DOE Challenge Home

Savings & Cost Estimate Summary

November 2013

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INTRODUCTION

In considering the business strategy for constructing and selling Zero Energy Ready Homes through the DOE Challenge Home program, builders and other program partners understandably want to know about the added costs. Upgrades in insulation, air sealing, mechanical equipment and other systems will mean both energy savings and added costs above code-minimum specifications. Therefore, this document presents an analysis-based cost estimate for building to DOE Challenge Home levels relative to:

- A 2009 International Energy Conservation Codes baseline house
- A 2012 International Energy Conservation Codes baseline house

The purpose of this analysis is to give builders, contractors, utilities, energy programs, and other stakeholders a general sense of 1) the magnitude and type of added costs, and 2) how these costs compare to the energy savings. It is critical to understand that both sets of findings are heavily dependent on several factors, including the following:

- The "real" baseline house. In this analysis, the baseline is a bare minimum IECC house (either 2009 or 2012). In many "real world" cases the baseline home will be somewhat above code.
- How a home actually complies. DOE Challenge Home affords great flexibility to reach the required performance targets, and the data in this analysis are based on a very small set of design solutions. Different design approaches will incur different added costs.
- Assigned costs for upgrades. As described below this analysis utilizes recognized cost data sources and maintains a methodology consistent with a similar study for ENERGY STAR Homes V3. In actual projects the cost impacts for various upgrades will vary.
- Project location. Specifications and pricing for actual projects are a function of the project location.

METHODOLOGY

DOE evaluated 3-bedroom, 2,200 ft^2 detached single-family prototype homes in Climate Zones 3 and 5 to provide estimates for a warmer and a colder climate zone. Window area to floor area ratio was 15% with windows evenly distributed on all four sides of the home. The Climate Zone 3 models assumed a slab on grade foundation with ducts in unconditioned space for the baseline home, while the zone 5 homes were modeled with a basement foundation and ducts in conditioned space for the baseline home. In each climate zone, an all-electric prototype was modeled along with a prototype using natural gas for space and water heating.

The energy efficiency features of the baseline homes were aligned with the 2009 IECC and 2012 IECC prescriptive paths, respectively, though Grade III insulation installation was assumed for walls and Grade II insulation installation was assumed for ceilings. The assumption of degraded insulation installation reflects DOE Challenge Home experience with typical homes built to code.

The DOE Challenge Home prototype models were designed based on a combination of prescriptive measures drawn from the Target Home and performance-based measures which optimized cost versus performance. The DOE Challenge Home prototype models were confirmed to meet the energy threshold of the program through the use of REM/Rate Version 14.3 software.

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A large part of the "delta" between a DOE Challenge Home and a minimally compliant IECC home is the jump to ENERGY STAR Homes Version 3 qualification, which is a prerequisite for DOE Challenge Home qualification. Therefore, this savings and cost estimate is designed to be consistent with a concurrent savings/cost analysis for ENERGY STAR Homes V3[1] in the following ways:

- Consistent costs for the same changes in building systems. In cases where a DOE Challenge Home implements the same measure as does an ENERGY STAR Home, then the added cost for that measure is the same as stated in the ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary (cited in the footnote below and often referred to as the "ENERGY STAR Analysis" in this report). This is the case for the ENERGY STAR checklists.
- Consistent data sources for similar changes in measures. In cases where a DOE Challenge Home implemented a similar measure as did the ENERGY STAR Home relative to code, then the DOE Challenge Home adopted the same cost data source and applied it in a similar fashion. For instance, in evaluating the cost to move from an 80 AFUE furnace to a 95 AFUE furnace in the Climate Zone 5 model, the DOE analysis uses the same cost data source (National Residential Efficiency Measures Database[2]) as the ENERGY STAR analysis used for an 80 to 90 AFUE upgrade, and applies the cost data in a consistent manner.
- Consistent energy savings from the 4 ENERGY STAR checklists. The ENERGY STAR analysis accounts for the impacts of the quality-control checklists that are not currently credited in the RESNET standards (i.e., Fully-Aligned Air Barrier and Air Sealing Sections of the Thermal Enclosure System Rater checklist and HVAC System Quality Installation Contractor and Rater checklists). These serve to increase energy savings for DOE Challenge Homes. The detailed adjustments are explained fully in the ENERGY STAR analysis.

For DOE Challenge Home measures not related to ENERGY STAR qualification, such as locating ducts within conditioned space, installing renewable-ready features, or installing renewable-ready features, industry data sources were used to estimated the added costs. These costs and associated data sources are noted in the summary tables which follow. Notable assumptions include:

- The cost to install the renewable readiness features required by DOE Challenge Home was estimated to be $350, based on DOE experience. In many circumstances, including all project sites where the average solar radiation is less than 5 kWh/m^2/day, the renewable ready checklist is not mandatory. The $350 cost is included in all models in this study, so sites where these measures are not required will not incur this cost.
- The cost to comply with the indoor air quality provisions of the EPA Indoor airPLUS is estimated at $1000. The actual cost of complying will vary based on house, site, and climate characteristics, baseline building practices, and numerous other factors. It should also be noted that many provisions of the Indoor airPLUS specification are already included within the ENERGY STAR checklists and the costs for those measures are not included within the $1000 estimate.

[1] "ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary." November 2013. Available online at: http://www.energystar.gov/ia/partners/bldrs_lenders_raters/downloads/EstimatedCostandSavings.pdf

[2] National Renewable Energy Laboratory, National Residential Efficiency Measures Database. Last accessed October 2013. Available online at: http://www.nrel.gov/ap/retrofits/

In terms of economic assumptions, energy rates used in this analysis were $0.11/kWh and $1.06/therm of natural gas. Monthly net cash flow calculations assumed a 30-year fixed rate mortgage with a 5% interest rate.

RESULTS

Table 1 below provides a summary of the HERS Index, energy savings, incremental costs for upgrades, and net monthly cash flow for the DOE Challenge Home models compared to a 2009 IECC baseline home. Table 2 shows the same information for DOE Challenge Home relative to a 2012 IECC baseline.

Appendix A, which follows Tables 1 and 2, contains the detailed cost estimating models for the 2009 and 2012 baseline homes, for both the all-electric prototype and the gas-electric prototype (for a total of 8 models). These tables are arranged into 3 main sections of specifications: the Mandatory DOE Challenge Home provisions; measures used to meet the Performance Path of compliance; and the 4 ENERGY STAR checklists. Appendix B summarizes the cost estimating data sources which were utilized.

Table 1: DOE Challenge Home Energy & Cost Comparison to 2009 IECC Baseline

Climate Zone	Space & Water Heating Energy Source	09 IECC - HERS Index	DCH - HERS Index	Monthly Energy Cost Savings for DCH House vs. 09 IECC House ($)	Estimated Marginal First Cost for DCH House ($)	Amortized Marginal First Cost for DCH House ($)	Net Monthly Cashflow ($)
3	Electric	88	57	$66	$7,291	$39	$26
3	Gas	86	54	$66	$6,868	$37	$29
5	Electric	78	53	$101	$5,590	$30	$71
5	Gas	72	49	$70	$5,083	$27	$43

Table 2: DOE Challenge Home Energy & Cost Comparison to 2012 IECC Baseline

Climate Zone	Space & Water Heating Energy Source	12 IECC - HERS Index	DCH - HERS Index	Monthly Energy Cost Savings for DCH House vs. 12 IECC House ($)	Estimated Marginal First Cost for DCH House ($)	Amortized Marginal First Cost for DCH House ($)	Net Monthly Cashflow ($)
3	ELECTRIC	74	57	$37	$4,663	$25	$12
3	GAS	72	54	$37	$4,216	$23	$14
5	ELECTRIC	61	53	$40	$4,403	$24	$16
5	GAS	59	49	$33	$3,896	$21	$12

APPENDIX A: DETAILED COST ESTIMATING TABLES FOR 8 MODELS

DOE Challenge Home Savings & Cost Estimate Summary - Appendices

SCENARIO: CLIMATE ZONE 3; ALL ELECTRIC; 2009 IECC BASELINE	
Baseline Home:	2200 SF prototype, compliant with 2009 IECC (prescriptive)
Design Home:	2200 SF prototype, compliant with DOE Challenge Home (performance)
Foundation Type:	Slab on Grade
City:	Ft. Worth , TX
Climate Zone:	3
Space & Water Fuel:	Electric

Cost	
INCREMENTAL COSTS	**$7,291**
MONTHLY PAYMENT	**$39.14**
MONTHLY UTILITY SAVINGS	**$66**
ASSUMED INTEREST RATE (same as V3 analysis)	**5.00%**
NET MONTHLY CASHFLOW	**$26.49**

DOE Challenge Home Mandatory Requirements: Exhibit 1

Measure	2009 IECC Baseline	DOE Challenge Home(Rev. 03)	UNIT COST	UNIT QTY	UNIT	Marginal Cost for Challenge Home
Home is ENERGY STAR V3 Qualified	N/A	V3 Cost Impacts Reflected in Items Below	-	-	-	-
Fenestration meets ENERGY STAR criteria	U=0.50; SHGC=0.30	U=0.30; SHGC=0.27	$0.91	330	Window Area (ft^2)	$301
Ceiling/Attic Insulation (2012 IECC)	Ceiling: R30 blown-in	BEDs: R-38 Attic Assembly: 1.5" of CCSPF over R-8 Duct Work and 2" of CCSPF over R-6 Duct Work, encapsulating duct work with R-8 of blownin FG added to the existing R-30.	$1,148.40	1	Buried Encapsulated Ducts (BEDs)	$1,148
Above Grade Wall Insulation (2012 IECC)	Wall: R13	Wall: R13+5	$0.83	1531	Sq. Ft.	$1,271
Floor Insulation (2012 IECC)	Floor: n/a	Floor: n/a	-	-	-	-
Foundation Insulation, Slab (2012 IECC)	Slab: 0	Slab: 0	-	-	-	-
Foundation Insulation, Wall (2012 IECC)	n/a	n/a	-	-	-	-
Duct location	Attic (100% of supply & return)	Ducts inside conditioned space	-	-	-	-
Total duct leakage	Total Leakage ≤ 12 cfm per 100 SF of CFA	Total Leakage < 8 cfm per 100 SF of CFA	$0.17	814	Duct Surface Area	$138
Water Efficiency	N/A	Meets EPA Water Sense Requirements for Hot Water Distribution	$193.00	1	Structured Plumbing System	$193
Dishwasher	Standard Efficiency Dishwasher	ENERGY STAR Dishwasher	$10.00	1	Dishwasher	$10
Refrigerator	Standard Efficiency Refrigerator	ENERGY STAR Refrigerator	$40.00	1	Refrigerator	$40
Clothes Washer	Not Provided by Builder	Not Provided by Builder	-	-	-	-
Lighting	50% of lighting is high efficacy	80% of lighting is high efficacy	$2.80	10.00	Lamps	$28
Bath Fans (WHMV)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan w/controller	$94.00	1	Bath Fan	$94
Bath Fan (Local Exhaust)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan	$31.00	2	Bath Fan	$62
EPA Indoor airPLUS Verification Checklist	-	Comply with EPA Indoor airPLUS	$1,000.00	1	IAPlus Home	$1,000
Consolidated Renewable Energy Ready Checklist	-	-	$350.00	1	Homes with Checklists Applied	$350
DOE Challenge Home PERFORMANCE PATH						
Cooling	-	-	-	-	-	-
Heating	7.7 HSPF / 13 SEER / 11 EER ASHP; Electric Backup	9.0 HSPF / 16 SEER / 13 EER ASHP; Electric Backup	$384.00	2	Tons	$768
Radiant Barrier	None	None	-	-	-	-
Ceiling Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Ceiling Insulation Installation	Grade II	Grade I	$0.07	2750	Insulated Ceiling SF	$193
AGW Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
AGW Insulation Installation	Grade III	Grade I	$0.09	1531	Insulated AGW SF	$138
Foundation Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Foundation Insulation Installation	Grade II	Grade I	-	-	-	-
Infiltration	7.0 ACH50	2.5 ACH50	$0.44	2200	CFA	$968
Windows	see Energy Star fenestration above	see Energy Star fenestration above	-	-	-	-
Doors	R-2.0	R-2.9	$2.17	2	Door	$4
Water Heater	0.92 EF electric storage; 50 gal.	0.95 EF electric storage; 50 gal.	$1.20	50	Gallons	$60
Thermostat	Programmable	Programmable	-	-	-	-
Duct Sealing	See Total Duct Leakage above	See Total Duct Leakage above	-	-	-	-
Duct Insulation	supplies R-8; returns R-6	supplies R-8; returns R-6	-	-	-	-

ENERGY STAR CHECKLISTS		
Thermal Enclosure System - Rater	Cost includes reduced lumber from Advanced Framing & Rater Verification; Other associated costs listed elsewhere include the home's insulation, windows and door improvements.	-$25
HVAC Sys. Quality Install. - Contractor	Cost includes Credential Fee, HVAC Commissioning, Contractor Completion of Checklist. Other costs associated with the requirement are reflected above in the WHMV system and in reduced capacity for HVAC Equipment.	$200
HVAC Sys. Quality Install. - Rater	Cost includes Document Collection & Review, Bedroom Pressure Balancing, Rater Verification. Other cost associated with the requirement are reflected in Duct Sealing and Duct Insulation.	$350

SCENARIO: CLIMATE ZONE 3; GAS SPACE & WATER HEATING; 2009 IECC BASELINE	
Baseline Home:	2200 SF prototype, compliant with 2009 IECC (prescriptive)
Design Home:	2200 SF prototype, compliant with DOE Challenge Home (performance)
Foundation Type:	Slab on Grade
City:	Ft. Worth , TX
Climate Zone:	3
Space & Water Fuel:	Gas

Cost	
INCREMENTAL COSTS	**$6,868**
MONTHLY PAYMENT	**$36.87**
MONTHLY UTILITY SAVINGS	**$66**
ASSUMED INTEREST RATE (same as V3 analysis)	**5.00%**
NET MONTHLY CASHFLOW	**$29.02**

DOE Challenge Home Mandatory Requirements: Exhibit 1

Measure	2009 IECC Baseline	DOE Challenge Home(Rev. 03)	UNIT COST	UNIT QTY	UNIT	MARGINAL COST FOR Challenge Home
Home is ENERGY STAR V3 Qualified	N/A	V3 Cost Impacts Reflected in Items Below	-	-	-	-
Fenestration meets ENERGY STAR criteria	U=0.50; SHGC=0.30	U=0.30; SHGC=0.27	$0.91	330	Window Area (ft^2)	$301
Ceiling/Attic Insulation (2012 IECC)	Ceiling: R30 blown-in	BEDs: R-38 Attic Assembly: 1.5" of CCSPF over R-8 Duct Work and 2" of CCSPF over R-6 Duct Work, encapsulating duct work with R-8 of blownin FG added to the existing R-30.	$1,148.40	1	Buried Encapsulated Ducts (BEDs)	$1,148
Above Grade Wall Insulation (2012 IECC)	Wall: R13	Wall: R13+5	$0.83	1531	Sq. Ft.	$1,271
Floor Insulation (2012 IECC)	Floor: n/a	Floor: n/a	-	-	-	-
Foundation Insulation, Slab (2012 IECC)	Slab: 0	Slab: 0	-	-	-	-
Foundation Insulation, Wall (2012 IECC)	n/a	n/a	-	-	-	-
Duct location	Attic (100% of supply & return)	Ducts inside conditioned space	-	-	-	-
Total duct leakage	Total Leakage ≤ 12 cfm per 100 SF of CFA	Total Leakage < 8 cfm per 100 SF of CFA	$0.17	814	Duct Surface Area	$138
Water Efficiency	N/A	Meets EPA Water Sense Requirements for Hot Water Distribution	$193.00	1	Structured Plumbing System	$193
Dishwasher	Standard Efficiency Dishwasher	ENERGY STAR Dishwasher	$10.00	1	Dishwasher	$10
Refrigerator	Standard Efficiency Refrigerator	ENERGY STAR Refrigerator	$40.00	1	Refrigerator	$40
Clothes Washer	Not Provided by Builder	Not Provided by Builder	-	-	-	-
Lighting	50% of lighting is high efficacy	80% of lighting is high efficacy	$2.80	10.00	Lamps	$28
Bath Fans (WHMV)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan w/controller	$94.00	1	Bath Fan	$94
Bath Fan (Local Exhaust)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan	$31.00	2	Bath Fan	$62
EPA Indoor airPLUS Verification Checklist	-	Comply with EPA Indoor airPLUS	$1,000.00	1	IAPlus Home	$1,000
Consolidated Renewable Energy Ready Checklist	-	-	$350.00	1	Homes with Checklists Applied	$350

DOE Challenge Home PERFORMANCE PATH						
Cooling	13 SEER A/C	15 SEER A/C	$156.00	2	Tons	$312
Heating	80 AFUE	90 AFUE	$6.60	24	kBtu/hr	$158
Radiant Barrier	None	None	-	-	-	-
Ceiling Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Ceiling Insulation Installation	Grade II	Grade I	$0.07	2750	Insulated Ceiling SF	$193
AGW Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
AGW Insulation Installation	Grade III	Grade I	$0.09	1531	Insulated AGW SF	$138
Foundation Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Foundation Insulation Installation	Grade II	Grade I	-	-	-	-
Infiltration	7.0 ACH50	2.5 ACH50	$0.44	2200	CFA	$968
Windows	see Energy Star fenestration above	see Energy Star fenestration above	-	-	-	-
Doors	R-2.0	R-2.9	$2.17	2	Door	$4
Water Heater	0.59 EF (0.71 RE) gas storage; 50 gal.	0.67 EF (0.76 RE) gas storage; 50 gal.	$0.70	50	Gallons	$35
Thermostat	Programmable	Programmable	-	-	-	-
Duct Sealing	See Total Duct Leakage above	See Total Duct Leakage above	-	-	-	-
Duct Insulation	supplies R-8; returns R-6	supplies R-8; returns R-6	-	-	-	-

ENERGY STAR CHECKLISTS		
Thermal Enclosure System - Rater	Cost includes reduced lumber from Advanced Framing & Rater Verification; Other associated costs listed elsewhere include the home's insulation, windows and door improvements.	-$25
HVAC Sys. Quality Install. - Contractor	Cost includes Credential Fee, HVAC Commissioning, Contractor Completion of Checklist. Other costs associated with the requirement are reflected above in the WHMV system and in reduced capacity for HVAC Equipment.	$200
HVAC Sys. Quality Install. - Rater	Cost includes Document Collection & Review, Bedroom Pressure Balancing, Rater Verification. Other cost associated with the requirement are reflected in Duct Sealing and Duct Insulation, Elimination of B-Vent	$250

SCENARIO: CLIMATE ZONE 5; ALL ELECTRIC; 2009 IECC BASELINE						
Baseline Home:	2200 SF prototype, compliant with 2009 IECC (prescriptive)					
Design Home:	2200 SF prototype, compliant with DOE Challenge Home (performance)					
Foundation Type:	Conditioned Basement					
City:	Indianapolis, IN					
Climate Zone:	5					
Space & Water Fuel:	Electric					
Cost						
INCREMENTAL COSTS						**$5,590**
MONTHLY PAYMENT						**$30.01**
MONTHLY UTILITY SAVINGS						**$101**
ASSUMED INTEREST RATE (same as V3 analysis)						**5.00%**
NET MONTHLY CASHFLOW						**$71.07**
DOE Challenge Home Mandatory Requirements: Exhibit 1						
Measure	**2009 IECC Baseline**	**DOE Challenge Home(Rev. 03)**	**UNIT COST**	**UNIT QTY**	**UNIT**	**MARGINAL COST FOR Challenge Home**
Home is ENERGY STAR V3 Qualified	N/A	V3 Cost Impacts Reflected in Items Below	-	-	-	-
Fenestration meets ENERGY STAR criteria	U=0.35; SHGC=0.45	U=0.30; SHGC=0.27	$0.69	330	Window Area (ft^2)	$227
Ceiling/Attic Insulation (2012 IECC)	Ceiling: R38 blown-in	Ceiling: R38 blown-in	$3.50	92	Top Plate Area (SF)	$322
Above Grade Wall Insulation (2012 IECC)	Wall: R21	Wall: R21	-	-	-	-
Floor Insulation (2012 IECC)	Floor: n/a	Floor: n/a	-	-	-	-
Foundation Insulation, Slab (2012 IECC)	Slab: 0	Slab: 0	-	-	-	-
Foundation Insulation, Wall (2012 IECC)	R-10	R-15	$0.22	1501	Material Cost (SF)	$330
Duct location	Ducts in conditioned space: basement and interior walls	Ducts inside conditioned space	-	-	-	-
Total duct leakage	Total Leakage ≤ 12 cfm per 100 SF of CFA	Total Leakage < 8 cfm per 100 SF of CFA	$0.19	1221	Duct Surface Area	$232
Water Efficiency	N/A	Meets EPA Water Sense Requirements for Hot Water Distribution	$193.00	1	Structured Plumbing System	$193
Dishwasher	Standard Efficiency Dishwasher	ENERGY STAR Dishwasher	$10.00	1	Dishwasher	$10
Refrigerator	Standard Efficiency Refrigerator	ENERGY STAR Refrigerator	$40.00	1	Refrigerator	$40
Clothes Washer	Not Provided by Builder	Not Provided by Builder	-	-	-	-
Lighting	50% of lighting is high efficacy	80% of lighting is high efficacy	$2.80	10.00	Lamps	$28
Bath Fans (WHMV)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan w/controller	$94.00	1	Bath Fan	$94
Bath Fan (Local Exhaust)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan	$31.00	2	Bath Fan	$62
EPA Indoor airPLUS Verification Checklist	-	Comply with EPA Indoor airPLUS	$1,000.00	1	IAPlus Home	$1,000
Consolidated Renewable Energy Ready Checklist	-	-	$350.00	1	Homes with Checklists Applied	$350
DOE Challenge Home PERFORMANCE PATH						
Cooling	-	-	-	-	-	-
Heating	7.7 HSPF / 13 SEER / 11 EER ASHP; Electric Backup	9.2 HSPF / 15 SEER / 13 EER ASHP; Electric Backup	$345.84	2	Tons	$692
Radiant Barrier	None	None	-	-	-	-
Ceiling Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Ceiling Insulation Installation	Grade II	Grade I	$0.07	2200	Insulated Ceiling SF	$154
AGW Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
AGW Insulation Installation	Grade III	Grade I	$0.04	1531	Insulated AGW SF	$61
Foundation Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Foundation Insulation Installation	Grade II	Grade I	$0.15	1501	Insulated Foundation Wall SF	$225
Infiltration	7.0 ACH50	2.0 ACH50	$0.48	2200	CFA	$1,056
Windows	see Energy Star fenestration above	see Energy Star fenestration above	-	-	-	-
Doors	R-2.9	R-3.1	$2.17	2	Door	$4
Water Heater	0.92 EF electric storage; 50 gal.	0.95 EF electric storage; 50 gal.	$1.20	50	Gallons	$60
Thermostat	Programmable	Programmable	-	-	-	-
Duct Sealing	See Total Duct Leakage above	See Total Duct Leakage above	-	-	-	-
Duct Insulation	R-0	R-0	-	-	-	-
ENERGY STAR CHECKLISTS						
Thermal Enclosure System - Rater	Cost includes reduced lumber from Advanced Framing & Rater Verification; Other associated costs listed elsewhere include the home's insulation, windows and door improvements.					-$100
HVAC Sys. Quality Install. - Contractor	Cost includes Credential Fee, HVAC Commissioning, Contractor Completion of Checklist. Other costs associated with the requirement are reflected above in the WHMV system and in reduced capacity for HVAC Equipment.					$200
HVAC Sys. Quality Install. - Rater	Cost includes Document Collection & Review, Bedroom Pressure Balancing, Rater Verification. Other cost associated with the requirement are reflected in Duct Sealing and Duct Insulation.					$350

DOE Challenge Home Savings & Cost Estimate Summary - Appendices

SCENARIO: CLIMATE ZONE 5; GAS SPACE & WATER HEATING; 2009 IECC BASELINE						
Baseline Home:	2200 SF prototype, compliant with 2009 IECC (prescriptive)					
Design Home:	2200 SF prototype, compliant with DOE Challenge Home (performance)					
Foundation Type:	Conditioned Basement					
City:	Indianapolis, IN					
Climate Zone:	5					
Space & Water Fuel:	Gas					
Cost						
INCREMENTAL COSTS						**$5,083**
MONTHLY PAYMENT						**$27.29**
MONTHLY UTILITY SAVINGS						**$70**
ASSUMED INTEREST RATE (same as V3 analysis)						**5.00%**
NET MONTHLY CASHFLOW						**$42.77**
DOE Challenge Home Mandatory Requirements: Exhibit 1						
Measure	**2009 IECC Baseline**	**DOE Challenge Home(Rev. 03)**	**UNIT COST**	**UNIT QTY**	**UNIT**	**MARGINAL COST FOR Challenge Home**
Home is ENERGY STAR V3 Qualified	N/A	V3 Cost Impacts Reflected in Items Below	-	-	-	-
Fenestration meets ENERGY STAR criteria	U=0.35; SHGC=0.45	U=0.30; SHGC=0.27	$0.69	330	Window Area (ft^2)	$227
Ceiling/Attic Insulation (2012 IECC)	Ceiling: R38 blown-in	Ceiling: R38 blown-in	$3.50	92	Top Plate Area (SF)	$322
Above Grade Wall Insulation (2012 IECC)	Wall: R21	Wall: R21	-	-	-	-
Floor Insulation (2012 IECC)	Floor: n/a	Floor: n/a	-	-	-	-
Foundation Insulation, Slab (2012 IECC)	Slab: 0	Slab: 0	-	-	-	-
Foundation Insulation, Wall (2012 IECC)	R-10	R-15	$0.22	1501	Material Cost (SF)	$330
Duct location	walls	Ducts inside conditioned space	-	-	-	-
Total duct leakage	Total Leakage ≤ 12 cfm per 100 SF of CFA	Total Leakage < 8 cfm per 100 SF of CFA	$0.19	1221	Duct Surface Area	$232
Water Efficiency	N/A	Meets EPA Water Sense Requirements for Hot Water Distribution	$193.00	1	Structured Plumbing System	$193
Dishwasher	Standard Efficiency Dishwasher	ENERGY STAR Dishwasher	$10.00	1	Dishwasher	$10
Refrigerator	Standard Efficiency Refrigerator	ENERGY STAR Refrigerator	$40.00	1	Refrigerator	$40
Clothes Washer	Not Provided by Builder	Not Provided by Builder	-	-	-	-
Lighting	50% of lighting is high efficacy	80% of lighting is high efficacy	$2.80	13.00	Lamps	$36
Bath Fans (WHMV)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan w/controller	$94.00	1	Bath Fan	$94
Bath Fan (Local Exhaust)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan	$31.00	2	Bath Fan	$62
EPA Indoor airPLUS Verification Checklist	-	Comply with EPA Indoor airPLUS	$1,000.00	1	IAPlus Home	$1,000
Consolidated Renewable Energy Ready Checklist	-	-	$350.00	1	Homes with Checklists Applied	$350
DOE Challenge Home PERFORMANCE PATH						
Cooling	13 SEER	13 SEER	-	-	-	-
Heating	80 AFUE	95 AFUE	$7.17	42	kBtu/hr	$301
Radiant Barrier	None	None	-	-	-	-
Ceiling Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Ceiling Insulation Installation	Grade II	Grade I	$0.07	2200	Insulated Ceiling SF	$154
AGW Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
AGW Insulation Installation	Grade III	Grade I	$0.04	1531	Insulated AGW SF	$61
Foundation Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Foundation Insulation Installation	Grade II	Grade I	$0.15	1501	Insulated Foundation Wall SF	$225
Infiltration	7.0 ACH50	2.0 ACH50	$0.48	2200	CFA	$1,056
Windows	see Energy Star fenestration above	see Energy Star fenestration above	-	-	-	-
Doors	R-2.9	R-3.1	$2.17	2	Door	$4
Water Heater	0.59 EF (0.71 RE) gas storage; 50 gal.	0.67 EF (0.76 RE) gas storage; 50 gal.	$0.70	50	Gallons	$35
Thermostat	Programmable	Programmable	-	-	-	-
Duct Sealing	See Total Duct Leakage above	See Total Duct Leakage above	-	-	-	-
Duct Insulation	R-0	R-0	-	-	-	-
ENERGY STAR CHECKLISTS						
Thermal Enclosure System - Rater	Cost includes reduced lumber from Advanced Framing & Rater Verification; Other associated costs listed elsewhere include the home's insulation, windows and door improvements.					-$100
HVAC Sys. Quality Install. - Contractor	Cost includes Credential Fee, HVAC Commissioning, Contractor Completion of Checklist. Other costs associated with the requirement are reflected above in the WHMV system and in reduced capacity for HVAC Equipment.					$200
HVAC Sys. Quality Install. - Rater	Cost includes Document Collection & Review, Bedroom Pressure Balancing, Rater Verification. Other cost associated with the requirement are reflected in Duct Sealing and Duct Insulation, Elimination of B-Vent					$250

DOE Challenge Home Savings & Cost Estimate Summary - Appendices

SCENARIO: CLIMATE ZONE 3; ALL ELECTRIC; 2012 IECC BASELINE	
Baseline Home:	2200 SF prototype, compliant with 2012 IECC (prescriptive)
Design Home:	2200 SF prototype, compliant with DOE Challenge Home (performance)
Foundation Type:	Slab on Grade
City:	Ft. Worth , TX
Climate Zone:	3
Space & Water Fuel:	Electric

Cost	
INCREMENTAL COSTS	**$4,663**
MONTHLY PAYMENT	**$25.03**
MONTHLY UTILITY SAVINGS	**$37**
ASSUMED INTEREST RATE (same as V3 analysis)	**5.00%**
NET MONTHLY CASHFLOW	**$12.44**

DOE Challenge Home Mandatory Requirements: Exhibit 1

Measure	2012 IECC Baseline	DOE Challenge Home(Rev. 03)	UNIT COST	UNIT QTY	UNIT	MARGINAL COST FOR Challenge Home
Home is ENERGY STAR V3 Qualified	N/A	V3 Cost Impacts Reflected in Items Below	-	-	-	-
Fenestration meets ENERGY STAR criteria	U=0.35; SHGC=0.25	U=0.30; SHGC=0.27	$0.63	330	Window Area (ft^2)	$208
Ceiling/Attic Insulation (2012 IECC)	Ceiling: R38 blown-in	BEDs: R-38 Attic Assembly: 1.5" of CCSPF encapsulating supply side and 2" of CCSPF on return side.	$708.40	1	Buried Encapsulated Ducts (BEDs)	$708
Above Grade Wall Insulation (2012 IECC)	Wall: R13+5	Wall: R13+5	-	-	-	-
Floor Insulation (2012 IECC)	Floor: n/a	Floor: n/a	-	-	-	-
Foundation Insulation, Slab (2012 IECC)	Slab: 0	Slab: 0	-	-	-	-
Foundation Insulation, Wall (2012 IECC)	n/a	n/a	-	-	-	-
Duct location	Attic (100% of supply & return)	Ducts inside conditioned space	-	-	-	-
Total duct leakage	Total Leakage ≤ 4 cfm per 100 SF of CFA (Not applicable-ducts are in conditoned space) Assume	Total Leakage < 8 cfm per 100 SF of CFA (Met via encapsulated duct work, see above)	-	-	-	-
Water Efficiency	N/A	Meets EPA Water Sense Requirements for Hot Water Distribution	$193.00	1	Structured Plumbing System	$193
Dishwasher	Standard Efficiency Dishwasher	ENERGY STAR Dishwasher	$10.00	1	Dishwasher	$10
Refrigerator	Standard Efficiency Refrigerator	ENERGY STAR Refrigerator	$40.00	1	Refrigerator	$40
Clothes Washer	Not Provided by Builder	Not Provided by Builder	-	-	-	-
Lighting	75% of lighting is high efficacy	80% of lighting is high efficacy	$2.80	10.00	Lamps	$28
Bath Fans (WHMV)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan w/controller	$94.00	1	Bath Fan	$94
Bath Fan (Local Exhaust)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan	$31.00	2	Bath Fan	$62
EPA Indoor airPLUS Verification Checklist	-	Comply with EPA Indoor airPLUS	$1,000.00	1	IAPlus Home	$1,000
Consolidated Renewable Energy Ready Checklist	-	-	$350.00	1	Homes with Checklists Applied	$350
DOE Challenge Home PERFORMANCE PATH						
Cooling	-	-	-	-	-	-
Heating	7.7 HSPF / 13 SEER / 11 EER ASHP; Electric Backup	9.0 HSPF / 16 SEER / 13 EER ASHP; Electric Backup	$384.00	2	Tons	$768
Radiant Barrier	None	None	-	-	-	-
Ceiling Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Ceiling Insulation Installation	Grade II	Grade I	$0.07	2750	Insulated Ceiling SF	$193
AGW Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
AGW Insulation Installation	Grade III	Grade I	$0.09	1531	Insulated AGW SF	$138
Foundation Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Foundation Insulation Installation	Grade II	Grade I	-	-	-	-
Infiltration	3.0 ACH50	2.5 ACH50	$0.13	2200	CFA	$286
Windows	see Energy Star fenestration above	see Energy Star fenestration above	-	-	-	-
Doors	R-2.9	R-2.9	-	-	-	-
Water Heater	0.92 EF electric storage; 50 gal.	0.95 EF electric storage; 50 gal.	$1.20	50	Gallon	$60
Thermostat	Programmable	Programmable	-	-	-	-
Duct Sealing	See Total Duct Leakage above	See Total Duct Leakage above	-	-	-	-
Duct Insulation	supplies R-8; returns R-6	supplies R-8; returns R-6	-	-	-	-
ENERGY STAR CHECKLISTS						
Thermal Enclosure System - Rater	Cost includes reduced lumber from Advanced Framing & Rater Verification; Other associated costs listed elsewhere include the home's insulation, windows and door improvements.					-$25
HVAC Sys. Quality Install. - Contractor	Cost includes Credential Fee, HVAC Commissioning, Contractor Completion of Checklist. Other costs associated with the requirement are reflected above in the WHMV system and in reduced capacity for HVAC Equipment.					$200
HVAC Sys. Quality Install. - Rater	Cost includes Document Collection & Review, Bedroom Pressure Balancing, Rater Verification. Other cost associated with the requirement are reflected in Duct Sealing and Duct Insulation.					$350

SCENARIO: CLIMATE ZONE 3; GAS SPACE & WATER HEATING; 2012 IECC BASELINE						
Baseline Home:	2200 SF prototype, compliant with 2012 IECC (prescriptive)					
Design Home:	2200 SF prototype, compliant with DOE Challenge Home (performance)					
Foundation Type:	Slab on Grade					
City:	Ft. Worth , TX					
Climate Zone:	3					
Space & Water Fuel:	Gas					
Cost						
INCREMENTAL COSTS						**$4,216**
MONTHLY PAYMENT						**$22.63**
MONTHLY UTILITY SAVINGS						**$37**
ASSUMED INTEREST RATE (same as V3 analysis)						**5.00%**
NET MONTHLY CASHFLOW						**$13.95**
DOE Challenge Home Mandatory Requirements: Exhibit 1						
Measure	**2012 IECC Baseline**	**DOE Challenge Home(Rev. 03)**	**UNIT COST**	**UNIT QTY**	**UNIT**	**MARGINAL COST FOR Challenge Home**
Home is ENERGY STAR V3 Qualified	N/A	V3 Cost Impacts Reflected in Items Below	-	-	-	-
Fenestration meets ENERGY STAR criteria	U=0.35; SHGC=0.25	U=0.30; SHGC=0.27	$0.63	330	Window Area (ft^2)	$208
Ceiling/Attic Insulation (2012 IECC)	Ceiling: R38 blown-in	BEDs: R-38 Attic Assembly: 1.5" of CCSPF encapsulating supply side and 2" of CCSPF on return side.	$708.40	1	Buried Encapsulated Ducts (BEDs)	$708
Above Grade Wall Insulation (2012 IECC)	Wall: R13+5	Wall: R13+5	-	-	-	-
Floor Insulation (2012 IECC)	Floor: n/a	Floor: n/a	-	-	-	-
Foundation Insulation, Slab (2012 IECC)	Slab: 0	Slab: 0	-	-	-	-
Foundation Insulation, Wall (2012 IECC)	n/a	n/a	-	-	-	-
Duct location	Attic (100% of supply & return)	Ducts inside conditioned space	-	-	-	-
Total duct leakage	Total Leakage ≤ 4 cfm per 100 SF of CFA (Not applicable-ducts are in conditoned space) Assume	Total Leakage < 8 cfm per 100 SF of CFA (Met via encapsulated duct work, see above)	-	-	-	-
Water Efficiency	N/A	Meets EPA Water Sense Requirements for Hot Water Distribution	$193.00	1	Structured Plumbing System	$193
Dishwasher	Standard Efficiency Dishwasher	ENERGY STAR Dishwasher	$10.00	1	Dishwasher	$10
Refrigerator	Standard Efficiency Refrigerator	ENERGY STAR Refrigerator	$40.00	1	Refrigerator	$40
Clothes Washer	Not Provided by Builder	Not Provided by Builder	-	-	-	-
Lighting	75% of lighting is high efficacy	80% of lighting is high efficacy	$2.80	10.00	Lamps	$28
Bath Fans (WHMV)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan w/controller	$94.00	1	Bath Fan	$94
Bath Fan (Local Exhaust)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan	$31.00	2	Bath Fan	$62
EPA Indoor airPLUS Verification Checklist	-	Comply with EPA Indoor airPLUS	$1,000.00	1	IAPlus Home	$1,000
Consolidated Renewable Energy Ready Checklist	-	-	$350.00	1	Homes with Checklists Applied	$350
DOE Challenge Home PERFORMANCE PATH						
Cooling	13 SEER A/C	15 SEER A/C	$144.00	2	Tons	$288
Heating	80 AFUE	90 AFUE	$6.60	24	kBtu/hr	$158
Radiant Barrier	None	None	-	-	-	-
Ceiling Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Ceiling Insulation Installation	Grade II	Grade I	$0.07	2750	Insulated Ceiling SF	$193
AGW Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
AGW Insulation Installation	Grade III	Grade I	$0.09	1531	Insulated AGW SF	$138
Foundation Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Foundation Insulation Installation	Grade II	Grade I	-	-	-	-
Infiltration	3.0 ACH50	2.5 ACH50	$0.13	2200	CFA	$286
Windows	see Energy Star fenestration above	see Energy Star fenestration above	-	-	-	-
Doors	R-2.9	R-2.9	-	-	-	-
Water Heater	0.59 EF (0.71 RE) gas storage; 50 gal.	0.67 EF (0.76 RE) gas storage; 50 gal.	$0.70	50	Gallons	$35
Thermostat	Programmable	Programmable	-	-	-	-
Duct Sealing	See Total Duct Leakage above	See Total Duct Leakage above	-	-	-	-
Duct Insulation	supplies R-8; returns R-6	supplies R-8; returns R-6	-	-	-	-
ENERGY STAR CHECKLISTS						
Thermal Enclosure System - Rater	Cost includes reduced lumber from Advanced Framing & Rater Verification; Other associated costs listed elsewhere include the home's insulation, windows and door improvements.					-$25
HVAC Sys. Quality Install. - Contractor	Cost includes Credential Fee, HVAC Commissioning, Contractor Completion of Checklist. Other costs associated with the requirement are reflected above in the WHMV system and in reduced capacity for HVAC Equipment.					$200
HVAC Sys. Quality Install. - Rater	Cost includes Document Collection & Review, Bedroom Pressure Balancing, Rater Verification. Other cost associated with the requirement are reflected in Duct Sealing and Duct Insulation, Elimination of B-Vent					$250

DOE Challenge Home Savings & Cost Estimate Summary - Appendices

SCENARIO: CLIMATE ZONE 5; ALL ELECTRIC; 2012 IECC BASELINE						
Baseline Home:	2200 SF prototype, compliant with 2012 IECC (prescriptive)					
Design Home:	2200 SF prototype, compliant with DOE Challenge Home (performance)					
Foundation Type:	Conditioned Basement					
City:	Indianapolis, IN					
Climate Zone:	5					
Space & Water Fuel:	Electric					
Cost						
INCREMENTAL COSTS						**$4,403**
MONTHLY PAYMENT						**$23.64**
MONTHLY UTILITY SAVINGS						**$40**
ASSUMED INTEREST RATE (same as V3 analysis)						**5.00%**
NET MONTHLY CASHFLOW						**$15.99**
DOE Challenge Home Mandatory Requirements: Exhibit 1						
Measure	**2012 IECC Baseline**	**DOE Challenge Home(Rev. 03)**	**UNIT COST**	**UNIT QTY**	**UNIT**	**MARGINAL COST FOR Challenge Home**
Home is ENERGY STAR V3 Qualified	N/A	V3 Cost Impacts Reflected in Items Below	-	-	-	-
Fenestration meets ENERGY STAR criteria	U=0.32; SHGC=0.45	U=0.30; SHGC=0.27	$0.44	330	Window Area (ft^2)	$144
Ceiling/Attic Insulation (2012 IECC)	Ceiling: R38 blown-in	Ceiling: R38 blown-in	$3.50	92	Top Plate Area (SF)	$322
Above Grade Wall Insulation (2012 IECC)	Wall: R21	Wall: R21	-	-	-	-
Floor Insulation (2012 IECC)	Floor: n/a	Floor: n/a	-	-	-	-
Foundation Insulation, Slab (2012 IECC)	Slab: 0	Slab: 0	-	-	-	-
Foundation Insulation, Wall (2012 IECC)	R-15	R-15	-	-	-	-
Duct location	walls	Ducts inside conditioned space	-	-	-	-
Total duct leakage	Total Leakage ≤ 4 cfm per 100 SF of CFA (Not applicable-ducts are in conditoned space) Assume	Total Leakage < 8 cfm per 100 SF of CFA	$0.19	1221	Duct Surface Area	$232
Water Efficiency	N/A	Meets EPA Water Sense Requirements for Hot Water Distribution	$193.00	1	Structured Plumbing System	$193
Dishwasher	Standard Efficiency Dishwasher	ENERGY STAR Dishwasher	$10.00	1	Dishwasher	$10
Refrigerator	Standard Efficiency Refrigerator	ENERGY STAR Refrigerator	$40.00	1	Refrigerator	$40
Clothes Washer	Not Provided by Builder	Not Provided by Builder	-	-	-	-
Lighting	75% of lighting is high efficacy	80% of lighting is high efficacy	$2.80	10.00	Lamps	$28
Bath Fans (WHMV)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan w/controller	$94.00	1	Bath Fan	$94
Bath Fan (Local Exhaust)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan	$31.00	2	Bath Fan	$62
EPA Indoor airPLUS Verification Checklist	-	Comply with EPA Indoor airPLUS	$1,000.00	1	IAPlus Home	$1,000
Consolidated Renewable Energy Ready Checklist	-	-	$350.00	1	Homes with Checklists Applied	$350
DOE Challenge Home PERFORMANCE PATH						
Cooling	-	-	-	-	-	-
Heating	7.7 HSPF / 13 SEER / 11 EER ASHP; Electric Backup	9.2 HSPF / 15 SEER / 13 EER ASHP; Electric Backup	$345.84	2	Tons	$692
Radiant Barrier	None	None	-	-	-	-
Ceiling Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Ceiling Insulation Installation	Grade II	Grade I	$0.07	2200	Insulated Ceiling SF	$154
AGW Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
AGW Insulation Installation	Grade III	Grade I	$0.04	1531	Insulated AGW SF	$61
Foundation Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-	-	-	-
Foundation Insulation Installation	Grade II	Grade I	$0.15	1501	Insulated Foundation	$225
Infiltration	3.0 ACH50	2.0 ACH50	$0.13	2200	CFA	$286
Windows	see Energy Star fenestration above	see Energy Star fenestration above	-	-	-	-
Doors	R-3.1	R-3.1	-	-	-	-
Water Heater	0.92 EF electric storage; 50 gal.	0.95 EF electric storage; 50 gal.	$1.20	50	Gallons	$60
Thermostat	Programmable	Programmable	-	-	-	-
Duct Sealing	See Total Duct Leakage above	See Total Duct Leakage above	-	-	-	-
Duct Insulation	R-0	R-0	-	-	-	-
ENERGY STAR CHECKLISTS						
Thermal Enclosure System - Rater	Cost includes reduced lumber from Advanced Framing & Rater Verification; Other associated costs listed elsewhere include the home's insulation, windows and door improvements.					-$100
HVAC Sys. Quality Install. - Contractor	Cost includes Credential Fee, HVAC Commissioning, Contractor Completion of Checklist. Other costs associated with the requirement are reflected above in the WHMV system and in reduced capacity for HVAC Equipment.					$200
HVAC Sys. Quality Install. - Rater	Cost includes Document Collection & Review, Bedroom Pressure Balancing, Rater Verification. Other cost associated with the requirement are reflected in Duct Sealing and Duct Insulation.					$350

DOE Challenge Home Savings & Cost Estimate Summary - Appendices

SCENARIO: CLIMATE ZONE 5; GAS SPACE & WATER HEATING; 2012 IECC BASELINE							
Baseline Home:	2200 SF prototype, compliant with 2012 IECC (prescriptive)						
Design Home:	2200 SF prototype, compliant with DOE Challenge Home (performance)						
Foundation Type:	Conditioned Basement						
City:	Indianapolis, IN						
Climate Zone:	5						
Space & Water Fuel:	Gas						
Cost							
INCREMENTAL COSTS							**$3,896**
MONTHLY PAYMENT							**$20.92**
MONTHLY UTILITY SAVINGS							**$33**
ASSUMED INTEREST RATE (same as V3 analysis)							**5.00%**
NET MONTHLY CASHFLOW							**$11.97**
DOE Challenge Home Mandatory Requirements: Exhibit 1							
Measure	**2012 IECC Baseline**	**DOE Challenge Home(Rev. 03)**	**UNIT COST**		**UNIT QTY**	**UNIT**	**MARGINAL COST FOR Challenge Home**
Home is ENERGY STAR V3 Qualified	N/A	V3 Cost Impacts Reflected in Items Below	-		-	-	-
Fenestration meets ENERGY STAR criteria	U=0.32; SHGC=0.45	U=0.30; SHGC=0.27	$0.44		330	Window Area (ft^2)	$144
Ceiling/Attic Insulation (2012 IECC)	Ceiling: R38 blown-in	Ceiling: R38 blown-in	$3.50		92	Top Plate Area (SF)	$322
Above Grade Wall Insulation (2012 IECC)	Wall: R21	Wall: R21	-		-	-	-
Floor Insulation (2012 IECC)	Floor: n/a	Floor: n/a	-		-	-	-
Foundation Insulation, Slab (2012 IECC)	Slab: 0	Slab: 0	-		-	-	-
Foundation Insulation, Wall (2012 IECC)	R-15	R-15	-		-	-	-
Duct location	walls	Ducts inside conditioned space	-		-	-	-
Total duct leakage	Total Leakage ≤ 4 cfm per 100 SF of CFA (Not applicable-ducts are in conditoned space) Assume	Total Leakage < 8 cfm per 100 SF of CFA	$0.19		1221	Duct Surface Area	$232
Water Efficiency	N/A	Meets EPA Water Sense Requirements for Hot Water Distribution	$193.00		1	Structured Plumbing System	$193
Dishwasher	Standard Efficiency Dishwasher	ENERGY STAR Dishwasher	$10.00		1	Dishwasher	$10
Refrigerator	Standard Efficiency Refrigerator	ENERGY STAR Refrigerator	$40.00		1	Refrigerator	$40
Clothes Washer	Not Provided by Builder	Not Provided by Builder	-		-	-	-
Lighting	75% of lighting is high efficacy	80% of lighting is high efficacy	$2.80		13.00	Lamps	$36
Bath Fans (WHMV)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan w/controller	$94.00		1	Bath Fan	$94
Bath Fan (Local Exhaust)	Standard Efficiency Bath Fans	ENERGY STAR Bath Fan	$31.00		2	Bath Fan	$62
EPA Indoor airPLUS Verification Checklist	-	Comply with EPA Indoor airPLUS	$1,000.00		1	IAPlus Home	$1,000
Consolidated Renewable Energy Ready Checklist	-	-	$350.00		1	Homes with Checklists Applied	$350
DOE Challenge Home PERFORMANCE PATH							
Cooling	13 SEER	13 SEER	-		-	-	-
Heating	80 AFUE	95 AFUE	$7.17		42	kBtu/hr	$301
Radiant Barrier	None	None	-		-	-	-
Ceiling Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-		-	-	-
Ceiling Insulation Installation	Grade II	Grade I	$0.07		2200	Insulated Ceiling SF	$154
AGW Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-		-	-	-
AGW Insulation Installation	Grade III	Grade I	$0.04		1531	Insulated AGW SF	$61
Foundation Insulation	see 2012 IECC insulation above	see 2012 IECC insulation above	-		-	-	-
Foundation Insulation Installation	Grade II	Grade I	$0.15		1501	Insulated Foundation Wall SF	$225
Infiltration	3.0 ACH50	2.0 ACH50	$0.13		2200	CFA	$286
Windows	see Energy Star fenestration above	see Energy Star fenestration above	-		-	-	-
Doors	R-3.1	R-3.1	-		-	-	-
Water Heater	0.59 EF (0.71 RE) gas storage; 50 gal.	0.67 EF (0.76 RE) gas storage; 50 gal.	$0.70		50	Gallons	$35
Thermostat	Programmable	Programmable	-		-	-	-
Duct Sealing	See Total Duct Leakage above	See Total Duct Leakage above	-		-	-	-
Duct Insulation	R-0	R-0	-		-	-	-
ENERGY STAR CHECKLISTS							
Thermal Enclosure System - Rater	Cost includes reduced lumber from Advanced Framing & Rater Verification; Other associated costs listed elsewhere include the home's insulation, windows and door improvements.						-$100
HVAC Sys. Quality Install. - Contractor	Cost includes Credential Fee, HVAC Commissioning, Contractor Completion of Checklist. Other costs associated with the requirement are reflected above in the WHMV system and in reduced capacity for HVAC Equipment.						$200
HVAC Sys. Quality Install. - Rater	Cost includes Document Collection & Review, Bedroom Pressure Balancing, Rater Verification. Other cost associated with the requirement are reflected in Duct Sealing and Duct Insulation, Elimination of B-Vent						$250

APPENDIX B: DATA SOURCES

System	Cost Estimating Data Source(s)
Fenestration	NREL National Residential Efficiency Measures Database*
Ceiling/Attic Insulation	RS Means Residential Cost Data 2013
Ceiling Insulation Installation	ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary." November 2013.
Above Grade Wall Insulation	RS Means Residential Cost Data 2013
AGW Insulation Installation	ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary." November 2013.
Foundation Insulation, Wall	RS Means Residential Cost Data 2013
Foundation Insulation Installation	RS Means Residential Cost Data 2013
Total duct leakage	ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary." November 2013.
Water Efficiency	Toolbase.org; Topic areas; PEX water supply; manifold distribution systems; accessed online June 2013.
Dishwasher	ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary." November 2013.
Refrigerator	ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary." November 2013.
Clothes Washer	ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary." November 2013.
Lighting	ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary." November 2013.
Whole House Mechanical Ventilation	ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary." November 2013.
Bath Fan (Local Exhaust)	Based on Internet pricing for intermittent timer controls (5 Manufacturers, Averaged cost); Completed 9/12/2013.
EPA Indoor airPLUS Verification Checklist	DOE Estimate
Renewable Energy Ready Checklist	DOE Estimate
Cooling	NREL National Residential Efficiency Measures Database *(equipment only)
Heating	NREL National Residential Efficiency Measures Database* (equipment only) + Additional estimate for elimination of B-vent flue
Radiant Barrier	Not used
Infiltration	NREL National Residential Efficiency Measures Database (equipment only)*
Doors	ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary." November 2013.
Water Heater	NREL National Residential Efficiency Measures Database*
Thermal Enclosure System - Rater	ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary." November 2013.
HVAC Sys. Quality Install. - Contractor	ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary." November 2013.
HVAC Sys. Quality Install. - Rater	ENERGY STAR Qualified Homes, Version 3 Savings & Cost Estimate Summary." November 2013.

*Because this database represents retrofit costs, the low-end of the cost range was used to approximate the costs for new construction