

DOE Zero Energy Ready Home

Savings & Cost Estimate Summary



October 2015

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INTRODUCTION

In considering the business strategy for constructing and selling Zero Energy Ready Homes through the DOE Zero Energy Ready 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 Zero Energy Ready 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 Zero Energy Ready 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 ft² 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 Zero Energy Ready Home experience with typical homes built to code.

The DOE Zero Energy Ready 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 Zero Energy Ready 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 Zero Energy Ready Home and a minimally compliant IECC home is the jump to ENERGY STAR Homes Version 3 qualification, which is a prerequisite for DOE Zero Energy Ready Home qualification. Therefore, this savings and cost estimate is designed to be consistent with a concurrent savings/cost analysis for ENERGY STAR Homes V3¹ in the following ways:

- Consistent costs for the same changes in building systems. In cases where a DOE Zero Energy Ready 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 Zero Energy Ready Home implemented a similar measure as did the ENERGY STAR Home relative to code, then the DOE Zero Energy Ready 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 Database²) 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 Zero Energy Ready Homes. The detailed adjustments are explained fully in the ENERGY STAR analysis.

For DOE Zero Energy Ready 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 estimate 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 Zero Energy Ready 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/m²/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/>



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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 Zero Energy Ready Home models compared to a 2009 IECC baseline home. Table 2 shows the same information for DOE Zero Energy Ready 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 Zero Energy Ready 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 Zero Energy Ready Home Energy & Cost Comparison to 2009 IECC Baseline

| Climate Zone | Space & Water Heating Energy Source | 09 IECC - HERS Index | ZERH - HERS Index | Monthly Energy Cost Savings for ZERH House vs. 09 IECC House (\$) | Estimated Marginal First Cost for ZERH House (\$) | Amortized Marginal First Cost for ZERH 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 Zero Energy Ready Home Energy & Cost Comparison to 2012 IECC Baseline

| Climate Zone | Space & Water Heating Energy Source | 12 IECC - HERS Index | ZERH - HERS Index | Monthly Energy Cost Savings for ZERH House vs. 12 IECC House (\$) | Estimated Marginal First Cost for ZERH House (\$) | Amortized Marginal First Cost for ZERH 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 |

DOE Zero Energy Ready Home Savings & Cost Estimate Summary - Appendices

APPENDIX A: DETAILED COST ESTIMATING TABLES FOR 8 MODELS

DOE Zero Energy Ready 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 BELS: 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. | \$0.91 | 330 | Window Area (ft ²) | \$301 |
| Ceiling/Attic Insulation (2012 IECC) | Ceiling: R30 blown-in | | | | Buried | |
| 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 Ceilene 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 |

DOE Zero Energy Ready Home Savings & Cost Estimate Summary - Appendices

| 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 BELUS: 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. | \$0.91 | 330 | Window Area (ft ²) | \$301 |
| Ceiling/Attic Insulation (2012 IECC) | Ceiling: R30 blown-in | Wall: R13+5 | \$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 Structured | \$138 |
| Water Efficiency | N/A | Meets EPA Water Sense Requirements for Hot Water Distribution | \$193.00 | 1 | 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 Homes with Checklists Applied | \$1,000 |
| Consolidated Renewable Energy Ready Checklist | - | - | \$350.00 | 1 | 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 |

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| 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 Structured | \$232 |
| Water Efficiency | N/A | Meets EPA Water Sense Requirements for Hot Water Distribution | \$193.00 | 1 | 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 Zero Energy Ready 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 |
| | | | \$3.50 | 92 | Top Plate Area (SF) | \$322 |
| Ceiling/Attic Insulation (2012 IECC) | Ceiling: R38 blown-in | Ceiling: R38 blown-in | - | - | - | - |
| 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 Structured | \$232 |
| Water Efficiency | N/A | Meets EPA Water Sense Requirements for Hot Water Distribution | \$193.00 | 1 | 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 Homes with Checklists Applied | \$1,000 |
| Consolidated Renewable Energy Ready Checklist | - | - | \$350.00 | 1 | 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 Zero Energy Ready 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 |
| | | 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 |
| Ceiling/Attic Insulation (2012 IECC) | Ceiling: R38 blown-in | | - | - | - | - |
| 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 conditioned 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 |

DOE Zero Energy Ready Home Savings & Cost Estimate Summary - Appendices

| 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 conditioned 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 Zero Energy Ready 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 |
| | | | \$3.50 | 92 | Top Plate Area (SF) | \$322 |
| Ceiling/Attic Insulation (2012 IECC) | Ceiling: R38 blown-in | Ceiling: R38 blown-in | - | - | - | - |
| 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 conditioned 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 Zero Energy Ready 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 conditioned space) Assume | Total Leakage < 8 cfm per 100 SF of CFA | \$0.19 | 1221 | Duct Surface Area Structured | \$232 |
| Water Efficiency | N/A | Meets EPA Water Sense Requirements for Hot Water Distribution | \$193.00 | 1 | 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 |

DOE Zero Energy Ready Home Savings & Cost Estimate Summary - Appendices

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