11.10	14.85	98.71		34.01				251.14	3.5%
Basement	40%-50% Case	41.23	2.49	24.46	12.92	3.58	4.45	37.15		11.10				137.39	47.2%
CZ 4A	BA Benchmark	38.60	3.19	12.49	22.77	5.52	12.00		99.70	0.00	20.94	7.42	0.87	223.50	
Gas	Reference	38.60	2.49	11.89	21.72	7.60	14.82		96.97	0.00	17.89	7.24	0.87	220.10	1.5%
Basement	40%-50% Case	30.10	2.49	9.31	12.92	2.73	5.69		49.03	1.26	3.64	7.24	0.87	125.29	43.9%
CZ 4C	BA Benchmark	41.23	3.19	28.68	22.77	7.28	1.61	75.10		42.91				222.77	
Electric	Reference	41.23	2.49	27.04	21.72	7.80	2.49	80.31		36.13				219.21	1.6%
Crawl	40%-50% Case	32.16	2.49	24.46	12.92	2.23	0.87	21.75		33.59				130.46	41.4%
CZ 4C	BA Benchmark	38.60	3.19	12.49	22.77	3.20	0.72		86.05		21.95	7.42	0.87	197.26	
Gas	Reference	38.60	2.49	11.89	21.72	4.27	1.76		83.76		18.74	7.24	0.87	191.34	3.0%
Crawl	40%-50% Case	30.10	2.49	9.31	12.92	1.71	0.53		37.56		12.59	7.24	0.87	115.33	41.5%
CZ 5A	BA Benchmark	41.23	3.19	28.68	22.77	14.19	6.19	142.23		44.57				303.05	
Electric	Reference	41.23	2.49	27.04	21.72	12.73	9.25	139.01		37.55				291.02	4.0%
Basement	40%-50% Case	32.16	2.49	24.46	12.92	4.07	2.53	50.20		15.09				143.91	52.5%
CZ 5A	BA Benchmark	38.60	3.19	12.49	22.77	5.72	5.98		127.11	0.00	22.64	7.42	0.87	246.79	
Gas	Reference	38.60	2.49	11.89	21.72	7.77	8.58		123.07	0.00	19.31	7.24	0.87	241.55	2.1%
Basement	40%-50% Case	38.60	2.49	9.31	12.92	2.65	3.81		51.98	1.23	5.26	7.24	0.87	136.36	44.7%
CZ 6A	BA Benchmark	38.60	3.19	12.49	22.77	6.62	5.02		148.95		23.83	7.42	0.87	269.76	
Gas	Reference	38.60	2.49	11.89	21.72	8.73	7.38		146.11		20.73	7.24	0.87	265.76	1.5%
Basement	40%-50% Case	30.10	2.49	10.50	12.92	5.28	3.63		63.99		13.32	7.24	0.87	150.34	44.3%
CZ 6B	BA Benchmark	38.60	3.19	12.49	22.77	5.56	1.71		134.86		24.12	7.42	0.87	251.59	
Gas	Reference	38.60	2.49	11.64	21.72	7.30	3.32		129.73		22.71	7.86	0.87	246.25	2.1%
Basement	40%-50% Case	30.10	2.49	9.31	12.92	4.45	1.31		59.08		14.40	7.24	0.87	142.18	43.5%
CZ 7	BA Benchmark	38.60	3.19	12.49	22.77	7.76	0.64		189.90		25.78	7.42	0.87	309.42	
Gas	Reference	38.60	2.49	11.89	21.72	9.61	1.62		181.49		21.93	7.24	0.87	297.46	3.9%
Basement	40%-50% Case	30.10	2.49	9.31	12.92	5.74	0.47		78.84		15.78	7.24	0.87	163.77	47.1%
CZ 8	BA Benchmark	38.60	3.19	12.49	22.77	13.90	0.02		304.12		28.65	7.42	0.87	432.04	
Gas	Reference	38.60	2.49	11.89	21.72	13.61	0.55		287.20		24.33	7.24	0.87	408.49	5.5%
Slab	40%-50% Case	30.10	2.49	9.31	12.92	7.67	0.15		105.27		18.17	7.24	0.87	194.20	55.1%

The highlighted boxes in Table 12 describe the principal practices that comprise the 40%–50% EE cases that were analyzed. Under the proposed draft point scheme of one point being equal to 1/2% energy savings, the range of savings suggested is 41%–51%, dependent on climate zone.

Table 12. Initial 40%–50% Case Practices Analysis

Chapter Section	Practice	Proposed Point Table by Climate Zone							
		1	2	3	4	5	6	7	8
	15% to < 20% UA Improvement	0	13	14	14	15	14	13	13
	≥ 20% UA Improvement	1	14	17	19	18	17	16	16
703.1.2	Insulation Installation Quality	2	2	2	2	2	2	2	2
	2ACH50	3	5	8	11	15	18	23	24
	1ACH50	4	3	9	13	17	19	26	25
703.1.6.2b	Fenestration Level 3	10	8	8	4	8	9	10	7
	Fenestration Level 4				6	9	9	10	7
	Gas Heater >98%	1	6	12	13	15	15	18	18
703.2.5 (1)	SEER 14	4	3	1	1	0	0	0	0
	SEER 19	17	12	6	3	2	1	0	0
	Any Type 24 EER 4.3 Coefficient of Performance	29	30	29	37	42	47	57	57
703.2.10	Programmable Thermostat 70/75	1	1	1	2	2	2	2	2
703.3.3	Duct Installation (Interior+)	17	11	11	8	4	3	3	23
	6% in	4	3	1	1	1	0	0	3
703.4.1 (1)	Water Heater Energy Factor ≥ 0.80	7	5	6	4	5	4	3	2
	SEF 2.31	24	20	20	14	23	16	13	7
	SEF 3.01	27	22	22	16	26	18	15	8
	Hardwired Lighting 95% HE	7	6	4	5	5	4	3	3
703.6.1	Passive Solar Design	10	10	10	2	7	7	7	2
	Total Points (1 point = 1/2% EE)	**102**	**102**	**101**	**102**	**100**	**82**	**91**	**102**

4.4 Energy Efficiency Point Value Recommendations

The final step in the analysis was conversion of the normalized savings estimates to the point scale used by ICC 700-2008 (ANSI/NAHB ICC 700-2008, 2009), which was one point for each half percent of energy savings. The normalized savings estimates were simply doubled and rounded to the nearest whole digit to convert the percentage of energy savings to suggested point values for the revised ICC 700. It is reasonable to keep the weight of the points similar from each version of the Standard to the next, thus, this analysis suggests the simplicity of the approach and presents a similar point scale for consideration based on the houses and practices described herein. In addition, where modeling was not feasible for some practices (e.g., insulation installation quality,) the extant point scale has been forwarded in this document. Table 13 and Table 14 present the draft point scale suggested by the process outlined herein. The columns on the left represent the simulated, normalized points recommended by this analysis and the columns on the right allow comparison of points for the practice to the original ANSI/NAHB ICC 700-2008. Further modifications to the table will be made through the ANSI Standard revision process.

Table 13. Initial Matrix of Proposed Points With Comparison to ANSI/NAHB ICC 700-2008 Points, 1 of 2

Chapter Section	Practice	Proposed Point Table								ICC-700-2008 Point Table							
		CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
703.1.1	0 to < 5% UA improvement	0	1	0	0	0	0	0	0	0	0	0	0	0		0	
	5% to < 10% UA improvement	0	2	-1	4	7	5	3	4	0	5	6	7	8		9	
	10% to < 15% UA improvement	0	6	5	8	11	12	9	10	0	10	12	14	16		18	
	15% to < 20% UA improvement	0	10	10	13	16	14	11	12	0	15	18	21	24		27	
	>= 20% UA improvement	2	14	17	18	18	17	14	16	0	20	24	28	32		36	
703.1.2	Insulation installation quality	2	2	2	2	2	2	2	2	15 - Grade 1, 10 Grade 2							
703.1.3	Mass walls >6" [1]	5	5	5	5	4	3	0	0	6				5		0	
	mass walls ≤ 6" [1]	3	3	3	3	2	2	0	0	4				3		0	
703.1.4	Radiant barrier	2	3	1	1	0	0	0	1	2			1	0			
703.1.5	Envelope leakage 5ACH50	2	3	3	4	6	7	8	9	3							
	4ACH50	3	4	5	7	10	12	13	14	6							
	3ACH50	3	5	6	9	13	15	17	19	9							
	2ACH50	4	6	8	11	15	18	20	23	12							
	1ACH50	4	5	8	12	17	19	22	24	15							
703.1.6.1	Fenestration level 1	ICC-700 Base (higher performance level than IECC2009)								Not Covered							
703.1.6.2	Fenestration level 2	10	5	6	2	5	5	5	4	8			5		6		
703.1.6.2b	Fenestration level 3	13	9	9	4	8	9	9	6	10			10		12		
	Fenestration level 4				5	9	9	9	7	Not Covered							
703.2.1	Combo heating system	4	4	4	4	4	4	4	4	4							
703.2.2 (1)	Gas Heater >90%	0	5	6	7	9	9	7	10	0	2	5	8	11	14		
	Gas Heater >92%	0	5	8	9	11	11	9	12	0	2	6	9	12	15		
	Gas Heater >94%	0	5	8	10	13	13	10	14	0	3	7	10	14	17		
	Gas Heater >96%	1	6	10	11	14	14	12	16	Not Covered							
	Gas Heater >98%	1	6	10	13	16	15	13	17	Not Covered							
703.2.2 (2)	Oil Furnace 85%	0	1	3	3	7	7	7	7	0	1	3	3	7	7		
	Oil Furnace 90%	0	2	5	8	11	14	14	14	0	2	5	8	11	14		
703.2.2 (3)	Gas Boiler >85%	0	9	16	18	17	16	13	26	0	1	3	4	6	7		
	Gas Boiler >90%	1	10	17	19	18	17	13	28	0	2	5	8	11	14		
	Gas Boiler >94%	1	10	18	19	19	17	14	29	0	3	7	10	14	17		
	Gas Boiler >96%	1	10	18	20	19	18	14	30								
703.2.2(4)	Oil Boil 85%	0	9	16	18	17	16	13	26	0	1	3	4	6	7		
	Oil Boiler 90%	1	10	17	19	18	17	13	28	0	2	5	8	11	14		
703.2.3	Boiler temperature reset	1	1	1	1	1	1	1	1	1							
703.2.4	8.2 HSPF	0	1	2	4	5	6	7	7	0	1	2	5	7	7		
	9.0 HSPF	0	3	6	9	12	14	17	17	0	2	5	10	11	12		
	9.5 HSPF	0	4	7	12	16	18	23	23	Not Covered							
	10.0 HSPF	1	4	9	15	19	22	28	27	Not Covered							

[1] Points for mass construction reduced from ICC-700-2008 by 25% for CZ 1-4, 33% for CZ 5-6, 50% for CZ 7-8

Grey highlighted features denote practices that could not be simulated with the available software.

Table 14. Initial Matrix of Proposed Points With Comparison to ANSI/NAHB ICC 700-2008 Points, 2 of 2

Proposed Point Table

Chapter Section	Practice	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
703.2.5 (1)	SEER 14	4	3	1	1	0	0	0	0
	SEER 15	7	5	2	1	1	0	0	0
	SEER 17	12	8	4	2	1	1	0	0
	SEER 19	16	11	6	3	2	1	0	0
	SEER 21	19	14	7	3	2	1	0	0
703.2.5(2)	WaterSource 15.0EER 4.0 COP	14	18	22	30	37	43	53	52
703.2.6	GSHP 16.2EER 3.6 cop	17	18	20	27	33	37	45	45
	GSHP 14.1EER 3.3 cop	12	14	16	22	27	31	38	38
	GSHP 15 EER 3.5 cop	14	16	19	25	31	35	43	42
	Any type 24 EER 4.3 cop	29	28	29	35	42	47	57	57
	Any type 28 EER 4.8 cop	32	32	32	40	47	53	64	63
703.2.7	E* ceiling fans	1	1	1	1	1	1	1	1
703.2.8	whole house ventilation fan	5	0	2	3	5	3	2	2
703.2.9	Submeter in multiunit	1	1	1	1	1	1	1	1
703.2.10	Programmable thermostat 70/78	2	1	1	1	2	2	1	1
703.3.1	Ductless heating system	0	4	7	7	6	3	3	23
703.3.2	Ductless cooling system	10	7	3	1	0	0	0	0
703.3.3	Duct installation (interior+)	11	11	11	8	4	3	15	28
703.3.4	Duct leakage 6%	5	8	4	2	2	1	1	8
	6% in	2	3	1	1	1	0	0	3
	6% both	5	8	4	2	2	1	1	8
703.4.1 (1)	Water heater energy factor ≥ .80	7	7	5	4	5	4	2	2
703.4.1 (2)	Water heater energy factor .95	2	1	2	1	1	1	1	1
703.4.1 (3)	Oil Water Heating	1	1	1	1	1	1	1	1
703.4.1 (4)	Heat Pump Water Heater EF 1.5	14	11	11	11	11	11	9	4
	Heat Pump Water Heater EF 2.0	19	15	16	15	15	15	12	6
	Heat Pump Water Heater EF 2.2	20	16	17	17	16	16	13	6
703.4.2	Desuperheater	17	11	8	8	8	7	5	4
703.4.3	Drainwater heat recovery	2	2	2	2	2	2	2	2
703.4.4	Indirect water heater	1	1	1	1	1	1	1	1
703.4.5	Solar water heater SEF 1.3	15	10	11	10	12	10	7	4
	SEF 1.51	18	12	14	12	15	12	8	5
	SEF 1.81	21	14	16	14	18	14	10	6
	SEF 2.31	24	17	19	17	22	16	12	7
	SEF 3.01	27	19	21	19	25	18	13	8
703.5.1	Hardwired lighting 75% HE	5	4	3	3	3	2	2	1
	Hardwired lighting 95% HE	9	6	5	4	4	3	2	1
703.5.2	Recessed lighting	2	2	2	2	2	2	2	2
703.5.3	E* Refrigerator	3	3	2	1	1	2	1	0
	E* DW	1	1	1	1	1	1	1	1
	E* Washing Machine	4	4	4	4	4	4	4	4
703.5.4	Induction cooktop	1	1	1	1	1	1	1	1
703.6.1	Passive solar design	5	5	5	5	5	5	5	5
703.6.2	Window shading (active)h/c	1	1	1	1	1	1	1	1
703.6.3	Passive cooling design	3+1	3+1	3+1	3+1	3+1	3+1	3+1	3+1
703.6.4	Passive heating (mass)	4	4	4	4	4	4	4	4

ICC-700-2008 Point Table

Chapter Section	Practice	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8
703.2.5 (1)	SEER 14	8	6	2	2	1	1		
	SEER 15	12	10	4	3	2	2		
	SEER 17	18	14	6	4	3	3		
	SEER 19	24	18	8	4	3	3		
	SEER 21	Not Covered							
703.2.5(2)	WaterSource 15.0EER 4.0 COP	18	14	6	4	3	3		
703.2.6	GSHP 16.2EER 3.6 cop	20							
	GSHP 14.1EER 3.3 cop	20							
	GSHP 15 EER 3.5 cop	20							
	Any type 24 EER 4.3 cop	30							
	Any type 28 EER 4.8 cop	Not Covered							
703.2.7	E* ceiling fans	1							
703.2.8	whole house ventilation fan	2							
703.2.9	Submeter in multiunit	1							
703.2.10	Programmable thermostat 70/78	1							
703.3.1	Ductless heating system	15							
703.3.2	Ductless cooling system	15							
703.3.3	Duct installation (interior+)	12							
703.3.4	Duct leakage 6%	15							
	6% in	5							
	6% both	15							
703.4.1 (1)	Water heater energy factor ≥ .80	10							
703.4.1 (2)	Water heater energy factor .95	1							
703.4.1 (3)	Oil Water Heating	1							
703.4.1 (4)	Heat Pump Water Heater EF 1.5	7							
	Heat Pump Water Heater EF 2.0	10							
	Heat Pump Water Heater EF 2.2	Not Covered							
703.4.2	Desuperheater	5				2			
703.4.3	Drainwater heat recovery	2							
703.4.4	Indirect water heater	1							
703.4.5	Solar water heater SEF 1.3	8							
	SEF 1.51	11							
	SEF 1.81	14							
	SEF 2.31	17							
	SEF 3.01	20							
703.5.1	Hardwired lighting 75% HE	Not Covered							
	Hardwired lighting 95% HE	Not Covered							
703.5.2	Recessed lighting	2							
703.5.3	E* Refrigerator	5							
	E* DW	2							
	E* Washing Machine	4							
703.5.4	Induction cooktop	1							
703.6.1	Passive solar design	5							
703.6.2	Window shading (active)h/c	1							
703.6.3	Passive cooling design	3 + 1							
703.6.4	Passive heating (mass)	4							

[1] Points for mass construction reduced from ICC-700-2008 by 25% for CZ 1-4, 33% for CZ 5-6, 50% for CZ 7-8

Grey highlighted features denote practices that could not be simulated with the available software.

5 Summary

The proposed point structure for the prescriptive approach of the Energy Efficiency chapter of the NGBS was developed with support from BA house design and simulation protocols. The source energy was calculated for both the reference home and the proposed house in each specific climate. This analysis also compared the simulated energy performance of a home designed to meet the revised NGBS Chapter 7 at the Gold level with reference to the 2010 BA Benchmark using the BA House Simulation Protocols. The results of modeling various houses in multiple climate zones indicate that the range of energy savings for the designs is 40%–50% for the Gold level. This range aligns well with BA program energy savings goals of 30%–50% whole-house energy savings.

Additional BA quality criteria, such as water management and indoor environmental quality, are promoted in Chapters 8 and 9 of the NGBS as both mandatory and point-based provisions. This aligns with the goals of BA and Builders Challenge to build homes that are energy efficient, safe, comfortable, and durable.

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Appendix A Cost Matrix: Electric and Gas

Table 15. Electric Rate Cost Matrix

			Electric Rate State Average, cents/kWh							
Average Across States ->			24.2	10.9	10.6	11.1	11.7	11.5	11.7	17.1
State Utility Rate										
State	Electric cents/kWh	Gas $/therm	CZ1	CZ2	CZ3	CZ4	CZ5	CZ6	CZ7	CZ8
Alabama	10.66	1.04			10.7					
Alaska	17.14	1.67							17.1	17.1
Arizona	10.73	1.04		10.7						
Arkansas	9.14	0.89			9.1					
California	14.74	1.44			14.7					
Colorado	10.00	0.97					10.0			
Connecticut	20.33	1.98					20.3			
Delaware	14.07	1.37				14.1				
District of Columbia	13.76	1.34				13.8				
Florida	12.39	1.21		12.4						
Georgia	10.13	0.99			10.1					
Hawaii	24.20	2.36	24.2							
Idaho	7.80	0.76					7.8	7.8		
Illinois	11.27	1.10					11.3			
Indiana	9.50	0.93					9.5			
Iowa	9.99	0.97					10.0	10.0		
Kansas	9.53	0.93				9.5				
Kentucky	8.37	0.81				8.4				
Louisiana	8.10	0.79		8.1	8.1					
Maine	15.65	1.52						15.7		
Maryland	14.98	1.46				15.0				
Massachusetts	16.87	1.64					16.9			
Michigan	11.60	1.13					11.6	11.6		
Minnesota	10.04	0.98						10.0	10.0	
Mississippi	10.22	1.00			10.2					
Missouri	8.54	0.83				8.5	8.5			
Montana	8.93	0.87						8.9		
Nebraska	8.52	0.83					8.5			
Nevada	12.86	1.25			12.9		12.9			
New Hampshire	16.26	1.58					16.3	16.3		
New Jersey	16.31	1.59				16.3	16.3			
New Mexico	10.02	0.98			10.0	10.0	10.0			
New York	17.50	1.70					17.5	17.5		
North Carolina	9.99	0.97			10.0	10.0				
North Dakota	7.58	0.74						7.6	7.6	
Ohio	10.67	1.04					10.7			
Oklahoma	8.49	0.83			8.5					
Oregon	8.68	0.85					8.7			
Pennsylvania	11.65	1.13					11.7			
Rhode Island	15.60	1.52					15.6			
South Carolina	10.44	1.02			10.4					
South Dakota	8.49	0.83						8.5		
Tennessee	9.32	0.91				9.3				
Texas	12.38	1.21		12.4	12.4					
Utah	8.48	0.83					8.5			
Vermont	14.90	1.45						14.9		
Virginia	10.61	1.03				10.6				
Washington	7.68	0.75					7.7			
West Virginia	7.90	0.77				7.9	7.9			
Wisconsin	11.94	1.16						11.9	11.9	
Wyoming	8.58	0.84						8.6		

Table 16. Gas Rate Cost Matrix

			Gas Rate State Average, $/therm							
Average Across States ->			2.36	1.06	1.03	1.08	1.14	1.12	1.14	1.67
State Utility Rate										
State	Electric cents/kWh	Gas $/therm	CZ1	CZ2	CZ3	CZ4	CZ5	CZ6	CZ7	CZ8
Alabama	10.66	1.04			1.04					
Alaska	17.14	1.67							1.67	1.67
Arizona	10.73	1.04		1.04						
Arkansas	9.14	0.89			0.89					
California	14.74	1.44			1.44					
Colorado	10.00	0.97					0.97			
Connecticut	20.33	1.98					1.98			
Delaware	14.07	1.37				1.37				
District of Columbia	13.76	1.34				1.34				
Florida	12.39	1.21		1.21						
Georgia	10.13	0.99			0.99					
Hawaii	24.20	2.36	2.36							
Idaho	7.80	0.76					0.76	0.76		
Illinois	11.27	1.10					1.10			
Indiana	9.50	0.93					0.93			
Iowa	9.99	0.97					0.97	0.97		
Kansas	9.53	0.93				0.93				
Kentucky	8.37	0.81				0.81				
Louisiana	8.10	0.79		0.79	0.79					
Maine	15.65	1.52						1.52		
Maryland	14.98	1.46				1.46				
Massachusetts	16.87	1.64					1.64			
Michigan	11.60	1.13					1.13	1.13		
Minnesota	10.04	0.98						0.98	0.98	
Mississippi	10.22	1.00			1.00					
Missouri	8.54	0.83				0.83	0.83			
Montana	8.93	0.87						0.87		
Nebraska	8.52	0.83					0.83			
Nevada	12.86	1.25			1.25		1.25			
New Hampshire	16.26	1.58					1.58	1.58		
New Jersey	16.31	1.59				1.59	1.59			
New Mexico	10.02	0.98			0.98	0.98	0.98			
New York	17.50	1.70					1.70	1.70		
North Carolina	9.99	0.97			0.97	0.97				
North Dakota	7.58	0.74						0.74	0.74	
Ohio	10.67	1.04					1.04			
Oklahoma	8.49	0.83			0.83					
Oregon	8.68	0.85					0.85			
Pennsylvania	11.65	1.13					1.13			
Rhode Island	15.60	1.52					1.52			
South Carolina	10.44	1.02			1.02					
South Dakota	8.49	0.83						0.83		
Tennessee	9.32	0.91				0.91				
Texas	12.38	1.21		1.21	1.21					
Utah	8.48	0.83					0.83			
Vermont	14.90	1.45						1.45		
Virginia	10.61	1.03				1.03				
Washington	7.68	0.75					0.75			
West Virginia	7.90	0.77				0.77	0.77			
Wisconsin	11.94	1.16						1.16	1.16	
Wyoming	8.58	0.84						0.84		

Appendix B: Summary Matrix

Table 17. Initial Normalized Percent Savings for Electric Fuel and Simulation Location

Proposed NGBS Section	Provision	1A hot, humid Miami, Florida Slab Foundation	2A hot, humid Houston, Texas Slab Foundation	2B hot, dry Phoenix, Arizona Slab Foundation	3A hot, humid Atlanta, Georgia Slab Foundation	3A hot, humid Atlanta, Georgia Vented Crawlspace	3B hot, dry Las Vegas, Nevada Slab Foundation	4A mixed, humid Baltimore, Maryland Slab Foundation	4A mixed, humid Baltimore, Maryland Basement	4C marine Seattle, Washington Vented Crawlspace	5A cold, humid Chicago, Illinois Basement	5B cold, dry Denver, Colorado Basement	6A cold humid Minneapolis, Minnesota Basement	6B cold, dry Helena, Montana Basement	7 very cold Duluth, Minnesota Basement	8 extreme cold Fairbanks, Alaska Slab
	Ratio Combined/Individual	69%	65%	59%	71%	70%	61%	74%	76%	67%	89%	88%	89%	90%	96%	77%
	Cost Highlight Percent Savings (Individual)	44%	46%	37%	47%	45%	45%	49%	44%	42%	52%	51%	50%	48%	54%	66%
	Base 2009 IECC	$1,889	$1,993	$2,276	$2,254	$2,174	$2,248	$2,607	$2,456	$2,150	$2,862	$2,490	$3,287	$2,976	$4,037	$7,264
	COOL	$702	$427	$859	$232	$241	$457	$159	$145	$24	$89	$92	$79	$41	$23	$14
	HEAT	$32	$388	$240	$792	$696	$435	$1,162	$1,015	$840	$1,424	$1,084	$1,806	$1,544	$2,532	$5,643
703.1.1	0 to < 5% UA improvement	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	5% to < 10% UA improvement	0%	2%	2%	2%	2%	1%	3%	2%	2%	3%	3%	3%	3%	1%	2%
	10% to < 15% UA improvement	0%	4%	3%	4%	4%	4%	6%	4%	4%	6%	6%	6%	6%	5%	5%
	15% to < 20% UA improvement	0%	5%	6%	4%	6%	6%	7%	6%	5%	8%	8%	7%	7%	6%	7%
	>= 20% UA improvement	1%	6%	5%	7%	7%	6%	9%	9%	6%	9%	9%	9%	9%	8%	9%
703.1.2	Insulation installation quality	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009 T402.4.2		Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009
703.1.3	Mass walls >6"	-1%	-2%	-2%	-3%	-3%	-3%	-4%	-4%	-10%	-14%	-11%	-15%	-14%	-18%	-15%
	mass walls ≤ 6"	-1%	-2%	-2%	-3%	70%	-3%	-4%	-4%	-10%	-13%	-11%	-15%	-14%	-18%	-15%
703.1.4	Radiant barrier	1%	1%	1%	1%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	1%
703.1.5	Envelope leakage 5ACH50	1%	1%	1%	1%	1%	1%	2%	2%	2%	4%	3%	4%	4%	5%	5%
	4ACH50	1%	2%	1%	2%	2%	2%	3%	3%	3%	5%	5%	7%	5%	8%	8%
	3ACH50	2%	2%	2%	3%	3%	2%	4%	4%	4%	7%	6%	9%	7%	10%	10%
	2ACH50	2%	2%	2%	4%	4%	3%	5%	5%	5%	8%	8%	10%	8%	12%	13%
	1ACH50	2%	3%	2%	4%	4%	3%	6%	6%	6%	8%	8%	11%	8%	13%	13%
703.1.6.1	Fenestration level 1	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory
703.1.6.2	Femestration level 2	4%	1%	3%	3%	3%	2%	1%	1%	1%	2%	3%	3%	3%	3%	2%
703.1.6.2b	Femestration level 3	5%	3%	4%	3%	3%	3%	2%	2%	2%	4%	4%	5%	5%	5%	4%
	Femestration level 4	None	None	None	None	None	None	2%	3%	3%	4%	4%	5%	4%	6%	4%
703.2.1	Combo heating system	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
703.2.2	Furnace/Boiler efficiency	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
703.2.3	Boiler temperature reset	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
703.2.4	SEER 14 HSPF8.6	2%	2%	2%	3%	3%	2%	4%	4%	3%	5%	4%	5%	5%	6%	6%
703.2.5	SEER 15 HSPF8.8	4%	3%	4%	4%	4%	3%	5%	5%	3%	6%	5%	6%	6%	8%	7%
	SEER 17 9.0	6%	5%	6%	5%	5%	5%	6%	6%	4%	7%	6%	8%	7%	9%	9%
	SEER 19 HSPF9.5	8%	7%	8%	7%	7%	6%	8%	7%	5%	9%	8%	10%	9%	11%	11%
	SEER 21 HSPF10	10%	8%	10%	8%	8%	7%	9%	9%	6%	11%	10%	12%	11%	14%	14%
703.2.5(2)	WaterSource 15.0EER 4.0 COP	7%	9%	8%	13%	12%	8%	16%	15%	12%	20%	18%	22%	21%	26%	26%
703.2.6	GSHP 16.2EER 3.6 cop	9%	9%	9%	12%	11%	8%	14%	13%	10%	17%	15%	19%	18%	23%	22%
	GSHP 14.1EER 3.3 cop	6%	7%	7%	9%	9%	6%	11%	11%	8%	15%	13%	16%	15%	19%	19%
	GSHP 15 EER 3.5 cop	7%	8%	8%	11%	10%	7%	13%	12%	9%	16%	14%	18%	17%	21%	21%
	Any type 24 EER 4.3 cop	14%	13%	15%	16%	15%	12%	18%	17%	13%	22%	20%	24%	23%	29%	28%
	Any type 28 EER 4.8 cop	16%	15%	17%	18%	17%	14%	20%	19%	14%	25%	22%	27%	26%	32%	32%
703.2.7	E* ceiling fans															
703.2.8	whole house ventilation fan	2%	1%	0%	1%	2%	0%	2%	2%	2%	2%	2%	1%	1%	1%	1%
703.2.9	Submeter in multiunit															
703.2.10	Programmable thermostat 70/78	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
703.3.1	Ductless heating system	0%	2%	1%	5%	3%	3%	6%	1%	5%	6%	2%	1%	1%	2%	16%
703.3.2	Ductless cooling system	4%	3%	4%	1%	1%	3%	1%	0%	0%	0%	0%	0%	0%	0%	0%
703.3.3	Duct installation (interior+)	5%	5%	5%	6%	4%	5%	6%	1%	6%	2%	2%	1%	2%	2%	16%
703.3.4	Duct leakage 6%	2%	8%	2%	2%	2%	2%	1%	0%	2%	2%	1%	1%	0%	1%	7%
	6% in	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run
	6% both	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run
703.4.1	Water heater energy factor .95	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%
703.4.2	Desuperheater	8%	6%	5%	4%	4%	5%	4%	4%	2%	4%	4%	4%	3%	3%	2%
703.4.3	Drainwater heat recovery															
703.4.4	Indirect water heater															
703.4.5	Solar water heater SEF 1.3	7%	6%	5%	6%	6%	5%	5%	5%	5%	5%	6%	5%	5%	4%	2%
	SEF 1.51	9%	7%	6%	7%	7%	6%	6%	7%	7%	7%	8%	6%	7%	5%	2%
	SEF 1.81	11%	9%	7%	9%	9%	8%	8%	9%	9%	9%	10%	8%	9%	7%	3%
	SEF 2.31	13%	11%	9%	11%	11%	9%	10%	11%	11%	11%	12%	9%	10%	8%	4%
	SEF 3.01	15%	13%	10%	12%	13%	11%	11%	12%	12%	12%	14%	11%	12%	9%	4%
703.5.1	Hardwired lighting 75% HE	2%	2%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%
	95% HE	4%	3%	2%	2%	3%	2%	2%	2%	2%	2%	1%	2%	1%	1%	0%
703.5.2	Recessed lighting						N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
703.5.3	E* appliances - Refrig	1%	1%	1%	0%	1%	1%	1%	1%	0%	0%	1%	1%	2%	0%	0%
	DW	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%
	Washing Machine	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
703.5.4	Induction cooktop	0%	-1%	0%	-1%	-2%	-1%	0%	-2%	0%	0%	0%	-1%	0%	0%	0%
703.6.1	Passive solar design	5%	4%	4%	3%	3%	9%	2%	2%	2%	3%	3%	3%	4%	3%	0%
703.6.2	Window shading (active)h/c	code .85/.70	code .85/.70	code .85/.70	code .85/.70	code .85/.70	code .85/.70	code .85/.70	code .85/.70	code .85/.70	code .85/.70	code .85/.70	code .85/.70	code .85/.70	code .85/.70	code .85/.70
703.6.3	Passive cooling design	0%	1%	1%	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%	0%	-1%
703.6.4	Passive heating (mass)	5%	4%	5%	4%	5%	9%	2%	3%	2%	0%	3%	2%	3%	2%	0%

Table 18. Initial Normalized Percent Savings for Gas Fuel and Simulation Location

Proposed NGBS Section	Provision	1A hot, humid Miami, Florida Slab Foundation	2A hot, humid Houston, Texas Slab Foundation	2B hot, dry Phoenix, Arizona Slab Foundation	3A hot, humid Atlanta, Georgia Slab Foundation	3A Crawl hot, humid Atlanta, Georgia Vented Crawlspace	3B Slab hot, dry Las Vegas, Nevada Slab Foundation	4A mixed, humid Baltimore, Maryland Slab Foundation	4A mixed, humid Baltimore, Maryland Basement	4C marine Seattle, Washington Vented Crawlspace	5A cold, humid Chicago, Illinois Basement	5B cold, dry Denver, Colorado Basement	6A cold humid Minneapolis, Minnesota Basement	6B cold, dry Helena, Montana Basement	7 very cold Duluth, Minnesota Basement	8 extreme cold Fairbanks, Alaska Slab
Ratio Combined/Individual		86%	47%	79%	77%	77%	80%	69%	71%	73%	72%	90%	71%	76%	53%	63%
Cost Highlight Percent Savings (Individual)		46%	46%	44%	49%	46%	47%	42%	39%	40%	37%	41%	36%	36%	39%	43%
	Base 2009 IECC	1,759	1,974	2,123	2,125	2,031	2,146	2,412	2,258	1,971	2,504	2,191	2,767	2,540	3,132	4,352
BASE	COOL $	520	442	816	224	235	505	166	144	17	82	84	71	32	15	5
BASE	HEAT $	12	477	276	894	785	619	1,218	1,084	948	1,374	1,074	1,627	1,451	2,021	3,185
703.1.1	0 to < 5% UA improvement*	0%	2%	0%	0%	0%	0%	0%	0%	-1%	0%	0%	0%	0%	0%	0%
	5% to < 10% UA improvement	0%	4%	-2%	-2%	-2%	-2%	3%	-1%	3%	3%	4%	2%	3%	2%	2%
	10% to < 15% UA improvement	0%	5%	1%	1%	1%	1%	5%	2%	5%	5%	7%	5%	6%	4%	4%
	15% to < 20% UA improvement	0%	6%	3%	3%	3%	10%	7%	6%	7%	7%	9%	6%	7%	5%	5%
	>= 20% UA improvement	1%	6%	10%	10%	8%	11%	9%	8%	8%	8%	10%	8%	9%	6%	6%
703.1.2	Insulation installation quality	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009	Mandatory - 2009
703.1.3	Mass walls >6"	-2%	1%	-3%	-4%	-4%	-4%	-5%	-5%	-13%	-12%	-13%	-12%	-13%	-10%	-12%
	mass walls < 6"	-2%	1%	-3%	-4%	-4%	-4%	-5%	-5%	-13%	-11%	-13%	-12%	-13%	-10%	-11%
703.1.4	Radiant barrier	1%	3%	1%	1%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
703.1.5	Envelope leakage 5ACH50	1%	3%	1%	2%	2%	2%	2%	2%	3%	3%	3%	4%	3%	3%	4%
	4ACH50	1%	4%	2%	3%	3%	3%	4%	4%	4%	5%	5%	6%	5%	5%	6%
	3ACH50	2%	4%	3%	4%	4%	3%	5%	5%	5%	6%	6%	8%	7%	6%	8%
	2ACH50	2%	4%	3%	5%	5%	4%	6%	6%	6%	7%	8%	9%	8%	8%	10%
	1ACH50	2%	1%	3%	5%	5%	5%	6%	6%	7%	8%	8%	10%	9%	9%	11%
703.1.6.1	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory
703.1.6.2	Fenestration level 2	6%	5%	1%	2%	5%	4%	1%	1%	1%	1%	3%	2%	3%	2%	2%
703.1.6.2b	Fenestration level 3	7%	6%	4%	6%	6%	5%	2%	2%	3%	3%	5%	4%	4%	3%	3%
	Fenestration level 4	None	None	None	None	None	N/A	3%	3%	4%	4%	5%	4%	4%	3%	3%
703.2.1	Combo heating system															
703.2.2 (3)	Gas Boiler >85%	0%	6%	3%	9%	8%	7%	11%	7%	11%	8%	9%	8%	8%	6%	13%
	Gas Boiler >90%	0%	6%	3%	10%	8%	8%	11%	7%	11%	8%	10%	8%	8%	7%	14%
	Gas Boiler >94%	0%	6%	4%	10%	9%	8%	12%	8%	12%	8%	10%	9%	9%	7%	14%
	Gas Boiler >96%	0%	6%	4%	10%	9%	8%	12%	8%	12%	9%	10%	9%	9%	7%	15%
703.2.3	Boiler temperature reset															
703.2.2 (1)	Gas Heater >90%	0%	4%	1%	3%	3%	2%	4%	4%	4%	4%	5%	5%	5%	4%	5%
	Gas Heater >92%	0%	4%	1%	4%	4%	3%	5%	5%	5%	5%	6%	6%	6%	5%	6%
	Gas Heater >94%	0%	4%	1%	5%	4%	3%	5%	5%	5%	6%	7%	6%	6%	5%	7%
	Gas Heater >96%	0%	4%	2%	6%	5%	4%	6%	5%	6%	7%	7%	7%	7%	6%	8%
	Gas Heater >98%	0%	5%	2%	6%	5%	4%	7%	6%	6%	7%	8%	8%	7%	6%	9%
703.2.2 (2)	Oil Furnace 85%	-1%	-4%	-6%	-23%	-21%	-16%	-25%	-24%	-25%	-28%	-31%	-30%	-31%	-24%	-33%
	Oil Furnace 90%	-1%	-3%	-5%	-20%	-18%	-14%	-21%	-21%	-21%	-24%	-27%	-25%	-26%	-21%	-28%
703.2.2(4)	Oil Boil 85%	-1%	0%	-1%	-9%	-10%	-6%	-9%	-15%	-9%	-18%	-19%	-20%	-21%	-16%	-14%
	Oil Boiler 90%	0%	0%	-1%	-10%	-10%	-6%	-10%	-16%	-10%	-19%	-20%	-21%	-21%	-17%	-15%
703.2.5(1)	SEER 14 EER11.5	2%	1%	2%	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	SEER 15 EER12.5	3%	1%	4%	1%	1%	3%	1%	1%	0%	0%	0%	0%	0%	0%	0%
	SEER 17 EER12.5	6%	2%	7%	2%	2%	4%	1%	1%	0%	1%	1%	0%	0%	0%	0%
	SEER 19 EER12.5	8%	3%	10%	3%	3%	6%	2%	1%	0%	1%	1%	1%	0%	0%	0%
	SEER 21 EER12.5	10%	4%	12%	3%	3%	7%	2%	2%	0%	1%	1%	1%	0%	0%	0%
703.2.6	GSHP															
703.2.7	E* ceiling fans															
703.2.8	whole house ventilation fan	3%	0%	0%	1%	1%	0%	2%	2%	3%	2%	3%	2%	2%	1%	2%
703.2.9	Submeter in multiunit															
703.2.10	Programmable thermostat 70/78	1%	0%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
703.3.1	Ductless heating system	0%	3%	2%	5%	3%	3%	6%	1%	5%	2%	2%	2%	2%	1%	7%
703.3.2	Ductless cooling system	6%	3%	5%	1%	1%	3%	1%	0%	0%	0%	0%	0%	0%	0%	0%
703.3.3	Duct installation (interior+)	6%	6%	7%	6%	4%	6%	7%	2%	5%	2%	2%	2%	2%	13%	13%
703.3.4	Duct leakage 6%	3%	4%	3%	2%	2%	3%	2%	1%	2%	1%	1%	1%	1%	1%	2%
	6% in	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run					
	6% both	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run	Do not run					
703.4.1	Water heater energy factor .64	1%	3%	1%	1%	1%	1%	0%	1%	1%	0%	1%	0%	0%	0%	0%
	Tankless > 200K Btuh TE 82%	3%	4%	2%	2%	2%	2%	2%	2%	4%	2%	2%	1%	2%	1%	1%
	Tankless 86% plus	3%	4%	2%	2%	3%	3%	2%	2%	4%	2%	3%	2%	2%	1%	1%
703.4.2	Desuperheater															
703.4.3	Drainwater heat recovery															
703.4.4	Indirect water heater															
703.4.5	Solar water heater SEF 1.3	8%	4%	6%	6%	6%	6%	5%	5%	6%	5%	7%	4%	5%	3%	2%
	SEF 1.51	9%	4%	7%	7%	7%	7%	5%	6%	7%	5%	9%	5%	5%	3%	3%
	SEF 1.81	10%	5%	7%	7%	8%	7%	6%	6%	7%	6%	12%	5%	6%	3%	3%
	SEF 2.31	11%	5%	8%	8%	8%	8%	6%	7%	8%	6%	14%	6%	7%	4%	3%
	SEF 3.01	12%	6%	9%	9%	9%	9%	7%	8%	9%	7%	16%	6%	7%	4%	4%
703.5.1	Hardwired lighting 75% HE	3%	4%	2%	2%	2%	2%	1%	1%	1%	1%	2%	1%	1%	1%	1%
	95% HE	5%	4%	3%	3%	3%	3%	2%	2%	2%	2%	3%	2%	2%	1%	1%
703.5.2	Recessed lighting															
703.5.3	E* appliances - Refrig	2%	3%	1%	1%	1%	1%	1%	1%	0%	1%	1%	1%	1%	0%	0%
	DW	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Washing Machine	0%	3%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	0%	0%
703.5.4	Induction cooktop	-1%	2%	0%	-1%	-1%	-1%	0%	-1%	2%	0%	-1%	0%	-1%	0%	0%
703.6.1	Passive solar design	7%	3%	7%	4%	4%	5%	2%	2%	3%	2%	4%	3%	3%	2%	2%
703.6.2	Window shading (active)H/C	.85/.70 2009code	.85/.70 2009code	.85/.70 2009code	.85/.70 2009code	.85/.70 2009code	.85/.70 2009code	.85/.70 2009code	.85/.70 2009code	.85/.70 2009code	.85/.70 2009code	.85/.70 2009code	.85/.70 2009code	.85/.70 2009code	.85/.70 2009code	.85/.70 2009code
703.6.3	Passive cooling design	3%	0%	1%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	1%
703.6.4	Passive heating (mass)	6%	4%	7%	5%	6%	6%	2%	3%	2%	2%	5%	2%	3%	2%	1%

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