Energy Efficiency Benchmarks for Housing
2009 AIA Upjohn Research Award

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This document is the final report for the research project titled “Energy Efficiency Benchmarks for Housing” funded by the 2009 AIA Upjohn Research Grant. This final report consists of the following:

1. The final report that includes titled paragraphs or sections on research method, results, key findings and conclusions (herein).
2. High-resolution images (if appropriate) with captions and photo credits (300 dpi images in the 3"x4" range) (separate attachment).
3. Addenda A to E that elaborate on the report and include any additional material that supports the report including data collected, additional images, etc (herein).

1. Introduction

Many high volume builders are increasing their interest in sustainability to improve their bottom line, however reaching toward the next level of net zero energy housing has been viewed as cost prohibitive and the methods by which to achieve such goals are generally unknown. 3rd party benchmarks have been established in recent years to aid in achieving energy efficient housing, including the Energy Star® (Energy Star) Program, National Green Building Standard™ (NGBS), United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) for Homes, and Passive House Planning Package (PHPP). These rating systems consider energy-efficiency performance in varying degrees, ranging from quantitative prescriptive rating strategies to qualitative rating strategies by performance.

The capabilities and culpabilities of each rating system can be difficult to determine for architects and builders alike. However, with the quantity of new homes projected by planners to be built in the next 50 years, more must be demanded of these rating systems to achieve net zero energy performance goals. The return on investment (ROI) of high performance, sustainable housing is also difficult to determine. This report summarizes the results about the following benchmark rating systems for their capacity to achieve net zero energy housing and the associated cost of such:

- Energy Protection Agency (EPA) Energy Star Qualified Homes
- USGBC LEED for Homes 2008
- ICC 700-2008 NGBS
- PHPP 2007-2010

2. Research Goals

This report performs a comparative study of energy efficient benchmark housing systems and their respective capability and culpability to achieve net zero energy for a residential case study project in Park City, Utah, which is located in the Utah Cold Climate Zone (Energy Star: Northern Climate Zone[i]; 2004 Supplement to the International Energy Conservation Code (IECC), the 2006 IECC, and American Society of Heating, Refrigeration, and Air-Conditioning (ASHRAE) 90.1-2004: Climate Zone 6, Figure 01). The measures taken to move the case study buildings closer to net zero energy during the design and construction process are evaluated for their ROI cost benefit. This research project is an extension of an energy performance evaluation project conducted by the same team for the Department of Energy Building America Program (DOE BA). The researchers documented and analyzed the design and construction process of 13 workforce

units designed and built to approximately 50% energy-efficiency above code standard. In order to determine the actual energy efficiency of the houses over a year, two prototypical units are currently evaluated for their performance; they have been instrumented and are being monitored for performance of the passive strategies, high R-enclosure, geothermal, PV and solar hot water systems for their contribution to the holistic energy efficiency (Figure 02).

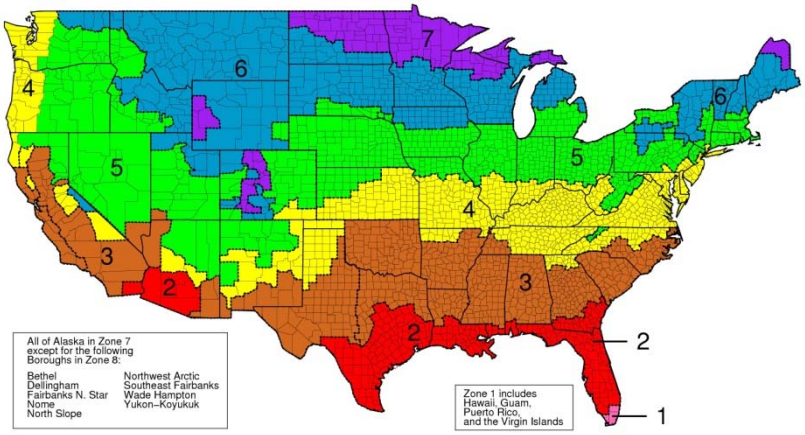

Figure 01. U.S. Climate Zones according to the 2006 IECC, and ASHRAE 90.1-2004. Source: http://resourcecenter.pnl.gov/cocoon/morf/ResourceCenter/article/1420/. Accessed on April 10, 2011

Figure 02. Two prototype units of 13 workforce units are being monitored and evaluated. Photo J. Rügemer 2010

3. Benchmark Systems

3.1 EPA Energy Star Qualified Homes

3.1.1 Description

Energy Star is a voluntary program launched by the Environmental Protection Agency in 1995. This rating system is evaluated and updated regularly and has evolved 3 times since its initiation. The most current version of Energy Star is Version 3-2011, with the most recently applied changes featuring indoor air quality requirements. Energy Star is founded upon cost effectiveness as the main guiding principle, where the cost to achieve Energy Star certification shall be equally offset by energy savings yielded. Energy Star is the most prevalent rating system in residential construction and draws value from brand recognition and market penetration. National market presence rates have increased from 12% in 2007 to 17% in 2008. By 2009, a total of 940,000 single-family homes had been Energy Star certified and 70% of households identified Energy Star as a recognizable brand. The accessibility of this program as a rating system has led it to be incorporated into other rating systems including LEED and NGBS.

3.1.2 Application

Energy Star for Homes is a widely applicable system. Currently there are two Energy Star programs: the original Energy Star for Homes and a test program Energy Star for Multi-Family High Rises. Energy Star for Homes can be applied to single-family and multi-family new construction as well as single-family and multi-family major renovation for residences under 3 stories. This rating system is currently only valid in the U.S. With the most recent version, Energy Star 2011, application of the rating system will require a home size adjustment factor. To account for variable energy usage due to fluctuating total conditioned floor areas, the EPA has established a benchmark range for residences consisting of 1 to 8 bedrooms. The benchmark conditioned floor areas begin at 1,000 square feet for a 1-bedroom single-family home residence and extend to 5,200 square feet for an 8-bedroom residence. For new construction that falls outside of the benchmark range, additional measures to achieve Energy Star will be required.

3.1.3 Objectives

The objectives of the Energy Star program are to increase energy performance and to improve indoor air quality specifically through the core goals of cost effectiveness and market transformation. The rating system is composed of a 100-point index that focuses on achieving these two objectives through construction efficiency and technology (with 100 points being the built-to-code benchmark building constructed to the minimum requirements of the IECC 2006). It takes into account different climate regions when determining prescribed recommendations and

compliance requirements will vary according to the 2004 International Residential Code climate zones. The final objective of this rating system is for new construction or remodel projects to achieve the minimum total index score. Energy Star requires a minimum index score of 85 (15% better performance over the IECC 2006 benchmark building). There is only one level of certification and only completed projects are eligible to receive Energy Star.

3.1.4 Requirements

To receive Energy Star, first a plan review is conducted to establish the compliance method to be used. The process will use either a performance based or prescriptive based set of requirements. For a performance-based approach, an energy model is created to analyze the projected Home Energy Rating System (HERS) index target of the residence. The model is built according to the minimum requirements of the IECC 2006 and meets an index score of 100 where a score of 0 on the same scale would denote net zero energy performance. A prescriptive based approach is only allowed on homes not exceeding the benchmark size and requires that state or regional energy code requirements that exceed Energy Star be met and optimized. With both approaches, the plans are approved and the homes may receive the label *Designed to Earn Energy Star®.* During and post construction, inspections and performance tests are conducted to verify energy efficiency.

The criteria for achieving Energy Star includes requirements concerning the general areas of building envelope, heating and cooling mechanical systems, appliances, and verification.

Field verification is conducted by Residential Energy Services Network (RESNET) certified professionals partnered with Energy Star to assess the home's energy performance. Multiple checklists are utilized concerning thermal bypass, framing quality, HVAC quality, indoor air quality, and water-management.

3.1.5 Accessibility

Energy Star is a highly accessible rating system for preliminary energy efficiency. Several characteristics allow for this rating system to be easily applicable in all projects. The objective is simply to achieve energy efficiency resulting in cost efficiency inherent to the rating system. Regionally, specifications are available for different climates. A third-party entity conducts the verification throughout the construction process, allowing for recommendations to be made. Energy Star is a component now applied within other energy rating systems due to its simplicity. The costs of achieving Energy Star are comparatively less than most other rating systems due to the simplicity of system evaluation. There is no cost for registration or certification.

3.2 USGBC Leadership in Energy and Environmental Design LEED for Homes 2008

3.2.1 Description

The USGBC coordinated a 3rd party national consensus rating system for the building industry to promote high performance sustainable buildings[ii]. USGBC is generated from its membership, which includes 14,000 companies and organizations. Since its inception in 1993, USGBC has led in providing green building standards and is undisputedly the industry standard for green building assessment methods. Initially developed for new construction in commercial buildings, LEED has expanded to existing buildings, schools, healthcare, commercial interiors, neighborhood development, and most recently to LEED for Homes in 2008[3,iii]. The rating system is voluntary, comparable to NGBS, which is adopted by an entity in the design and construction of new buildings. LEED has 7 categories with point based checklist options and a total of 136 possible points. In addition to flexible sustainable checklist options, LEED is founded upon 18 pre-requisites that are mandatory to certification. LEED as a brand is well known among the building and design industry and is prevalent in sustainable commercial construction. The general LEED for Homes threshold point ratings for buildings include performance levels and associated points as such:

- Certified: 45 points
- Silver: 60 points
- Gold: 75 points
- Platinum: 90 points

The thresholds might vary, because LEED for Homes allows compensating for the effort of home size on resource consumption[iv].

3.2.2 Application

LEED for Homes can be applied towards new and retrofit residences on the condition that retrofit projects constitute a major renovation and full systems renewal. Eligible typologies include single-family attached and detached units as well as multifamily units three stories or less, but the residence must have its own cooking and bathroom facility/unit. In addition, the project must be registered with the USGBC; to achieve certification, points must meet minimum scores within each category. Home size adjustment factors are established through benchmark conditioned floor areas from 1 – 5 bedrooms ranging from 900 - 2,850 square feet, respectively. Guidelines suggest adding 250 square feet for additional bedrooms. The minimum point requirements are adjusted according to the number of bedrooms and the total square footage of the project.

3.2.3 Objectives

LEED for Homes is a voluntary program with the ultimate goal of encouraging sustainable design and construction. The LEED program includes both residential and commercial applications and is currently the dominant commercial rating system. Integrated project planning is an important objective of the LEED certification process.

3.2.4 Requirements

The process of achieving LEED for Homes begins with the Builder / Project Manager choosing a LEED for Homes Provider. The project team establishes an outline of sustainability goals and strategies to be implemented, then performs a design evaluation, and using score estimation certifies the LEED level achievable in the project. The project is built and inspected during construction and post construction. Final inspection and performance testing is conducted; final project documents are submitted to the USGBC for certification.

The certification criteria consist of 18 prerequisites and 136 total achievable points. There are 8 categories beyond the 18 mandatory prerequisite items. These categories are innovation and design, location and linkages, sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and awareness and education. Each category has a minimum number of points it is associated with and some of the items within the categories compose the 18 prerequisite items that must be completed in all projects. The verification process is conducted in part by USGBC trained Green Raters as well as by the project building inspector. The USGBC trains and supports LEED for Home providers. Verification generally is composed of 3 components. These are documentation verification, performance testing, and at least two on-site inspections.

3.2.5 Accessibility

The accessibility of the process of achieving LEED for Homes certification is comparable to the process of achieving NGBS certification. While LEED does not offer as many achievable points as NGBS, the complexity LEED for Homes is similar in the variety and quantity of points required and points achievable. LEED for Homes establishes more minimum mandatory actions and includes early project planning collaboration not required in other rating systems. The respective weight of LEED categories also varies when compared to the categories of NGBS or other rating systems. The cost of LEED certification includes both registration and certification fees that each range from $150 - $300 depending on membership. In addition, the process includes separate fees for Green Raters and HERS Raters as well as fees for materials such as the LEED Reference Guide; those can be anything from $2,000 for a moderate sized home to $6,000 for a larger structure.

3.3 ICC 700-2008 National Green Building Standard NGBS

3.3.1 Description:

The National Association of Home Builders (NAHB) is a trade association that was established post World War II. The NAHB helps promote the policies that make housing a national priority in the U.S. Since 1942, NAHB has been serving its members, which are local NAHB chapters and production builders, with research, resources, and advocacy in governmental policy[v,vi]. Efforts to develop an NAHB green building policy were initiated in 1998. However, it was not until 2004 that the Association developed the NAHB Model Green Home Building Guidelines. The committee that developed the guidelines included home building and associated industry stakeholders. These guidelines were first published in 2005 and provide the basis for many green building programs in North America. The rating system is applicable to building construction as well as sustainable land development and was approved by the American National Standards Institute in 2009. For the residential buildings, there are 6 categories of requirements and a point system of over 1,000 total achievable points. Each category holds mandatory baseline requirements, which are then built upon with further energy efficient practices. The NGBS threshold point ratings for green buildings include performance levels and associated points as such:

- Bronze: 222 - 405 points
- Silver: 406 - 557 points
- Gold: 558 - 696 points
- Emerald: 607 points or greater

3.3.2 Application

NGBS is applicable to a wide range of typologies. In residential applications, the rating system is eligible for all residential projects that are not institutional. It also extends to subdivisions, retrofit and remodel projects, mixed-use residential, and historic buildings. NGBS considers regional climate impacts and is applicable in all US climate zones. In single-family residential projects, the home size adjustment factor for NGBS consists of a point neutral conditioned floor area of 2,501 to 4,000 square feet.

3.3.3 Objectives

NGBS is a voluntary program that is adopted by a regulating entity. The NAHB Research Center serves as the certification organization. The expansive point system supports a main goal of affording a maximum flexibility of the rating system. NGBS addresses the nature of a fluctuating market through an organized selection of diverse sustainable options.

3.3.4 Requirements

The process of certification varies depending on the entity that adopts NGBS but begins by the adopting entity choosing their own certification and verification process. Alternatively, the NAHB Research Center may administer the process. The first step towards certification begins with the NAHB Online Green Scoring tool, which is used as a checklist of applicable actions. The checklist includes links with information on how to verify and implement the action items. As construction begins, the builder identifies an NAHB verifier and forwards the original checklist. A rough inspection is completed. Following the inspection, builder and verifier sign and forward the report for review by the research center. Finally, verification fee is paid and the final, signed report generates the Green Home Certificate.

The criteria for NGBS is composed of 6 categories. These are site design and development, lot design and preparation, resource efficiency, energy efficiency, water efficiency, indoor environmental quality, and operation maintenance and homeowner education. Some categories include mandatory actions and each category pertains to a minimum point value for certification and final performance levels. Verification of the final performance is conducted by a third-party organization identified by the adopting entity or by NAHB. The online tool provides descriptions for required verification materials.

3.3.5 Accessibility

NGBS is more complex to apply to projects than a standard such as Energy Star. Mandatory actions are required for multiple categories as well as mandatory performance testing. NGBS verification fees can be lower than a rating system such as LEED due to few requirements on official verification during early design stages. The online NAHB scoring tool is free for use and score generation but costs greatly in time investment to complete. There are no registration costs but NGBS certification costs range from $200 - $500 for members and non-members.

3.4 Passive Home Planning Package PHPP 2007-2010

3.4.1 Description

The PHPP (1998 German, 2004 English) software package and design tool is a product of the Passive House Institute PHI founded in Germany by Dr. Wofgang Feist in 1996[vii,viii]. The Passive House Institute is an independent research institution developing solutions for energy efficiency in building performance. The rating system is both a standard benchmark, such as LEED, but focuses directly on energy efficiency through quantitative performance strategies and measures. The program began as a measure for housing, but has been used on smaller commercial and institutional structures as well. PHPP is intended to be a design tool during the schematic and

design development phases of a project; it is a modeling design software using advanced Excel spreadsheets and tabulated formulas to create a simplified planning tool for achieving energy usage goals. Data is entered numerically into the multifaceted Excel spreadsheet; there are no geometrical inputs. Once the required data is inputted into the spreadsheet, PHPP gives an instant feedback about the expected energy performance of the building in numerical kBTU/(ft^2yr).

3.4.2 Application

Passive House certification can be applied to new and retrofit construction as well as both residential and non-residential applications. Home size and floor area are adjusted through strict requirements on the floor area and volume eligible for entry into the datasheet. Performance is improved with a high floor area to volume ratio. Floor area is included only if contained entirely within the thermal envelope and reductions apply depending on space types. Non-habitable spaces such as closets, stairs, mechanical rooms, etc. receive between 40-60% reductions in treated floor area calculations.

3.4.3 Objectives

Passive House standard addresses achievement of the lowest energy usage and maximum building performance through the use of “passive” design. This entails decisions such as high insulation, airtight envelope, maximized surface-to-area ratio, maximum thermal gain, and minimum thermal bridges. Building components’ performance is optimized through the use of high performance windows and doors, heat recovery systems, mechanical systems, ventilation units, and other critical systems.

3.4.4 Requirements

The process to achieve the Passive House standard begins with project design and planning. By using PHPP software, decisions on orientation, construction method, choice of products, and mechanical systems are prescribed and optimized; with the spreadsheet giving the architect or engineer immediate feedback on every measure. PHPP software is an Excel spreadsheet with 20+ worksheets that must be completed with project information. The completed PHPP is verified by a Passive House Institute approved certifier to receive final certification.

The criteria for Passive House certification require strict energy performance. Specific space heat demand must be equal or less than 4.75 kBTU/(ft^2yr) and specific primary energy demand must be at or less than 38 kBTU/(ft^2yr). Pressurization test results for the project must be at 0.6 Air Changes per Hour at 50 Pascal (ACH_{50}) or less. PHPP allows freedom in design and a very holistic design approach so long as the final performance results are within the regulated value. Lower performing components, for example due to a desired higher design quality, can be

offset with other measures, and vice versa, as long as the overall performance stays within the requirements.

For verification, the Passive House Institute requires a checklist of items to be submitted. These include the complete and signed PHPP document, construction documents including site planning and building schematics, a complete list of product specifications and manufacturing information, air tightness verification, completed declaration from construction manager, photos, and any supplementary final testing ordered by the certifier.

3.3.5 Accessibility

PHPP is one of the most stringent certification and planning programs currently in practice. The software is easy to understand as it is founded upon entering values into a tabulated spreadsheet. The formulas and complex analysis is built into the system and the software simply requires submitting values. However, the range of information required from the software might limit its accessibility to users familiar with the software or those that have been PHPP certified. The costs associated with PHPP certification include variable consultation costs, when required, certification fees, and the software cost at $225.

4. Park City Snow Creek Reference Units

Designed by the Elliot Workgroup in Park City[ix], the Snow Creek Cottages at 2061 Park Avenue, Park City, UT 84068, USA, is a planned affordable housing project located at a site adjacent to Park City's Snow Creek at an average altitude of 6,800 ft or 2,070 m. The project consists of 13, energy-efficient, two- to three-story single-family detached buildings that will be marketed on the affordable housing market (Figure 02, Figure 03). Unit sizes range from 1,932 square feet for the larger DEER units down to 1,305 square feet for the smallest FOX units. The overall cost for construction for the project was at $3.492 million, excluding costs for land, impact fees, and architectural fees. That number calculates down to $131.88/sq.ft. Due to high cost in the provision of utility services, the project is not serviced by natural gas – electrical energy is the sole energy source provided by a utility.

To reduce overall energy use, several energy-saving/energy-producing building strategies, technologies, and materials have been employed. All houses were designed to compact volumes with maximal interior volume and minimal exterior surface area, which led to two- to three-story structures throughout the development. To comply with American Disability Act (ADA) code requirements, two of the houses had to be outfitted with elevators. Building materials and technologies include 6½ inch Structural Insulated Panels (SIPs) exterior walls from top of foundation to roof bearing, 12¼ inch SIPs roof structure (Table 01), photovoltaic (PV) cells, ground-coupled heat pump heating, solar hot water systems, clearstory roof windows, and heat-recovery ventilation (HRV).

Table 01. Construction definition Snow Creek Units

Building Component	Code R-Value	Standard Build	As Built R-Value	Actual Construction
Walls	R-19	2x6 Fiberglass Batt	R-22	6" SIPs
Roof	R-49	16" Joist with Fiberglass Batt	R46	12" SIPs
Slab	R-10	XPS along Perimeter	-	XPS along Perimeter + XPS along Stem Wall
Infiltration	7 ACH 50	-	5.2 ACH 50 2.9 ACH 50	Unit #10 Fox Unit #11 Deer

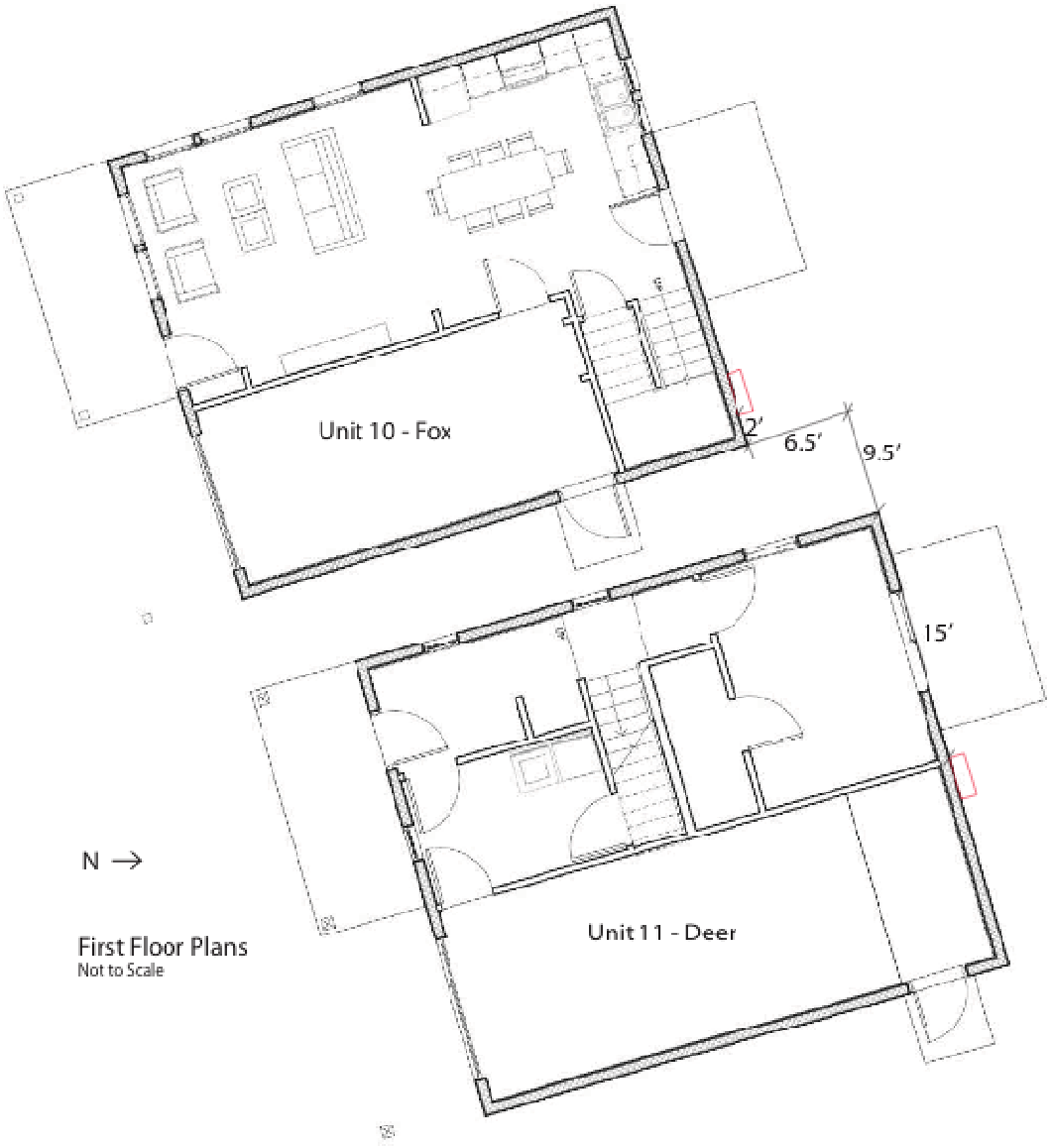

Figure 03. Floor plans FOX and DEER Units (prepared by Jennifer Gill).

To post-occupancy energy-monitor 2 of the 13 units, the research group installed a monitoring system (thermocouples) in those 2 units, to gather temperature data and monitor the buildings' energy consumption after the houses' completion in June 2010 (Figure 04, Figure 05). Units compared were FOX Unit 10, with 1,305 square feet, and DEER Unit 11, with 1,932 square feet. The square feet numbers are according to the architects and include the single-car garage, which is of a built-in type. The buildings' energy data provided by the thermocouple sensors was modeled against a simulated IECC 2006 benchmark building in accordance with BA Research Benchmark Definition of identical size and configuration, as in the prototype houses in Snow Creek, and the collection of those whole building performance data provide targeted source

energy savings estimates based on BA performance analysis procedures and energy performance measurements[x].

Figure 04. Thermocouple locations in DEER Unit 11 (prepared by Thomas Lane).

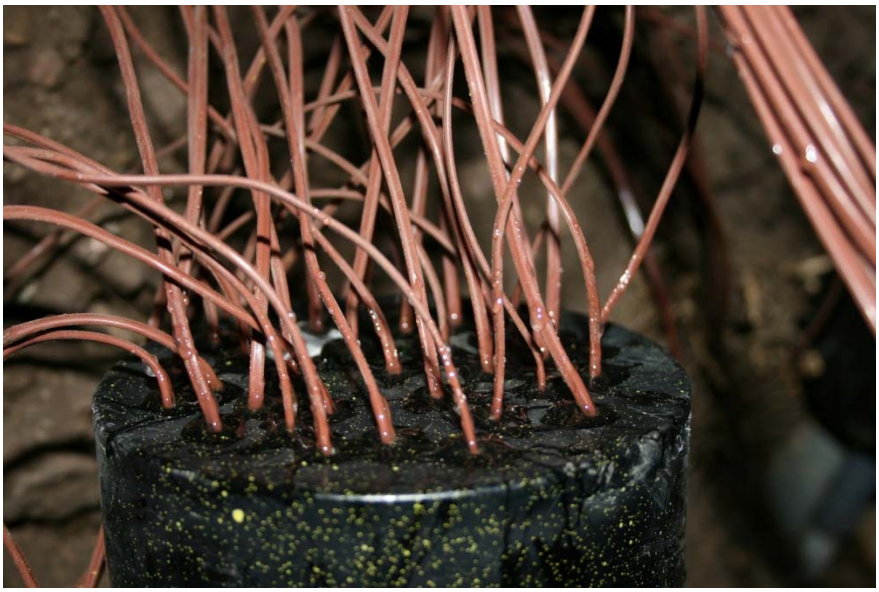

Figure 05. Thermocouple during installation – geothermal system (Photo C. Workman 2009)

5. Research Methods and Findings per Rating System

5.1 EPA Energy Star® Qualified Homes

5.1.1 Method

Energy analysis was performed on housing units 10 and 11 to project the HERS index for these units. HERS was developed by RESNET as a set of guidelines for determining the energy performance of houses. HERS has a design index number of its anticipated performance and a final rating in post-construction that determines its actual performance. A house designed to the IECC 2006 baseline has a HERS index of 100. Each additional HERS index point is equal to 1% increase in energy use over the IECC 2006 benchmark building. More energy efficient houses therefore have a HERS index below 100 and less energy efficient performance indices above 100. Net zero energy performance is indicated by a HERS of 0. The performance-based method was applied to FOX Unit 10 and DEER Unit 11, including blower door occupied space pressure testing to test infiltration rate, and duct blaster duct pressure testing to test duct leakage rate. Test data and data of construction details, orientation, and climate was included in an energy analysis using REMrate, to achieve a HERS rating for each unit. The HERS index value was then used to determine compliance with *ENERGY STAR Qualified Home* requirements (see Addendum A).

Results show the projected energy usage of the prototypical project units as designed is 52% to 47% less than same size housing units if built to baseline requirements. This is reflected in the HERS index values of 52 and 47 for the representative units (Table 02). The resulting HERS index values meets requirements for *ENERGY STAR Qualified Home* (required HERS of 80 or less). The analysis shows energy budget numbers very close to requirements of Federal Energy Efficient Home Tax Credit, with the three-story DEER Unit expected to pass requirements, but with the two-story FOX unit just failing to meet the requirement of energy usage less than 50% of normalized energy consumption compared to 2004 IECC.

Table 02. Test data chart for prototype units 10, FOX, and 11, DEER. CFM50 is the tested air leakage rate in ft^3 per minute under test pressure of 50 Pascals. The ACH50 is tested air leakage rate in air changes per hour under test pressure of 50 Pascals. HERS is the calculated HERS index (lower value is lower energy usage relative to code reference home). MMBtu/y is projected total energy usage in million British thermal units per year.

Unit	Model	Address	ADA	Listed ft^2	Rated ft^2	Vol ft^3	CFM50	ACH50	**HERS**	MMBtu/y
10	**Fox**	594 Court	N	1,079	1,261	11,829	1,023	5.19	**52**	31.4
11	**Deer**	598 Court	N	1,618	1,917	15,137	730	2.89	**47**	39.6

5.1.2 Capability to achieve Net Zero Energy Homes

The Energy Star Rating System with the HERS scale and the performance based path indicates when net zero energy performance has been achieved in a building. To achieve an Energy Star rated home, the required HERS rating must be 80 or less. A HERS rating of 0 would clearly indicate the net zero energy achievement. HERS rating system limits the amount of renewable energy for projects toward net zero energy to 40%, forcing architects, designers, and builders to achieve 60% efficiency through means of passive design and high performance and airtight envelopes and components. Therefore, HERS within the Energy Star rating system is capable of identifying and rating net zero buildings, but the system does not provide a reliable tool or strategy to reach this goal. Measures for effective insulation, high performance windows, and tight construction of the building envelope are laid out for cost effectiveness as the main guiding principle of the rating system, where the cost to achieve Energy Star certification shall be equally offset by energy savings yielded. This measure is relative; to achieve net zero energy performance, measures must be much more rigorous and must focus on much better energy performance. A comparison with the passive house standard, which requires an average HERS rating of 10 (90% efficient over the benchmark building), shows the discrepancies: R-values for a Passive House standard wall are well above R-40 and higher, compared to an R-19 to 22 for Energy Star; Passive House high performance windows must perform with U-values of 0.11 to 0.17 or better, compared to 0.32 for Energy Star. Envelope air tightness for a Passive House must be at 0.60 ACH50 or better, compared to 2.89 and 5.19 in the prototype houses, which both passed Energy Star certification. Other measures, such as sealed ductwork, efficient heating and cooling equipment, and energy-efficient appliances, lighting, and hot water heater, are solely defined to reach the specific Energy Star benchmark, which is approximately 20 better performance. Even the Energy Star Qualified Homes 2011 version, which improves some of those measures, cannot substitute for a sound strategy in sustainable and energy-efficient design that is required to bring a building to net zero energy performance. Only the HERS rating component of the rating system can be used to determine that the specific goal was reached; the rating system describes no pathway towards the goal. Thus the responsibility to develop strategies for net zero energy homes remains with the architect, designer, builder, or contractor.

5.2 USGBC LEED for Homes 2008

5.2.1 Method

Measures for net zero energy designed houses in LEED for Homes are in the categories of Innovation and Design Process (ID) and Energy and Atmosphere (EA). ID 1.5 *Building Orientation for Solar Design* offers one point towards net zero homes. EA can be assessed

through either the performance or prescriptive pathway. EA 1 *Optimize Energy Performance* requires the use of approved energy analysis software to demonstrate overall energy performance for the design of the house design. EA 2.10 for prescriptive pathways outlines insulation, air infiltration, windows, heating and cooling systems, space heating and cooling equipment, water heating, lighting, appliances and renewable energy prescriptive methods to be employed that are intended to reach an overall energy performance. Both the performance and prescriptive pathways are worth a total of 38 possible points toward earning LEED credits. Therefore the sum of possible points in regard to net zero strategies add up to 39 possible points in the LEED for Homes system[xi].

EA 1 *Optimize Energy Performance* is the performance pathway that was applied to both DEER and FOX Units when simulating their performance in the LEED for Homes rating system. EA 1 is intended to improve overall energy performance of the house under consideration by meeting or exceeding the performance of the Energy Star label. EA 1 includes a prerequisite 1.1 which ensures the house meets the performance requirements of Energy Star for Homes, including third-party inspection. Credit 1.2 ensures exceptional performance, exceeding the Energy Star for Homes minimum requirement, using the HERS Index. In EA 1, a house is required to meet the minimum Energy Star for Homes rating, which is equal to a HERS index of 85 or less for warm to moderate climate zones 1 through 5 and a HERS index of 80 or less for cold climate zones 6 through 8. The home is consequently verified by a third-party rater to ensure that the design will improve the energy performance of the housing including a thermal bypass inspection for insulation; visual inspection of all energy efficient measures; and performance tests including envelope and duct tightness[xii]. Since the Snow Creek units were not rated for the LEED for Homes rating system, third-party verifications were not accomplished other than those required for the Energy Star label.

LEED for Homes Checklist from the USGBC LEED for Homes website[xiii] was used to simulate LEED ratings for Snow Creek Units 10 and 11. Within the spreadsheet, the *Summary* and *Simple Checklist* tabs were used to insert simulated building data. Due to a different Home Size Adjustment factor for the differently sized buildings, the thresholds for the specific rating are as such:

- FOX Unit 10 thresholds are:
    - Certified 42.5
    - Silver 57.5
    - Gold 72.5
    - Platinum 87.5

- DEER Unit 11 thresholds are:

- Certified 45.0
- Silver 60.0
- Gold 75.0
- Platinum 90.0

For each units, three scenarios were modeled: the benchmark building with a HERS of 100; the as-is construction, with HERS index between 52 – 47, and the net zero energy configuration with an assumed HERS index of 0 (see data in Addendum C). For the build as-is configuration, FOX Unit would have received a LEED for Homes *Silver* rating, achieving 63 points, with the threshold to Silver at 57.5; DEER Unit would have been rated at *Silver* too, receiving 64.5 points, with the threshold to Silver level at 60.0.

In the benchmark configuration with a HERS of 100, both units would have not reached any certification level: FOX Unit was rated at 40, with the threshold to Certified rating at 42.5; DEER Unit received also 40 points, with the threshold to Certified rating at 45.0.

For the net zero energy simulation with a HERS index of 0, and 1 extra point in the ID category under 1.5 *Building Orientation for Solar Design*, FOX Unit reached 81 points and would have been rated *Gold*, with the threshold to Gold level at 72.5 and Platinum level at 87.5; DEER Unit was also rated *Gold*, reaching 81 points with the thresholds at 75.0 for Gold and 90.0 for Platinum certification.

5.2.2 Capability to achieve Net Zero Energy Homes

With a maximum of 38+1 points that are possible for either the prescriptive or performance based method, the LEED for Homes rating system acknowledges efforts in the area of high performance buildings and net zero energy constructions. The performance based modeling is the better quantifier of the passive and solar contribution of total energy efficiency evaluation: EA 1 Optimize Energy Performance presents a potential of using solar thermal, PV, and many passive and efficiency measures not available in the prescriptive pathway. This is important because net zero energy performance in buildings usually cannot be reached by means of passive design only, thus they have to rely on renewable energy systems to a certain degree. This requires a holistic integrated approach to both passive and solar oriented design and technology, which is more difficult in the prescriptive method. Performance based modeling quantifies the result, allowing architects, designer, and project teams to come closer to achieving energy efficiency goals of 50-100% performance. As with the other rating systems, LEED for Homes does not provide for direct guidelines in how to reach net zero energy in homes, but supports the process through quantifiable results.

5.3 ICC 700-2008 NGBS National Green Building Standard™

5.3.1 Capability to achieve Net Zero Energy Homes

Contribution toward net zero, passive, and solar of the NGBS is in Site Design and Development; Lot Design, Preparation and Development; and Energy Efficiency. Chapter 4 Site Design and Development is intended to minimize site disturbance and maximize site orientation. NGBS 403.2 Building Orientation requires that a minimum of 75% of the building sites are designed with the longer dimension of the structure to the face within 20% of south. This credit is worth the maximum number of points for an area - 6. For the Snow Creek project this requirement is not fulfilled, because only 5 out of the 13 buildings are facing south with their longer dimension. Site Orientation is not a requirement and may be avoided altogether, and still achieve enough points to meet the highest rating in NGBS. For example, solar orientation is weighed comparable to offering community based amenities such as open space, parks, and plazas[xiv].

In Development and Lot Design, section 503.5 Landscape Plan calls for a plan to limit water and energy use while preserving or enhancing the natural environment. In addition to many categories specific to low water use plants and irrigation control systems, plant species and locations for tree planting that can provide summer shading of streets, parking areas, and buildings to moderate temperatures.

Similar to the LEED approach, Chapter 7 Energy Efficiency can be accomplished by either a prescriptive or performance path. Outside of both tracks mandatory section 701 requirements must be met including baseline HVAC, ducting, insulation and air sealing, floors/foundations/crawlspaces, walls, ceiling and attics and fenestration. Additional points may be earned in the 703 prescriptive path for similar categories. There are not explicit passive solar contributions to the prescriptive path. However, under the 702-performance path, points are earned based on energy cost performance levels. Energy efficiency is determined by the percentage of performance of the proposed house as it exceeds documented analysis using software in accordance with ICC IECC Section 404 or 506.2 through 506.5. These programs are the aforementioned HERS software platforms accredited by RESNET . Percentage improvements include the following increments:

- 15% - 30 points
- 30% - 60 points
- 50% - 100 points
- 60% - 120 points

NGBS Section 704 Additional Practices are points that can be earned in addition to either 702-performance path or 703 prescriptive path. Passive solar contribution to additional practices

includes 704.3 Renewable energy and solar heating and cooling. 704.3.1.1 Sun–tempered design awards a maximum of 5 points for building orientation, size of glazing and design of overhangs / exterior shading devices; additional points are possible under additional practices, which includes exterior solar protection, passive solar heating and solar water heating, and other passive design features that aid in a more passive design approach toward possible net zero performance in buildings. 704.3.3 Additional renewable energy options such as PV panels in any size or configuration receive a total of 1 point only, and active solar space heating systems only receive ½ point.

In summary, NGBS rating system rewards up to 120 points for a HERS index of 40, or 60% performance over the IECC 2006 benchmark standard, with no additional points for better performance. Hence NGBS neither considers efforts toward net zero energy homes to its fullest extend, nor does it support a design process by providing a comprehensive tool or strategies to reach a net zero energy goal in a residential building.

The calculated energy cost performance levels (per IECC section 404) applied to the NGBS section 702.2 *Energy cost performance levels* results in 60 credit points (cost performance exceed IECC by 37% to 40%).

5.4 PHPP Passive Home Planning Package 2007-2010

5.4.1 Method

For the PHPP simulations, building data from the Snow Creek DEER Unit 11 was inserted into the PHPP version 2010 software. The software includes worksheets addressing auxiliary electricity input including PV for power, solar hot water, as well as heat pump and ventilation unit entries. Data inserted for DEER Unit included general building dimensions and areas, orientation, wall, roof, and floor slab components and assemblies with their respective R-values, heat losses via ground, windows and frame type and orientation, shading devices, ventilation, and building envelope air tightness performance in ACH_{50}. The structure of PHPP allows for a detailed definition of components assemblies, therefore making it easy to enter SIPs as a specific assembly of materials that make up a walls or a roof. From the evaluation of the software, difficulties arouse in translating American standards to European standards: in further investigating the inputs requested by the program, multiple areas of entry require modification and conversion to produce a more accurate result. The PHPP version 2010 has corrected some of these discrepancies for the American market, thus making it easier to work with PHPP.

The result for DEER Unit is a specific annual space heat demand of 46.24 kBTU/(ft^2/yr). To achieve Passive House certification, a performance of 4.75 kBTU/(ft^2/yr) is required; the results show that DEER Unit consumes approximately 10 times more energy than a Passive House.

5.4.2 Capability to achieve Net Zero Energy Homes

The principle of PHPP software package is simple: through different design strategies and component and material choices, a building is designed towards a specific benchmark, which requires a maximum annual space heat demand of 4.75 kBTU/(ft^2/yr). This would be approximately 90% efficient over the 2006 IECC benchmark building, or at a HERS index of 10. Once a building is designed to this performance, only few additional measures or components are necessary to reach net-zero energy performance: a small photovoltaic system, a solar hot water system, or a ground source heat pump will provide the required renewable energy to perform at or above net zero. Different to the rating systems described above, PHPP allows for a direct, quantitative energy-consumption based evaluation of each design step or material/component choice, which has been proven to be extremely helpful during the design process. When working with PHPP, the spreadsheet-based modeling format holds the potential for simple input and consistent output data. No advanced computer software knowledge is required to run the calculations. However, the software would be more accurate if it were adaptable to a broader range of building standards, especially in the U.S. Most of the problems experienced with PHPP stem from misunderstanding the information being requested for input as well as a lack of standardized specifications to input.

As it is the case with the other rating systems described, PHPP software cannot substitute sound knowledge in passive design and energy strategies, but it can successfully support any design process toward better performing buildings. Comprehensive literature describing strategies and listing and analyzing structural and design details necessary to reach the benchmark supports the process. To test the software's capability, the research team ran several alternatives for the DEER unit. The results are shown in Table 03 below.

Table 03. Material and Component Modifications and their Impact onto Performance Results in PHPP.

Configuration	**Specific Space Heat Demand in kBTU/(ft^2/yr)**
As-built	49.24
With 12" SIPS wall panels	43.58
With Alpine Windows and Frames	42.06
Air tightness at 0.6 ACH_{50}	45.31
All the above measures together	**20.47**

Beyond a change of components and a better air tightness, there is little more that can be done for a better performance after completion of the building. Although the above proposed changes

enhance the performance of the building considerably, the remaining gap to Passive House performance can only be closed through the application of smart design strategies that incorporate the specific climate zone, site orientation and context, surface to area ratio, and specific requirements for a Passive House such as a design towards high solar gains in the winter time. These have to be applied **during** the design process. When the team explored the potential of the software for the DEER Unit, it learned that bigger windows to the south would only enhance the overall building performance if the chosen frames and glasses were high performance units with a high SHGC and a U-value of 0.16 or better. Applying the same design step to the low performance Energy Star rated windows that are installed in the units, would have lowered the performance due to high heat losses of the windows during a cold winter night.

6. Cost Analysis and ROI

For cost analysis and comparison of the Park City Snow Creek Reference Units, the actual construction cost of the two prototypical units 10 - FOX, and 11 – DEER, were compared to cost simulations of the BA Research Benchmark Definition of identical size and configuration in the same location. The reference used for the benchmark building cost is the 28th annual edition of RSMeans Residential Cost Data book, 2009, which is the year in which construction of the two units started. The cost analysis for the actual structures is limited to the cost of construction only. The preparation of the specific site in Park City was difficult due to ground water issues and the project's location in wetlands, which resulted in approx. 44% higher preparation cost than anticipated, bumping up land cost from initially $475,314.80 to $685,268.30. For this reason, land value, impact fees, and cost to prepare the specific location for construction are not factored in to allow for comparability between the actual built houses and the benchmark simulations. Design and architectural fees are not included in the cost per square foot either. According to RSMeans, the chosen category 'custom' (see 6.2 Benchmark Simulated Houses – Calculation Method below) includes a 5% design fee in the costs for general square footage. This is below the regular 9-10% design fee for a licensed architect, because in the custom category it is assumed that a non-licensed designer modifies stock plans. This is different from actually designing an entire building, as it was done in the Snow Creek development. In the spreadsheets in addendum E, 5% are subtracted from the general square footage price. The numbers from the architects do not include design fees either.

6.1 Snow Creek Project - Final Accounting Summary

The architects provided the following final accounting summary for the overall project:

6.1.1 Final contract amount

Original contract amount:	$3,232,490.00
Change orders	$260,289.40
Final contract amount	$3,492,779.40

6.1.2 Site cost

Basic site (100,550 sq.ft.)	
$475,314.80	
Change orders (site only)	$209,953.50
Total site value	$685,268.30

6.1.2.1 Site cost/sq.ft		
Site (Limits of disturbance)		100,550 sq.ft.
Buildings (plus patio and porches)		11,983 sq.ft.
Net site (including roads and sidewalks)		88,567 sq.ft.
Site cost/sq.ft. (average)	$685,268.30 / 88,567 sq.ft.	$7.74 / sq.ft.

6.1.2.2 Land value estimated by Park City Municipal Corporation (PCMC)	$2,200,000.00
6.1.2.3 Impact fees estimated by PCMC	300,000.00

6.1.3 Unit cost

Basic units	$2,967,129.00
Change orders (units only)	$50,335.60
Total unit value	$3,017,464.60

6.1.3.1 Unit square footage (habitable + garage)		
Deer unit	(4 ea at 1,932 sq.ft.)	7,728 sq.ft.
Elk unit	(3 ea at 1,881 sq.ft.)	5,642 sq.ft.
Fox unit	(3 ea at 1,305 sq.ft.)	3,915 sq.ft.
Moose unit	(3 ea at 1,865 sq.ft.)	5,595 sq.ft.
Total	(13 units)	22,881 sq.ft.
Unit cost/sq.ft. (average)	**$3,017,464.60/22,881 sq.ft.**	**131,88/sq.ft.**

6.1.3.2 Renewable Energy System costs (included in line item above)	
Photovoltaic Solar Panels: $140,000.00 + 20%*	$168,000.00

Evacuated Tube Solar Panels: $96,000.00 + 20%*	$115,200.00
Geothermal (Drilling & Piping): $78,500.00 + 20%*	$94,200.00
Total (Equipment, Installation, Subcontractor & General Contractor Burden)	$377,400.00
Renewable Energy System cost per unit: 377,400.00 / 13	$29,030.76

*General Contractor/Overhead/Profit

Total SF habitable space + garage (from 2.3.1)	(13 units)	22,881 sq.ft.
$377,400.00 / 22,881 sq.ft.		$16.49 / sq.ft.

Unit cost / sq.ft. (average): 131.88 – System costs 16.49	$115.39 / sq.ft.
Unit cost / sq.ft. (construction only without systems)	*115,39/sq.ft.*

6.2 Benchmark Simulated Houses – Calculation Method

To simulate the costs for two, similar to unit 10 and unit 11, buildings, built to BA Research Benchmark Definition, the Square Foot Cost Section of the 28th annual edition of RSMeans Residential Cost Data book, 2009, was used. The Square Foot Cost Section contains cost per square foot for four classes of construction (Economy, Average, Custom, Luxury) in seven building types (1; 1-1/2; 2; 2-1/2; 3 story; Bi-level; Tri-level). In general, all levels and building types are applicable to the benchmark definition, which describes the performance of specific components of a residential building, rather then a design method or specific building size. The chosen method allows for adjustment of the base cost of each class of building. Non-standard items are added to the benchmark structures. Although the HVAC systems in the Snow Creek units 10 and 11 are not specified for cooling, they are capable to do so through the geothermal system in tandem with the heat pump and central forced air system. The Energy Recovery Ventilator (ERV) in the Snow Creek units offsets cost for the air condition system included in the benchmark cases. Therefore, standard HVAC systems for the simulated houses include forced air and air conditioning. To allow for comparability of construction only costs as well as overall cost that include the renewable energy systems of the Snow Creek Project, such as geothermal, photovoltaic (PV) and solar hot water array, those are listed separately.

For both benchmark simulations, the custom class has been chosen, because a designer, with materials and workmanship above average, designs buildings in that class. Elliot Workgroup Architects out of Park City designed the Snow Creek homes. 'Materials and workmanship above average' applies to the construction of the Structural Insulated Panels SIPs only, but is not the case for the general interior; the cost per square foot was adjusted under *6 – Interiors* on the cost worksheet, using the cost per square foot for an average building (Addendum E, pp. 06, 11). For FOX Unit 10, the custom 1-1/2 story building type was used

(Addendum E, pp. 04, 05); for DEER Unit 11, the custom 2-1/2 story building type was used to calculate the cost per square foot (Addendum E, pp. 09, 10). The number of bathrooms was adjusted, and cost for washer and dryer added (Addendum E, p. 15). The cost for the garage, which is build into the ground floor, was considered according to the RSMeans work sheet (Addendum E, p. 16).

According to RSMeans, the location factor for Salt Lake City/Utah is 0.81 (Addendum E, pp. 18, 19). Park City is a more expensive location, but real data is not available in the data list. To approximate, the number for Boulder, Colorado (0.92), was used; Boulder is also a resort town and therefore the closest to the Park City location. A rough 10% above the Salt Lake City average also reflects the (undocumented) experience with building cost in the residential sector in the professional field of architecture. In any case, this number represents an approximation only!

6.3 Calculation Results for the Benchmark Simulations

The two data spreadsheets for FOX Unit 10, and DEER Unit 11 show the calculation method based on the RSMeans method for Square Foot Cost for the benchmark simulations.

a) Unit 10 – **FOX** (Addendum E, pp. 02, 03) benchmark simulation
Page 09: Square feet cost without adjustment is $131.64/sq.ft., or $171,790.20 for the entire building (1,305.00 sq.ft.). Minus 5% ($8,589.51) for design fees = **$163.200.69**
The final sum for construction only is at **$154.062,03** for the entire building, which calculates to **$118.06/sq.ft.** for FOX Unit 10 simulation.

b) Unit 11 – **DEER** (Addendum E, pp. 07, 08) benchmark simulation
Page 14: Square feet cost without adjustment is $113.28/sq.ft., or $218,856.96 for the entire building (1,932.00 sq.ft.). Minus 5% ($10,942.85) for design fees = **$207,914.11**
The final sum for construction only is at **$201,342.56** for the entire building, which calculates to **$104.21/sq.ft.** for DEER Unit 11 simulation.

c) **Interpolation for the actual Snow Creek Units as built** (Addendum E, p. 12)
The architect's data for the Snow Creek building's cost per square foot is based on an overall sum for construction for all 13 units, divided by the overall square footage of all units. Therefore, the dollar cost/sq.ft. results of the benchmark simulated houses need to be added and divided by the sum of the two units (see summary sheet FOX and DEER units), to allow for closest approximation of the different cases:

Overall construction sum FOX and DEER:	$355,404.59
Gross SF (incl. garage) FOX and DEER:	3,237.00 sq.ft
$405,841.70 / 3,237.00 sq.ft.	**$109.79 / sq.ft.**

6.4 Costs and ROI with renewable systems upgrades

The average square footage price for a structure built to the 2009 Building America Research Benchmark Definition that is comparable to the Park City Snow Creek units 10 and 11 is **$109.79/sq.ft**. This compares to $**131,88/sq.ft.** for the actual built structures, with a difference of **$22.09/sq.ft**. These numbers include the renewable energy systems in the prototype houses: geothermal, photovoltaic, and solar hot water systems. The numbers demonstrate that the actual prototype units are about 20% more expensive than the benchmark simulation cases. Economy of scale of mass-producing the 13 Snow Creek units, which comes at a modest cost advantage over the benchmark simulations, is not considered in this calculation. The benchmark simulations were calculated as single-house constructions by single builders, because there are no cost tables available for developments that could have been used for this specific comparison.

For the single units as-built versus benchmark, price difference for adjusted building cost are:

Unit 10 – **FOX**:	**1,305 sq.ft. x $131.88 / sq.ft.**	**$172,103.40**
Benchmark simulated case:		**$154,062.03**
Difference in cost		**$18,041.37**
Unit 11 – **DEER**:	**1,932 sq.ft. x $131.88 / sq.ft.**	**$254,792.16**
Benchmark simulated case:		**$201,342.56**
Difference in cost		**$53,449.60**

It is concluded that the cost per square foot for construction of the Snow Creek houses as-built are roughly 20% more expensive than a comparable structure built to the 2009 Building America Research Benchmark Definition, with the simulated benchmark buildings based on 2x6 framing construction with R-19 insulation and R-30 roofs, and the Snow Creek houses constructed from 6” (walls, R 23) to 12” (roofs, R 45) structural insulated panels (SIPs) (Table 01). The latter construction method guarantees a higher air tightness and better insulation value compared to standard framing, which is a critical prerequisite for an energy-efficient building.

The research team conducted an EnergyPlus building simulation that was calibrated to the actual performance of the two units by using the monitoring data between November 24, 2010, and March 15, 2011. Operational costs for the baseline building and the as-built construction of the two units were compared against different sources for heating (Table 04).

Natural gas costs were calculated using a 78% AFUE furnace with gas rates, taxes and fees as described by Questar, which is the local natural gas utilities company. Heat pump costs

were calculated using electrical rates, taxes and fees as described by Rocky Mountain Power, which is the local electricity utilities company.

The underperformance of the heat pump, which is apparent from Table 04, has a detrimental effect on the payback period for the efficiency improvements. Comparing the baseline house, heated with natural gas, to the upgraded as-built house, heated with the actual COP heat pump, shows a 13% decrease in energy use for the DEER Unit and a 3% *increase* in energy use for the FOX Unit.

Table 04. Operational costs for different heat sources for the baseline building and the as-built construction of FOX Unit #10 and DEER Unit 11.

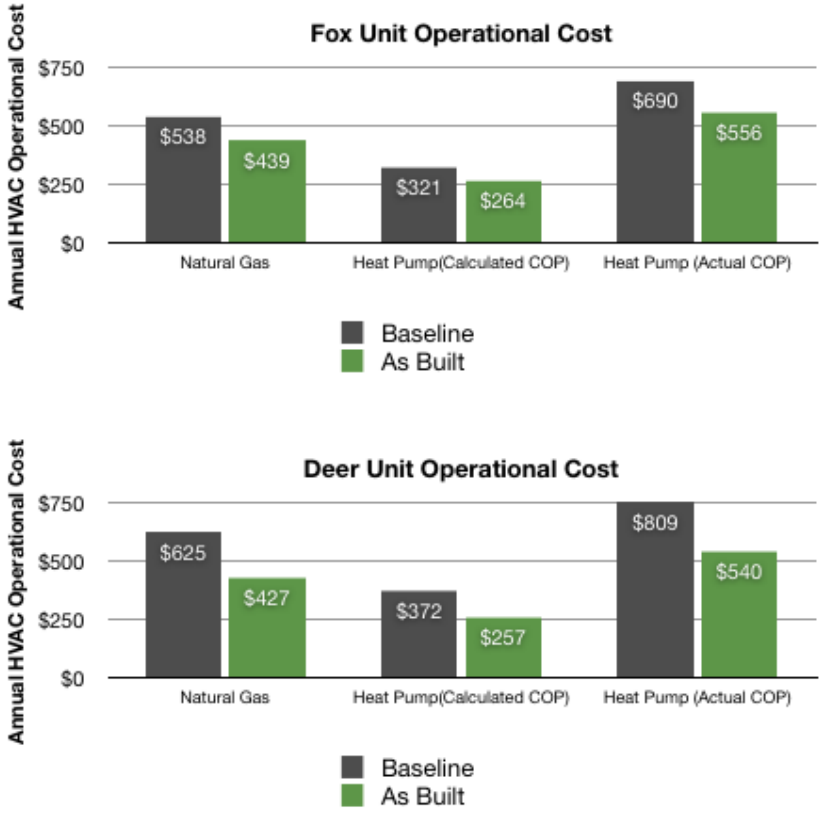

Table 05 below shows the final economic analysis, which compares envelope and HVAC upgrade costs to annual operational savings to get a payback period in years. Envelope upgrade costs were estimated for the cost of upgrading to SIPs and adding the stem wall insulation. HVAC upgrade costs were estimated for the added cost of the heat pump and components (pumps,

valves, etc.). Bore hole and piping costs are actual numbers provided by the architect.

Table 05. Economical analysis that compares envelope and HVAC upgrade costs to annual operational savings.

	Fox Unit	Deer Unit
Code Operational Cost	$538	$625
As Built Operational Cost	$556	$540
Annual Operational Savings	-$18	$85
Envelope Upgrade Cost	$3,800	$5,600
HVAC Upgrade Cost	$4,000	$5,000
Bore Hole and Piping Cost	$7,246	$7,246
Total Upgrade Costs	$15,046	$17,846
Payback Period (years)	-	210

Operational savings from the DEER Unit will pay back the costs of the upgrade in 210 years. Because the as-built FOX Unit is less efficient than the baseline building, it will never pay off the costs of the upgrades. Because the performance data of the photovoltaic system was not available to the team, possible costs offsets could not be considered in these calculations. It is expected though that the renewable energy from the photovoltaic panels would cut down the number of payback years considerably. Increasing cost fossil energy will also shorten ROI periods considerably. Above data is based on an average price of $0.078/kWh (net), and 0.218 (gross), which is the cost for electric energy in Utah as of February 2011.

6.5 Costs and ROI with construction upgrades only

To allow for a direct, isolated cost comparisons between the two different construction methods SIPs versus standard 2x6" stick framing, the cost for the renewable energy systems in the prototype houses were subtracted in the following calculations. The houses would still perform, using the built-in forced air/HRV combination and electric power to heat and ventilate the buildings; therefore such a comparison is realistic. According to the numbers in 6.1.3.2 above, the cost per square foot for Unit 10 and 11 on the Snow Creek Project would drop to **$115.39/sq.ft**, now with a difference of **$5.60/sq.ft**. compared to the cost of the simulated cases. This equals roughly 5.% higher costs over the benchmark buildings. This result shows that a building that considers passive means and strategies of energy-efficiency (airtight envelope, above standard insulation) can be constructed at approximately 5-6% higher cost than the benchmark building.

The ROI for this case would be as follows:

For the single units as-built, without renewable energy systems, versus benchmark, price difference for adjusted building cost are:

Unit 10 – **FOX**:	**1,305 sq.ft. x $115.39 / sq.ft.**	**$150,483.40**
Benchmark simulated case:		**$154,062.03**
Difference in cost		**$-3,478.08**
Unit 11 – **DEER**:	**1,932 sq.ft. x $115.39 / sq.ft.**	**$222,933.48**
Benchmark simulated case:		**$201,342.56**
Difference in cost		**$21,590.92**

The dissimilarity in adjusted building costs for the two units - FOX being less expensive in the actual build version vs. DEER being more expensive - can be explained through the applied calculation method, in which the RSMeans cost per sq.ft. are generally more expensive for smaller units, but costing less for bigger houses. This is not reflected in the architects cost data of the actual buildings due to the fact that the project's 13 units were build as one single development, with cost per building not being reflected in the provided cost data. Therefore, only the general the cost per square foot for the two units should be compared directly to each other.

Using the projected annual energy savings from the Energy Star Certification calculations (Addendum A), the following ROI's would apply for each unit, based on the built-as-is case:

- FOX Unit #10:
  Projected annual Energy Savings: $311 (Addendum A, p. 02)
  Cost difference to standard benchmark construction: $-3,478.08
  ROI: Instantly

- DEER Unit 11:
  Projected annual Energy Savings: $507 (Addendum A, p. 07)
  Cost difference to standard benchmark construction: $21,590.92
  ROI: $21,590.92 / $507 = 42 years

7. Key Findings and Conclusions

The research makes clear that all rating systems that were analyzed as part of this report consider energy efficiency and building performance in varying degrees; only PHPP helps to bring the goals of net zero energy performance housing within reach, demanding an energy efficiency based performance of 90% efficiency over the benchmark building. None of the rating systems provide a comprehensive strategy to design a building to net zero energy performance; they do not require post-occupancy monitoring to evaluate a building's performance. Architects, designers, builders and owners have to develop their own strategies to build as energy-efficient as possible; in regard to performance they have to solely rely on simulations of their buildings. Post-occupancy monitoring improves the accuracy of any rating system and the performance and quality of energy and performance rated building, because it allows for better evaluation of steps being taken towards outstanding performance.

Energy Star, although theoretically capable to identify a net zero energy achievement, is developed to cost effectiveness, where the cost to achieve certification shall be equally offset by energy savings yielded. With its major requirements – Energy Star rated windows, better insulation, sealed ductwork, HERS rating, and Energy Star lighting and appliances – it provides a good tool to achieve 15-20% better performance over the benchmark building, all at reasonable costs and with a short ROI period.

LEED for Homes awards up to 39 points for energy efficient measures, including net zero energy efforts with a HERS index of 0. This constitutes a potential of 43% of points necessary to reach the highest Platinum level at 90 points or greater. But energy efficiency is not a major category in the rating system; by offsetting points in other categories, both LEED and NGBS allow achievement of the highest possible rating with relatively low performing buildings, treating energy performance only marginal.

NGBS rewards up to 120 points for 60% performance over the IECC 2006 benchmark building, but awards no extra points for additional performance, although it becomes more difficult with performance heading toward net zero energy. This constitutes a potential of only 20% or 1/5th of points necessary to reach the highest Emerald level at 607 points or greater.

Finally, PHPP, since applied through a passive design approach and strategy, presents the best solution to achieve close to net zero energy performance for residential building. Passive Houses have to perform at approximately 90% over the IECC 2006 benchmark, or at a HERS index of 10, without the application of technology. From there it is only a small step to achieve a net zero energy building, employing technology at a small scale and therefore affordable cost. The ROI and cost analysis of this report shows that the passive approach is the most cost-effective; compared to the benchmark building, the Snow Creek homes come at relatively high cost due to extensive use of technical components. Other research suggests that investments

into passive strategies such as an extremely airtight and high performance envelope are the best choice towards net zero energy buildings.

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Addendum A

Results of Final Performance Testing for Snow Creek FOX Unit 10, and DEER Unit 11

April 30, 2011

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ENERGY STAR

Nexant

ENERGY STAR HOME REPORT

Date:	July 28, 2010	Rating No.:	W09-039-F
Building Name:	Fox 10	Rating Org.:	Nexant
Owner's Name:	Park City Muni	Phone No.:	8012616238
Property:	594 Snow Creek Ct	Rater's Name:	Dennis Gray
Address:	Park City, UT 84060	Rater's No.:	UT-72208
Builder's Name:	R & O Construction		
Weather Site:	Park City, UT	Rating Type:	Verified Condition
File Name:	W09-039 Final 594 Fox.blg	Rating Date:	7/8/10

Normalized, Modified End-Use Loads (MMBtu/year)

	ENERGY STAR	*As Designed*
Heating:	36.8	28.2
Cooling:	4.3	1.5
Water heating:	9.2	2.8
Lighting & Appliances:	15.6	20.6
Total:	65.9	53.1
HERS Index:	**80**	**52**

ENERGY STAR Mandatory Requirements

[X]	Thermal Bypass Inspection Checklist *	[X]	ENERGY STAR Products *
[X]	Ductwork Requirements	[X]	ENERGY STAR Scoring Exceptions

** Thermal Bypass Checklist and ENERGY STAR Products are not checked in REM/Rate at this time.*

This home MEETS OR EXCEEDS the energy efficiency requirements for designation as an EPA ENERGY STAR Qualified Home.

Pollution Prevented

Type of Emissions	*Reduction*
Carbon Dioxide (CO2) - tons/yr	4.1
Sulfur Dioxide (SO2) - lbs/yr	7.6
Nitrogen Oxides (NOx) - lbs/yr	14.6

Energy Cost Savings ($/year)

Heating:	$80
Cooling:	$14
Water Heating:	$238
Lights & Appliances:	$-20
Total:	$311

The energy savings and pollution prevented are calculated by comparing the Rated Home to the Reference Home as defined in the "Mortgage Industry National Home Energy Rating Systems Standards" as promulgated by the Residential Energy Services Network (RESNET) . In accordance with these guidelines, building inputs affecting setpoints, infiltration rates, window shading and the existence of mechanical systems may have been changed prior to calculating loads.

ENERGY STAR

Nexant

ENERGY STAR HOME VERIFICATION SUMMARY

Date:	July 28, 2010	Rating No.:	W09-039-F
Building Name:	Fox 10	Rating Org.:	Nexant
Owner's Name:	Park City Muni	Phone No.:	8012616238
Property:	594 Snow Creek Ct	Rater's Name:	Dennis Gray
Address:	Park City, UT 84060	Rater's No.:	UT-72208
Builder's Name:	R & O Construction		
Weather Site:	Park City, UT	Rating Type:	Verified Condition
File Name:	W09-039 Final 594 Fox.blg	Rating Date:	7/8/10

Building Information

Conditioned Area (sq ft):	1261	Housing Type:	Single-family detached
Conditioned Volume (cubic ft):	11829	Foundation Type:	Slab
Insulated Shell Area (sq ft):	3293	HERS Index:	52 *****+
Number of Bedrooms:	2		

Building Shell

Ceiling w/Attic:	None	Window/Wall Ratio:	0.16
Vaulted Ceiling:	R-47 SIP U=0.020	Window Type:	Dbl/LoE/Arg .35/.40
Above Grade Walls:	SIP 6-3/8" U=0.037	Window U-Value:	0.350
Found. Walls (Cond):	None	Window SHGC:	0.400
Found. Walls (Uncond):	None	Infiltration:	Htg: 1023 Clg: 1023 CFM50
Frame Floors:	R-33 U=0.042	Measured Duct Leakage:	62.00 CFM25
Slab Floors:	R-7.5 Perim/under U=0.061	Leakage to Outside:	62.00 CFM

Mechanical Systems

Heating:	Ground-source heat pump, 24.0 kBtuh, 4.4 COP.
Cooling:	Ground-source heat pump, 27.2 kBtuh, 18.6 EER.
Water Heating:	Conventional, Elec, 0.95 EF.
Programmable Thermostat:	Heat=Yes; Cool=Yes

Note: Where feature level varies in home, the dominant value is shown.

This home MEETS OR EXCEEDS the EPA's requirements for an ENERGY STAR Home.

An ENERGY STAR® Qualified Home

This home built at

594 Snow Creek Ct, Park City, UT

by R & O Construction
has been verified by Nexant , an independent professional or organization,
to meet or exceed strict energy efficiency guidelines
set by the U.S. Environmental Protection Agency.

HERS Index: 52

7/8/10

David Lee
Chief
ENERGY STAR Residential Branch

Sam Rashkin
National Director
ENERGY STAR for Homes

www.energystar.gov

REM/Rate - Residential Energy Analysis and Rating Software v12.84

04

Home Energy Rating Certificate

594 Snow Creek Ct

Park City, UT 84060

5 Stars Plus
Verified Condition

Uniform Energy Rating System | **Energy Efficient**

1 Star	1 Star Plus	2 Stars	2 Stars Plus	3 Stars	3 Stars Plus	4 Stars	4 Stars Plus	5 Stars	5 Stars Plus
500-401	400-301	300-251	250-201	200-151	150-101	100-91	90-86	85-71	70 or Less

HERS Index: **52**

General Information

Conditioned Area:	1261 sq. ft.	HouseType:	Single-family detached
Conditioned Volume:	11829 cubic ft.	Foundation:	Slab
Bedrooms:	2		

Mechanical Systems Features

Heating:	Ground-source heat pump, Electric, 4.4 COP.
Cooling:	Ground-source heat pump, Electric, 18.6 EER.
Water Heating:	Conventional, Electric, 0.95 EF, 80.0 Gal.
Duct Leakage to Outside:	62.00 CFM.
Ventilation System:	Balanced: ERV, 100 cfm, 120.0 watts.
Programmable Thermostat:	Heating: Yes Cooling: Yes

Building Shell Features

Ceiling Flat:	NA	Exposed Floor:	R-30
Vaulted Ceiling:	R-47	Window Type:	Dbl/LoE/Arg .35/.40
Above Grade Walls:	R-24, R-15	**Infiltration:**	
Foundation Walls:	NA	Rate:	Htg: 1023 Clg: 1023 CFM50
Slab:	R-7.5 Edge, R-7.5 Under	Method:	Blower door test

Lights and Appliance Features

Percent Fluorescent Pin-Based:	10.00	Clothes Dryer Fuel:	Electric
Percent Fluorescent CFL:	70.00	Range/Oven Fuel:	Electric
Refrigerator (kWh/yr):	378.00	Ceiling Fan (cfm/Watt):	70.40
Dishwasher Energy Factor:	0.46		

The Home Energy Rating Standard Disclosure for this home is available from the rating provider.

REM/Rate - Residential Energy Analysis and Rating Software v12.84

Rating Number: **W09-039-F**
Certified Energy Rater: Dennis Gray
Rating Date: 7/8/10
Rating Ordered For: Park City Muni

Estimated Annual Energy Cost

Verified Condition

Use	MMBtu	Cost	Percent
Heating	15.8	$351	48%
Cooling	0.2	$5	1%
Hot Water	3.0	$67	9%
Lights/Appliances	18.9	$427	59%
Photovoltaics	-6.6	$-149	-21%
Service Charges		$24	3%
Total		**$724**	**100%**

This home meets or exceeds the minimum criteria for all of the following:

EPA ENERGY STAR Home

2006 International Energy Conservation Code

Nexant Inc.
4021 South 700 East #250
Salt Lake City UT 84107
Ph 801.639.5600
Fx 801.266.4786

05

RESNET HOME ENERGY RATING
Standard Disclosure

For home located at: 594 Snow Creek Ct

City: Park City **State:** UT

1. [X] The Rater or the Rater's employer is receiving a fee for providing the rating on this home.

2. [ ] In addition to the rating, the Rater or Rater's employer has also provided the following consulting services for this home:

   - [ ] A. Mechanical system design
   - [ ] B. Moisture control or indoor air quality consulting
   - [ ] C. Performance testing and/or commissioning other than required for the rating itself
   - [ ] D. Training for sales or construction personnel
   - [ ] E. Other (specify below)

3. [ ] The Rater or Rater's employer is:

   - [ ] A. The seller of this home or their agent
   - [ ] B. The mortgagor for some portion of the financed payments on this home
   - [ ] C. An employee, contractor or consultant of the electric and/or natural gas utility serving this home

4. [ ] The Rater or Rater's employer is a supplier or installer of products, which may include:

	Installed in this home by:		OR	Is in the business of:	
HVAC systems	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer
Thermal insulation systems	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer
Air sealing of envelope or duct systems	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer
Windows or window shading systems	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer
Energy efficient appliances	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer
Construction (builder, developer, construction contractor, etc.)	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer
Other (specify below):	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer

I attest that the above information is true and correct to the best of my knowledge. As a Rater or Rating Provider I abide by the rating quality control provisions of the Mortgage Industry National Home Energy Rating Standard as set forth by the Residential Energy Services Network (RESNET). The national rating quality control provisions of the rating standard are contained in Chapter One 4.C.8 of the standard and are posted at http://www.natresnet.org/accred/standards.pdf. This home may have been verified under the provisions of Chapter Six, Section 603, "Technical Requirements for Sampling" of the Standard.

Dennis Gray
Rater's Printed Name

UT-72208
Certification #

Rater's Signature

July 28, 2010
Date

RESNET Form 0300-2

ENERGY STAR HOME REPORT

Date:	July 28, 2010	Rating No.:	W09-039-D
Building Name:	Deer 11	Rating Org.:	Nexant
Owner's Name:	Park City Muni	Phone No.:	(801 261 6238
Property:	598 Snow Creek Court	Rater's Name:	Dennis Gray
Address:	Park City, UT 84060	Rater's No.:	UT-72208
Builder's Name:	R & O Construction		
Weather Site:	Park City, UT	Rating Type:	Confirmed Rating
File Name:	W09-039 final-598 DEER.blg	Rating Date:	7/12/10

Normalized, Modified End-Use Loads (MMBtu/year)

	ENERGY STAR	*As Designed*
Heating:	51.8	29.6
Cooling:	6.3	3.2
Water heating:	11.1	4.7
Lighting & Appliances:	20.5	26.3
Total:	89.7	63.8
HERS Index:	**80**	**47**

ENERGY STAR Mandatory Requirements

[X]	Thermal Bypass Inspection Checklist *	[X]	ENERGY STAR Products *
[X]	Ductwork Requirements	[X]	ENERGY STAR Scoring Exceptions

** Thermal Bypass Checklist and ENERGY STAR Products are not checked in REM/Rate at this time.*

This home MEETS OR EXCEEDS the energy efficiency requirements for designation as an EPA ENERGY STAR Qualified Home.

Pollution Prevented

Type of Emissions	*Reduction*
Carbon Dioxide (CO2) - tons/yr	6.6
Sulfur Dioxide (SO2) - lbs/yr	12.2
Nitrogen Oxides (NOx) - lbs/yr	23.3

Energy Cost Savings ($/year)

Heating:	$239
Cooling:	$18
Water Heating:	$253
Lights & Appliances:	$-3
Total:	$507

The energy savings and pollution prevented are calculated by comparing the Rated Home to the Reference Home as defined in the "Mortgage Industry National Home Energy Rating Systems Standards" as promulgated by the Residential Energy Services Network (RESNET) . In accordance with these guidelines, building inputs affecting setpoints, infiltration rates, window shading and the existence of mechanical systems may have been changed prior to calculating loads.

REM/Rate - Residential Energy Analysis and Rating Software v12.84

ENERGY STAR

Nexant

ENERGY STAR HOME VERIFICATION SUMMARY

Date:	July 28, 2010	Rating No.:	W09-039-D
Building Name:	Deer 11	Rating Org.:	Nexant
Owner's Name:	Park City Muni	Phone No.:	(801 261 6238
Property:	598 Snow Creek Court	Rater's Name:	Dennis Gray
Address:	Park City, UT 84060	Rater's No.:	UT-72208
Builder's Name:	R & O Construction		
Weather Site:	Park City, UT	Rating Type:	Confirmed Rating
File Name:	W09-039 final-598 DEER.blg	Rating Date:	7/12/10

Building Information

Conditioned Area (sq ft):	1917	Housing Type:	Single-family detached
Conditioned Volume (cubic ft):	15137	Foundation Type:	Slab
Insulated Shell Area (sq ft):	3759	HERS Index:	47 *****+
Number of Bedrooms:	3		

Building Shell

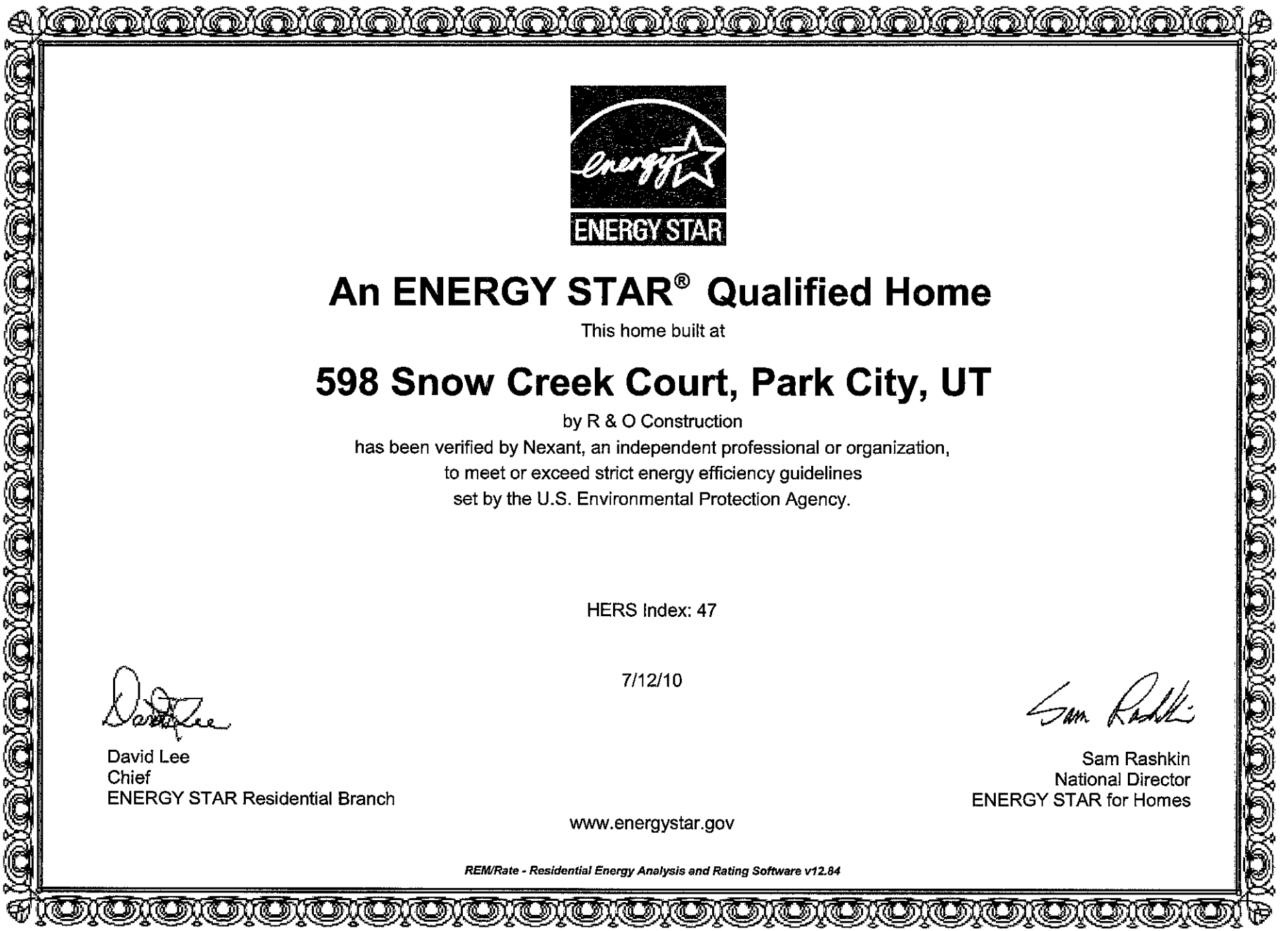
Ceiling w/Attic:	None	Window/Wall Ratio:	0.20
Vaulted Ceiling:	R-47 SIP U=0.020	Window Type:	Dbl/LoE/Arg .35/.40
Above Grade Walls:	SIP 6-3/8" U=0.037	Window U-Value:	0.350
Found. Walls (Cond):	None	Window SHGC:	0.400
Found. Walls (Uncond):	None	Infiltration:	Htg: 730 Clg: 730 CFM50
Frame Floors:	R-33 U=0.042	Measured Duct Leakage:	62.00 CFM25
Slab Floors:	R-7.5 Perim/under U=0.061	Leakage to Outside:	62.00 CFM

Mechanical Systems

Heating:	Ground-source heat pump, 27.0 kBtuh, 4.2 COP.
Cooling:	Ground-source heat pump, 40.2 kBtuh, 20.1 EER.
Water Heating:	Conventional, Elec, 0.95 EF.
Programmable Thermostat:	Heat=Yes; Cool=Yes

Note: Where feature level varies in home, the dominant value is shown.

This home MEETS OR EXCEEDS the EPA's requirements for an ENERGY STAR Home.



An ENERGY STAR® Qualified Home

This home built at

598 Snow Creek Court, Park City, UT

by R & O Construction
has been verified by Nexant, an independent professional or organization,
to meet or exceed strict energy efficiency guidelines
set by the U.S. Environmental Protection Agency.

HERS Index: 47

7/12/10

David Lee
Chief
ENERGY STAR Residential Branch

Sam Rashkin
National Director
ENERGY STAR for Homes

www.energystar.gov

REM/Rate - Residential Energy Analysis and Rating Software v12.84

Home Energy Rating Certificate

598 Snow Creek Court

Park City, UT 84060

5 Stars Plus
Confirmed Rating

Uniform Energy Rating System | **Energy Efficient**

1 Star	1 Star Plus	2 Stars	2 Stars Plus	3 Stars	3 Stars Plus	4 Stars	4 Stars Plus	5 Stars	5 Stars Plus
500-401	400-301	300-251	250-201	200-151	150-101	100-91	90-86	85-71	70 or Less

HERS Index: **47**

General Information

Conditioned Area:	1917 sq. ft.	HouseType:	Single-family detached
Conditioned Volume:	15137 cubic ft.	Foundation:	Slab
Bedrooms:	3		

Mechanical Systems Features

Heating:	Ground-source heat pump, Electric, 4.2 COP.
Cooling:	Ground-source heat pump, Electric, 20.1 EER.
Water Heating:	Conventional, Electric, 0.95 EF, 80.0 Gal.
Duct Leakage to Outside:	62.00 CFM.
Ventilation System:	Balanced: ERV, 100 cfm, 120.0 watts.
Programmable Thermostat:	Heating: Yes Cooling: Yes

Building Shell Features

Ceiling Flat:	NA	Exposed Floor:	R-30
Vaulted Ceiling:	R-47	Window Type:	Dbl/LoE/Arg .35/.40
Above Grade Walls:	R-24, R-15	**Infiltration:**	
Foundation Walls:	NA	Rate:	Htg: 730 Clg: 730 CFM50
Slab:	R-7.5 Edge, R-7.5 Under	Method:	Blower door test

Lights and Appliance Features

Percent Fluorescent Pin-Based:	10.00	Clothes Dryer Fuel:	Electric
Percent Fluorescent CFL:	70.00	Range/Oven Fuel:	Electric
Refrigerator (kWh/yr):	378.00	Ceiling Fan (cfm/Watt):	70.40
Dishwasher Energy Factor:	0.46		

The Home Energy Rating Standard Disclosure for this home is available from the rating provider.

REM/Rate - Residential Energy Analysis and Rating Software v12.84

Rating Number: **W09-039-D**
Certified Energy Rater: Dennis Gray
Rating Date: 7/12/10
Rating Ordered For: Park City Muni

Estimated Annual Energy Cost

Confirmed Rating

Use	MMBtu	Cost	Percent
Heating	16.7	$370	40%
Cooling	0.5	$11	1%
Hot Water	4.9	$112	12%
Lights/Appliances	24.1	$548	60%
Photovoltaics	-6.6	$-150	-16%
Service Charges		$24	3%
Total		**$914**	**100%**

This home meets or exceeds the minimum criteria for all of the following:

EPA ENERGY STAR Home

2006 International Energy Conservation Code

Nexant Inc.
4021 South 700 East #250
Salt Lake City UT 84107
Ph 801.639.5600
Fx 801.266.4786

RESNET HOME ENERGY RATING
Standard Disclosure

For home located at: 598 Snow Creek Court

City: Park City **State:** UT

1. [X] The Rater or the Rater's employer is receiving a fee for providing the rating on this home.

2. [X] In addition to the rating, the Rater or Rater's employer has also provided the following consulting services for this home:

   - [ ] A. Mechanical system design
   - [ ] B. Moisture control or indoor air quality consulting
   - [ ] C. Performance testing and/or commissioning other than required for the rating itself
   - [ ] D. Training for sales or construction personnel
   - [X] E. Other (specify below)
     Testing data for Nataional Green Building Standard

3. [ ] The Rater or Rater's employer is:

   - [ ] A. The seller of this home or their agent
   - [ ] B. The mortgagor for some portion of the financed payments on this home
   - [ ] C. An employee, contractor or consultant of the electric and/or natural gas utility serving this home

4. [ ] The Rater or Rater's employer is a supplier or installer of products, which may include:

	Installed in this home by:		OR	Is in the business of:	
HVAC systems	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer
Thermal insulation systems	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer
Air sealing of envelope or duct systems	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer
Windows or window shading systems	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer
Energy efficient appliances	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer
Construction (builder, developer, construction contractor, etc.)	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer
Other (specify below):	[ ] Rater	[ ] Employer		[ ] Rater	[ ] Employer

I attest that the above information is true and correct to the best of my knowledge. As a Rater or Rating Provider I abide by the rating quality control provisions of the Mortgage Industry National Home Energy Rating Standard as set forth by the Residential Energy Services Network (RESNET). The national rating quality control provisions of the rating standard are contained in Chapter One 4.C.8 of the standard and are posted at http://www.natresnet.org/accred/standards.pdf. This home may have been verified under the provisions of Chapter Six, Section 603, "Technical Requirements for Sampling" of the Standard.

Dennis Gray — Rater's Printed Name

UT-72208 — Certification #

Rater's Signature

July 28, 2010 — Date

RESNET Form 0300-2

Addendum B

Rem/Rate Residential Energy Analysis and Rating Software v12.61 Energy Modeling for Snow Creek FOX Unit 10, and DEER Unit 11

April 30, 2011

Authors:

Integrated Technology in Architecture Center
University of Utah

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Co-PI: Ryan Smith
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Wasatch
ENERGY ENGINEERING

2006 IECC ANNUAL ENERGY COST COMPLIANCE

Date:	July 21, 2009	Rating No.:	W09-039-F
Building Name:	Fox A Unit 10	Rating Org.:	Wasatch Energy Engineering
Owner's Name:	Park City Muni	Phone No.:	(435) 901-0954
Property:	Snow Creek Cottages	Rater's Name:	Dennis Gray
Address:	Park City, UT 84060	Rater's No.:	UT-72208
Builder's Name:	R & O Construction		
Weather Site:	Park City, UT	Rating Type:	Projected Rating
File Name:	W09-039 PCMuni-Snow-Fox-A-10.blg	Rating Date:	7/20/09

	Annual Energy Cost		
	2006 IECC	As Designed	
Heating:	430	328	
Cooling:	29	12	
Water Heating:	282	67	
Lights & Appliances:	361	428	
Photovoltaics:	-0	-149	
Service Charge:	24	24	
Total:	1126	710	*
Window U-Value Check (per Section 402.6)			
Window U-Value (Design must be lower):	0.400	0.350	

This home MEETS the annual energy cost requirements in accordance with Section 404 of the 2006 International Energy Conservation Code based on a climate zone of 6B. In fact, this home surpasses the requirements by 36.9%.

* Design energy cost is based on the following systems:
Heating: Ground-source heat pump, 19.5 kBtuh, 4.2 COP.
Cooling: Ground-source heat pump, 27.2 kBtuh, 18.6 EER.
Water Heating: Conventional, Elec, 0.95 EF.
Window-to-Wall Area Ratio: 0.16
Blower door test: Htg: 0.14 Clg: 0.07 ACHnat

In accordance with IECC, building inputs, such as setpoints, infiltration rates, and window shading may have been changed prior to calculating annual energy cost. Furthermore, the standard reference design HVAC system efficiencies are set

to the "prevailing federal minimum standards" as of January, 2006. These standards are subject to change, and software

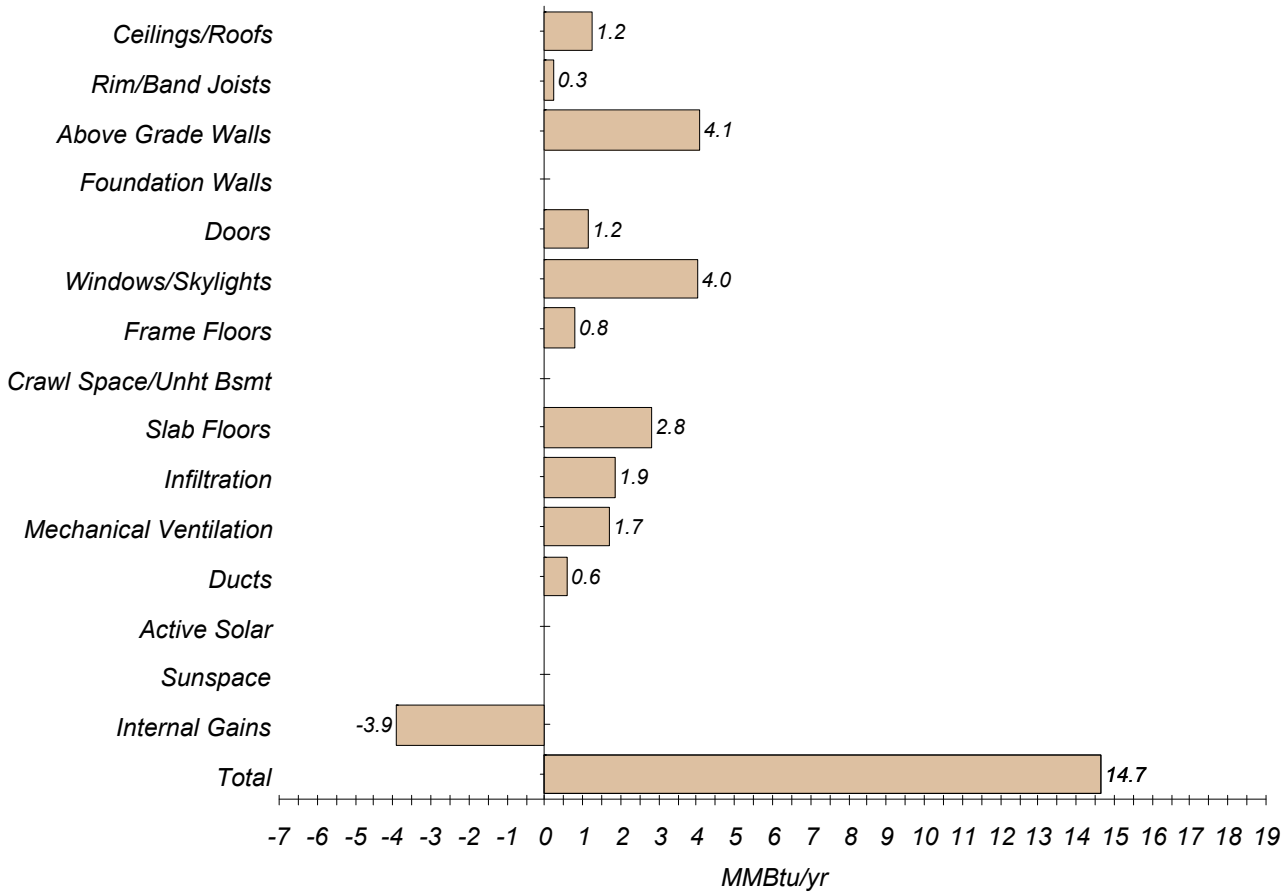
updates should be obtained periodically to ensure the compliance calculations reflect current federal minimum standards.

Wasatch
ENERGY ENGINEERING

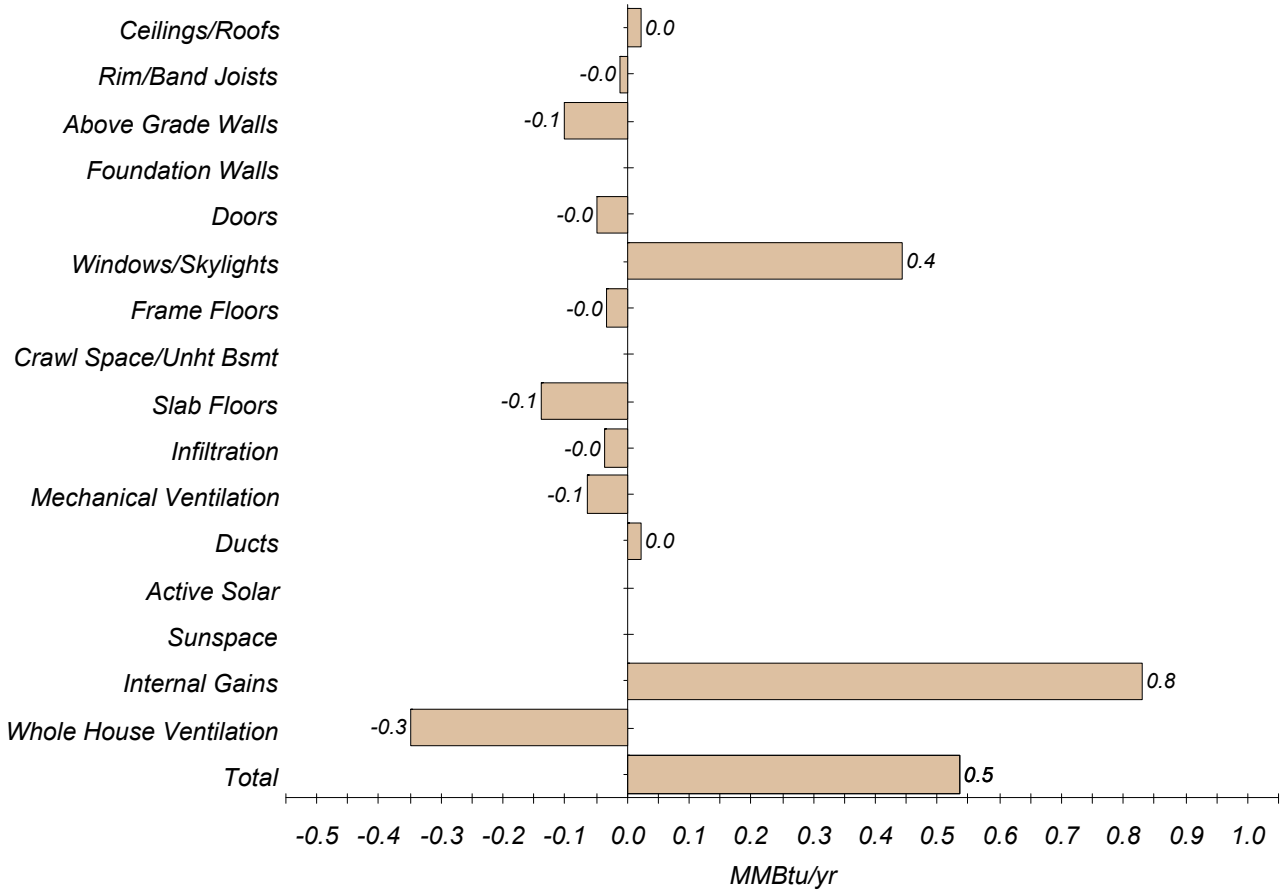
COMPONENT CONSUMPTION SUMMARY

Date:	July 21, 2009	Rating No.:	W09-039-F
Building Name:	Fox A Unit 10	Rating Org.:	Wasatch Energy Engineering
Owner's Name:	Park City Muni	Phone No.:	(435) 901-0954
Property:	Snow Creek Cottages	Rater's Name:	Dennis Gray
Address:	Park City, UT 84060	Rater's No.:	UT-72208
Builder's Name:	R & O Construction		
Weather Site:	Park City, UT	Rating Type:	Projected Rating
File Name:	W09-039 PCMuni-Snow-Fox-A-10.blg	Rating Date:	7/20/09

Heating Season



Cooling Season



Wasatch
ENERGY ENGINEERING

2006 IECC ANNUAL ENERGY COST COMPLIANCE

Date:	July 21, 2009	Rating No.:	W09-039-D
Building Name:	Deer A Unit 11	Rating Org.:	Wasatch Energy Engineering
Owner's Name:	Park City Muni	Phone No.:	(435) 901-0954
Property:	Snow Creek Cottages	Rater's Name:	Dennis Gray
Address:	Park City, UT 84060	Rater's No.:	UT-72208
Builder's Name:	R & O Construction		
Weather Site:	Park City, UT	Rating Type:	Projected Rating
File Name:	W09-039 PCMuni-Snow-Deer-A-11.blg	Rating Date:	7/20/09

	Annual Energy Cost	
	2006 IECC	As Designed
Heating:	580	351
Cooling:	45	24
Water Heating:	363	112
Lights & Appliances:	492	550
Photovoltaics:	-0	-151
Service Charge:	24	24
Total:	1504	909 *
Window U-Value Check (per Section 402.6)		
Window U-Value (Design must be lower):	0.400	0.350
Skylight U-Value Check (per Section 402.6)		
Skylight U-Value (Design must be lower):	0.750	0.350

This home MEETS the annual energy cost requirements in accordance with Section 404 of the 2006 International Energy Conservation Code based on a climate zone of 6B. In fact, this home surpasses the requirements by 39.5%.

* Design energy cost is based on the following systems:
Heating: Ground-source heat pump, 27.0 kBtuh, 4.2 COP.
Cooling: Ground-source heat pump, 40.2 kBtuh, 20.1 EER.
Water Heating: Conventional, Elec, 0.95 EF.
Window-to-Wall Area Ratio: 0.20
Blower door test: Htg: 0.14 Clg: 0.07 ACHnat

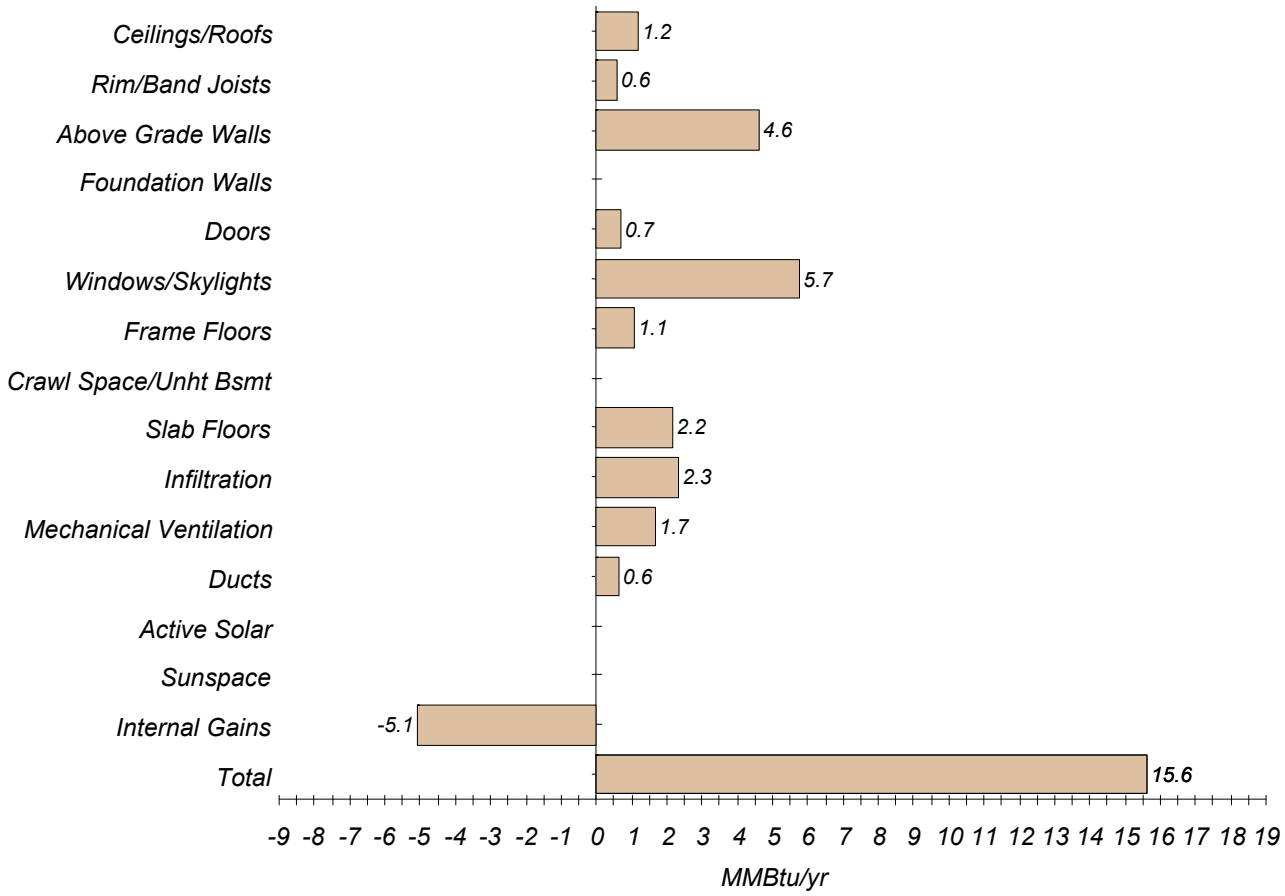
In accordance with IECC, building inputs, such as setpoints, infiltration rates, and window shading may have been changed prior to calculating annual energy cost. Furthermore, the standard reference design HVAC system efficiencies are set to the "prevailing federal minimum standards" as of January, 2006. These standards are subject to change, and software updates should be obtained periodically to ensure the compliance calculations reflect current federal minimum standards.

Wasatch
ENERGY ENGINEERING

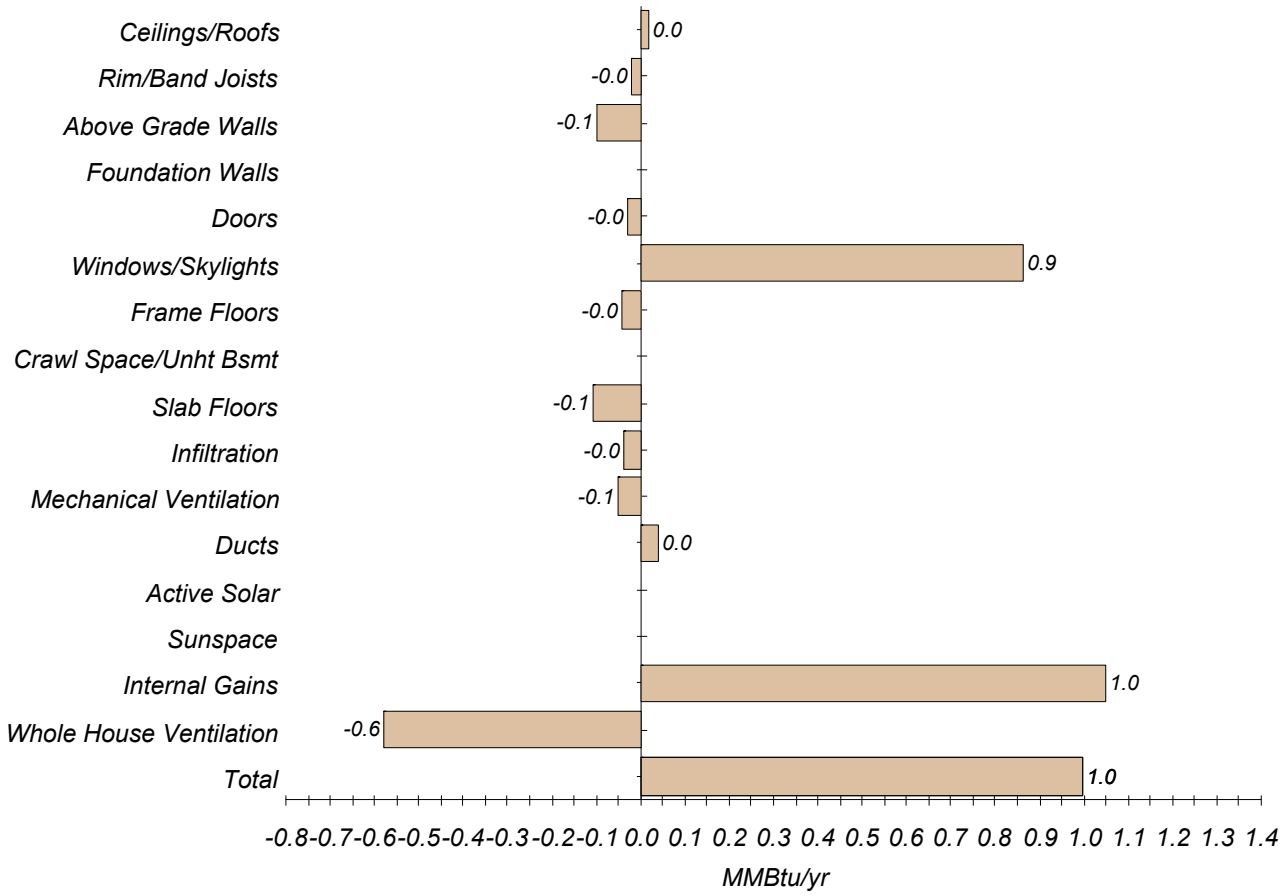
COMPONENT CONSUMPTION SUMMARY

Date:	July 21, 2009	Rating No.:	W09-039-D
Building Name:	Deer A Unit 11	Rating Org.:	Wasatch Energy Engineering
Owner's Name:	Park City Muni	Phone No.:	(435) 901-0954
Property:	Snow Creek Cottages	Rater's Name:	Dennis Gray
Address:	Park City, UT 84060	Rater's No.:	UT-72208
Builder's Name:	R & O Construction		
Weather Site:	Park City, UT	Rating Type:	Projected Rating
File Name:	W09-039 PCMuni-Snow-Deer-A-11.blg	Rating Date:	7/20/09

Heating Season



Cooling Season



Addendum C

LEED Ratings for Snow Creek FOX Unit 10 and DEER Unit 11, built ot benchmark (HERS 100): built-as-is (HERS 52-47), and designed to Net Zero (HERS 0)

April 30, 2011

Authors:

Integrated Technology in Architecture Center
University of Utah

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Co-PI: Ryan Smith
Director I-TAC, Associate Professor
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Jessica Batty, Eric Carter
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FOX unit #10

HERS 47 - built as-is

LEED for Homes Simplified Project Checklist

for Homes

Builder Name:	***R+O Construction***
Project Team Leader (if different):	***Roger Durst, Elliott Workgroup Architecture***
Home Address (Street/City/State):	***2061 Park Avenue, Salt Lake City, Utah***

Project Description:

Building type: ***Single detached***
# of bedrooms: ***2***
Project type: ***Multi-family Dev***
Floor area: ***1261***

Adjusted Certification Thresholds

Certified: ***42,5***
Silver: ***57,5***
Gold: ***72,5***
Platinum: ***87,5***

Project Point Total

Prelim: ***22 + 0 maybe pts***
Final: ***63***

Certification Level

Prelim: ***Not Certified***
Final: ***Not Certified***

Final Credit Category Total Points

ID: 6 ***SS: 13*** ***EA: 22*** ***EQ: 2***
LL: 5 ***WE 3*** ***MR: 9*** ***AE: 3***

Min. Point Thresholds Not Met for Prelim. OR Final Rating

date last updated :
last updated by :

					Max Points	Project Points Preliminary			Final
Innovation and Design Process (ID)			(No Minimum Points Required)		Max	Y/Pts	Maybe	No	Y/Pts
1. Integrated Project Planning		1,1	Preliminary Rating		Prereq				
		1,2	Integrated Project Team		1	0	0		1
		1,3	Professional Credentialed with Respect to LEED for Homes		1	0	0		1
		1,4	Design Charrette		1	0	0		1
		1,5	Building Orientation for Solar Design		1	0	0		0
2. Durability Management Process		2,1	Durability Planning		Prereq				
		2,2	Durability Management		Prereq				
		2,3	Third-Party Durability Management Verification		3	0	0		3
3.Innovative or Regional Design	⊘	3,1	Innovation #1 _____		1	0	0		0
	⊘	3,2	Innovation #2 _____		1	0	0		0
	⊘	3,3	Innovation #3 _____		1	0	0		0
	⊘	3,4	Innovation #4 _____		1	0	0		0
				Sub-Total for ID Category:	**11**	0	0		**6**
Location and Linkages (LL)			(No Minimum Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. LEED ND		1	LEED for Neighborhood Development	**LL2-6**	10	0	0		**5**
2. Site Selection	⊘	2	Site Selection		2	0	0		0
3. Preferred Locations		3,1	Edge Development	**LL 3.2**	1	0	0		0
		3,2	Infill		2	0	0		1
		3,3	Previously Developed		1	0	0		0
4. Infrastructure		4	Existing Infrastructure		1	0	0		0
5. Community Resources/ Transit		5,1	Basic Community Resources / Transit	**LL 5.2, 5.3**	1	0	0		0
		5,2	Extensive Community Resources / Transit	**LL 5.3**	2	0	0		2
		5,3	Outstanding Community Resources / Transit		3	0	0		0
6. Access to Open Space		6	Access to Open Space		1	0	0		1
				Sub-Total for LL Category:	**10**	0	0		**5**
Sustainable Sites (SS)			(Minimum of 5 SS Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Site Stewardship		1,1	Erosion Controls During Construction		Prereq				
		1,2	Minimize Disturbed Area of Site		1	0	0		1
2. Landscaping	⊘	2,1	No Invasive Plants		Prereq				
	⊘	2,2	Basic Landscape Design	**SS 2.5**	2	0	0		2
	⊘	2,3	Limit Conventional Turf	**SS 2.5**	3	0	0		2
	⊘	2,4	Drought Tolerant Plants	**SS 2.5**	2	0	0		2
	⊘	2,5	Reduce Overall Irrigation Demand by at Least 20%		6	0	0		6
3. Local Heat Island Effects	⊘	3	Reduce Local Heat Island Effects		1	0	0		0
4. Surface Water Management	⊘	4,1	Permeable Lot		4	0	0		4
		4,2	Permanent Erosion Controls		1	0	0		1
	⊘	4,3	Management of Run-off from Roof		2	0	0		0
5. Nontoxic Pest Control		5	Pest Control Alternatives		2	0	0		0
6. Compact Development		6,1	Moderate Density	**SS 6.2, 6.3**	2	0	0		1
		6,2	High Density	**SS 6.3**	3	0	0		0
		6,3	Very High Density		4	0	0		0
				Sub-Total for SS Category:	**22**	0	0		**13**

FOX unit #10

HERS 47 - built as-is

LEED for Homes Simplified Project Checklist (continued)

					Max Points	Project Points Preliminary			Final
Water Efficiency (WE)			(Minimum of 3 WE Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Water Reuse		1,1	Rainwater Harvesting System	**WE 1.3**	4	0	0		0
		1,2	Graywater Reuse System	**WE 1.3**	1	0	0		0
		1,3	Use of Municipal Recycled Water System		3	0	0		0
2. Irrigation System	✎	2,1	High Efficiency Irrigation System	**WE 2.3**	3	0	0		0
		2,2	Third Party Inspection	**WE 2.3**	1	0	0		0
	✎	2,3	Reduce Overall Irrigation Demand by at Least 45%		4	0	0		0
3. Indoor Water Use		3,1	High-Efficiency Fixtures and Fittings		3	0	0		3
		3,2	Very High Efficiency Fixtures and Fittings		6	0	0		0
				Sub-Total for WE Category:	**15**	0	0		3
Energy and Atmosphere (EA)			(Minimum of 0 EA Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Optimize Energy Performance		1,1	Performance of ENERGY STAR for Homes		Prereq				
		1,2	Exceptional Energy Performance		34	22	0		22
7. Water Heating	✎	7,1	Efficient Hot Water Distribution		2	0	0		0
		7,2	Pipe Insulation		1	0	0		0
11. Residential Refrigerant Management		11,1	Refrigerant Charge Test		Prereq				
		11,2	Appropriate HVAC Refrigerants		1	0	0		0
				Sub-Total for EA Category:	**38**	22	0		22
Materials and Resources (MR)			(Minimum of 2 MR Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Material-Efficient Framing		1,1	Framing Order Waste Factor Limit		Prereq				
		1,2	Detailed Framing Documents	**MR 1.5**	1	0	0		1
		1,3	Detailed Cut List and Lumber Order	**MR 1.5**	1	0	0		1
		1,4	Framing Efficiencies	**MR 1.5**	3	0	0		3
		1,5	Off-site Fabrication		4	0	0		2
2. Environmentally Preferable Products	✎	2,1	FSC Certified Tropical Wood		Prereq				
	✎	2,2	Environmentally Preferable Products		8	0	0		2
3. Waste Management		3,1	Construction Waste Management Planning		Prereq				
		3,2	Construction Waste Reduction		3	0	0		2
				Sub-Total for MR Category:	**16**	0	0		9
Indoor Environmental Quality (EQ)			(Minimum of 6 EQ Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. ENERGY STAR with IAP		1	ENERGY STAR with Indoor Air Package		13	0	0		0
2. Combustion Venting		2,1	Basic Combustion Venting Measures	**EQ 1**	Prereq				
		2,2	Enhanced Combustion Venting Measures	**EQ 1**	2	0	0		0
3. Moisture Control		3	Moisture Load Control	**EQ 1**	1	0	0		0
4. Outdoor Air Ventilation	✎	4,1	Basic Outdoor Air Ventilation	**EQ 1**	Prereq				
	✎	4,2	Enhanced Outdoor Air Ventilation		2	0	0		2
		4,3	Third-Party Performance Testing	**EQ 1**	1	0	0		0
5. Local Exhaust	✎	5,1	Basic Local Exhaust	**EQ 1**	Prereq				
		5,2	Enhanced Local Exhaust		1	0	0		0
		5,3	Third-Party Performance Testing		1	0	0		0
6. Distribution of Space Heating and Cooling	✎	6,1	Room-by-Room Load Calculations	**EQ 1**	Prereq				
		6,2	Return Air Flow / Room by Room Controls	**EQ 1**	1	0	0		0
		6,3	Third-Party Performance Test / Multiple Zones	**EQ 1**	2	0	0		0
7. Air Filtering		7,1	Good Filters	**EQ 1**	Prereq				
		7,2	Better Filters	**EQ 7.3**	1	0	0		0
		7,3	Best Filters		2	0	0		0
8. Contaminant Control	✎	8,1	Indoor Contaminant Control during Construction	**EQ 1**	1	0	0		0
		8,2	Indoor Contaminant Control		2	0	0		0
	✎	8,3	Preoccupancy Flush	**EQ 1**	1	0	0		0
9. Radon Protection	✎	9,1	Radon-Resistant Construction in High-Risk Areas	**EQ 1**	Prereq				
	✎	9,2	Radon-Resistant Construction in Moderate-Risk Areas	**EQ 1**	1	0	0		0
10. Garage Pollutant Protection		10,1	No HVAC in Garage	**EQ 1**	Prereq				
		10,2	Minimize Pollutants from Garage	**EQ 1, 10.4**	2	0	0		0
		10,3	Exhaust Fan in Garage	**EQ 1, 10.4**	1	0	0		0
		10,4	Detached Garage or No Garage	**EQ 1**	3	0	0		0
				Sub-Total for EQ Category:	**21**	0	0		2
Awareness and Education (AE)			(Minimum of 0 AE Points Required)		Max	Y/Pts	Maybe	No	Y/Pts
1. Education of the Homeowner or Tenant	✎	1,1	Basic Operations Training		Prereq				
	✎	1,2	Enhanced Training		1	0	0		1
		1,3	Public Awareness		1	0	0		1
2. Education of Building Manager	✎	2	Education of Building Manager		1	0	0		1
				Sub-Total for AE Category:	**3**	0	0		3

FOX unit #10

HERS 47 - built as-is

LEED for Homes Simplified Project Checklist

Addendum: Prescriptive Approach for Energy and Atmosphere (EA) Credits

Points cannot be earned in both the Prescriptive (below) and the Performance Approach (pg 2) of the EA section.

Energy and Atmosphere (EA) (No Minimum Points Required)				OR	Max Points	Project Points Preliminary			Final
					Max	Y/Pts	Maybe	No	Y/Pts
2. Insulation		2,1	Basic Insulation		Prereq				
		2,2	Enhanced Insulation		2	*0*	*0*		***0***
3. Air Infiltration		3,1	Reduced Envelope Leakage		Prereq				
		3,2	Greatly Reduced Envelope Leakage		2	*0*	*0*		***0***
		3,3	Minimal Envelope Leakage	**EA 3.2**	3	*0*	*0*		***0***
4. Windows		4,1	Good Windows		Prereq				
		4,2	Enhanced Windows		2	*0*	*0*		***0***
		4,3	Exceptional Windows	**EA 4.2**	3	*0*	*0*		***0***
5. Heating and Cooling Distribution System		5,1	Reduced Distribution Losses		Prereq				
		5,2	Greatly Reduced Distribution Losses		2	*0*	*0*		***0***
		5,3	Minimal Distribution Losses	**EA 5.2**	3	*0*	*0*		***0***
6. Space Heating and Cooling Equipment		6,1	Good HVAC Design and Installation		Prereq				
		6,2	High-Efficiency HVAC		2	*0*	*0*		***0***
		6,3	Very High Efficiency HVAC	**EA 6.2**	4	*0*	*0*		***0***
7. Water Heating		7,1	Efficient Hot Water Distribution		2	*0*	*0*		***0***
		7,2	Pipe Insulation		1	*0*	*0*		***0***
		7,3	Efficient Domestic Hot Water Equipment		3	*0*	*0*		***0***
8. Lighting		8,1	ENERGY STAR Lights		Prereq				
		8,2	Improved Lighting		2	*0*	*0*		***0***
		8,3	Advanced Lighting Package	**EA 8.2**	3	*0*	*0*		***0***
9. Appliances		9,1	High-Efficiency Appliances		2	*0*	*0*		***0***
		9,2	Water-Efficient Clothes Washer		1	*0*	*0*		***0***
10. Renewable Energy		10	Renewable Energy System		10	*0*	*0*		***0***
11. Residential Refrigerant Management		11,1	Refrigerant Charge Test		Prereq				
		11,2	Appropriate HVAC Refrigerants		1	*0*	*0*		***0***
				Sub-Total for EA Category:	***38***	*22*	*0*		***22***

FOX unit #10

HERS 100 - built to benchmark

LEED for Homes Simplified Project Checklist

for Homes

Builder Name:	***R+O Construction***
Project Team Leader (if different):	***Roger Durst, Elliott Workgroup Architecture***
Home Address (Street/City/State):	***2061 Park Avenue, Salt Lake City, Utah***

Project Description:

Building type: ***Single detached***
# of bedrooms: ***2***
Project type: ***Multi-family Dev***
Floor area: ***1261***

Adjusted Certification Thresholds

Certified: ***42,5*** Silver: ***57,5*** Gold: ***72,5*** Platinum: ***87,5***

Project Point Total

Prelim: ***0 + 0 maybe pts*** Final: ***40***

Certification Level

Prelim: ***Not Certified*** Final: ***Not Certified***

Final Credit Category Total Points

ID: 6 ***SS: 14*** ***EA: 0*** ***EQ: 2***
LL: 5 ***WE: 3*** ***MR: 7*** ***AE: 3***

Min. Point Thresholds Not Met for Prelim. OR Final Rating

date last updated :
last updated by :

					Max Points	Project Points Preliminary			Final
Innovation and Design Process (ID)			(No Minimum Points Required)		Max	Y/Pts	Maybe	No	Y/Pts
1. Integrated Project Planning		1,1	Preliminary Rating		Prereq				
		1,2	Integrated Project Team		1	0	0		1
		1,3	Professional Credentialed with Respect to LEED for Homes		1	0	0		1
		1,4	Design Charrette		1	0	0		1
		1,5	Building Orientation for Solar Design		1	0	0		0
2. Durability Management Process		2,1	Durability Planning		Prereq				
		2,2	Durability Management		Prereq				
		2,3	Third-Party Durability Management Verification		3	0	0		3
3.Innovative or Regional Design		3,1	Innovation #1 _____		1	0	0		0
		3,2	Innovation #2 _____		1	0	0		0
		3,3	Innovation #3 _____		1	0	0		0
		3,4	Innovation #4		1	0	0		0
				Sub-Total for ID Category:	**11**	0	0		**6**
Location and Linkages (LL)			(No Minimum Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. LEED ND		1	LEED for Neighborhood Development	**LL2-6**	10	0	0		**5**
2. Site Selection		2	Site Selection		2	0	0		0
3. Preferred Locations		3,1	Edge Development	**LL 3.2**	1	0	0		0
		3,2	Infill		2	0	0		0
		3,3	Previously Developed		1	0	0		0
4. Infrastructure		4	Existing Infrastructure		1	0	0		0
5. Community Resources/ Transit		5,1	Basic Community Resources / Transit	**LL 5.2, 5.3**	1	0	0		0
		5,2	Extensive Community Resources / Transit	**LL 5.3**	2	0	0		2
		5,3	Outstanding Community Resources / Transit		3	0	0		0
6. Access to Open Space		6	Access to Open Space		1	0	0		1
				Sub-Total for LL Category:	**10**	0	0		**5**
Sustainable Sites (SS)			(Minimum of 5 SS Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Site Stewardship		1,1	Erosion Controls During Construction		Prereq				
		1,2	Minimize Disturbed Area of Site		1	0	0		1
2. Landscaping		2,1	No Invasive Plants		Prereq				
		2,2	Basic Landscape Design	**SS 2.5**	2	0	0		2
		2,3	Limit Conventional Turf	**SS 2.5**	3	0	0		2
		2,4	Drought Tolerant Plants	**SS 2.5**	2	0	0		2
		2,5	Reduce Overall Irrigation Demand by at Least 20%		6	0	0		6
3. Local Heat Island Effects		3	Reduce Local Heat Island Effects		1	0	0		0
4. Surface Water Management		4,1	Permeable Lot		4	0	0		4
		4,2	Permanent Erosion Controls		1	0	0		1
		4,3	Management of Run-off from Roof		2	0	0		0
5. Nontoxic Pest Control		5	Pest Control Alternatives		2	0	0		0
6. Compact Development		6,1	Moderate Density	**SS 6.2, 6.3**	2	0	0		2
		6,2	High Density	**SS 6.3**	3	0	0		0
		6,3	Very High Density		4	0	0		0
				Sub-Total for SS Category:	**22**	0	0		**14**

FOX unit #10

HERS 100 - built to benchmark

LEED for Homes Simplified Project Checklist (continued)

					Max Points	Project Points Preliminary			Final
Water Efficiency (WE)			(Minimum of 3 WE Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Water Reuse		1,1	Rainwater Harvesting System	**WE 1.3**	4	0	0		0
		1,2	Graywater Reuse System	**WE 1.3**	1	0	0		0
		1,3	Use of Municipal Recycled Water System		3	0	0		0
2. Irrigation System	✎	2,1	High Efficiency Irrigation System	**WE 2.3**	3	0	0		0
		2,2	Third Party Inspection	**WE 2.3**	1	0	0		0
	✎	2,3	Reduce Overall Irrigation Demand by at Least 45%		4	0	0		0
3. Indoor Water Use		3,1	High-Efficiency Fixtures and Fittings		3	0	0		3
		3,2	Very High Efficiency Fixtures and Fittings		6	0	0		0
				Sub-Total for WE Category:	**15**	0	0		3
Energy and Atmosphere (EA)			(Minimum of 0 EA Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Optimize Energy Performance		1,1	Performance of ENERGY STAR for Homes		Prereq				
		1,2	Exceptional Energy Performance		34	0	0		0
7. Water Heating	✎	7,1	Efficient Hot Water Distribution		2	0	0		0
		7,2	Pipe Insulation		1	0	0		0
11. Residential Refrigerant Management		11,1	Refrigerant Charge Test		Prereq				
		11,2	Appropriate HVAC Refrigerants		1	0	0		0
				Sub-Total for EA Category:	**38**	0	0		0
Materials and Resources (MR)			(Minimum of 2 MR Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Material-Efficient Framing		1,1	Framing Order Waste Factor Limit		Prereq				
		1,2	Detailed Framing Documents	**MR 1.5**	1	0	0		1
		1,3	Detailed Cut List and Lumber Order	**MR 1.5**	1	0	0		1
		1,4	Framing Efficiencies	**MR 1.5**	3	0	0		3
		1,5	Off-site Fabrication		4	0	0		2
2. Environmentally Preferable Products	✎	2,1	FSC Certified Tropical Wood		Prereq				
	✎	2,2	Environmentally Preferable Products		8	0	0		0
3. Waste Management		3,1	Construction Waste Management Planning		Prereq				
		3,2	Construction Waste Reduction		3	0	0		2
				Sub-Total for MR Category:	**16**	0	0		7
Indoor Environmental Quality (EQ)			(Minimum of 6 EQ Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. ENERGY STAR with IAP		1	ENERGY STAR with Indoor Air Package		13	0	0		0
2. Combustion Venting		2,1	Basic Combustion Venting Measures	**EQ 1**	Prereq				
		2,2	Enhanced Combustion Venting Measures	**EQ 1**	2	0	0		0
3. Moisture Control		3	Moisture Load Control	**EQ 1**	1	0	0		0
4. Outdoor Air Ventilation	✎	4,1	Basic Outdoor Air Ventilation	**EQ 1**	Prereq				
	✎	4,2	Enhanced Outdoor Air Ventilation		2	0	0		2
		4,3	Third-Party Performance Testing	**EQ 1**	1	0	0		0
5. Local Exhaust	✎	5,1	Basic Local Exhaust	**EQ 1**	Prereq				
		5,2	Enhanced Local Exhaust		1	0	0		0
		5,3	Third-Party Performance Testing		1	0	0		0
6. Distribution of Space Heating and Cooling	✎	6,1	Room-by-Room Load Calculations	**EQ 1**	Prereq				
		6,2	Return Air Flow / Room by Room Controls	**EQ 1**	1	0	0		0
		6,3	Third-Party Performance Test / Multiple Zones	**EQ 1**	2	0	0		0
7. Air Filtering		7,1	Good Filters	**EQ 1**	Prereq				
		7,2	Better Filters	**EQ 7.3**	1	0	0		0
		7,3	Best Filters		2	0	0		0
8. Contaminant Control	✎	8,1	Indoor Contaminant Control during Construction	**EQ 1**	1	0	0		0
		8,2	Indoor Contaminant Control		2	0	0		0
	✎	8,3	Preoccupancy Flush	**EQ 1**	1	0	0		0
9. Radon Protection	✎	9,1	Radon-Resistant Construction in High-Risk Areas	**EQ 1**	Prereq				
	✎	9,2	Radon-Resistant Construction in Moderate-Risk Areas	**EQ 1**	1	0	0		0
10. Garage Pollutant Protection		10,1	No HVAC in Garage	**EQ 1**	Prereq				
		10,2	Minimize Pollutants from Garage	**EQ 1, 10.4**	2	0	0		0
		10,3	Exhaust Fan in Garage	**EQ 1, 10.4**	1	0	0		0
		10,4	Detached Garage or No Garage	**EQ 1**	3	0	0		0
				Sub-Total for EQ Category:	**21**	0	0		2
Awareness and Education (AE)			(Minimum of 0 AE Points Required)		Max	Y/Pts	Maybe	No	Y/Pts
1. Education of the Homeowner or Tenant	✎	1,1	Basic Operations Training		Prereq				
	✎	1,2	Enhanced Training		1	0	0		1
		1,3	Public Awareness		1	0	0		1
2. Education of Building Manager	✎	2	Education of Building Manager		1	0	0		1
				Sub-Total for AE Category:	**3**	0	0		3

FOX unit #10

HERS 100 - built to benchmark

LEED for Homes Simplified Project Checklist

Addendum: Prescriptive Approach for Energy and Atmosphere (EA) Credits

Points cannot be earned in both the Prescriptive (below) and the Performance Approach (pg 2) of the EA section.

Energy and Atmosphere (EA) (No Minimum Points Required)				OR	Max Points Max	Project Points Preliminary Y/Pts	Preliminary Maybe	Preliminary No	Final Y/Pts
2. Insulation		2,1	Basic Insulation		Prereq				
		2,2	Enhanced Insulation		2	*0*	*0*		***0***
3. Air Infiltration		3,1	Reduced Envelope Leakage		Prereq				
		3,2	Greatly Reduced Envelope Leakage		2	*0*	*0*		***0***
		3,3	Minimal Envelope Leakage	**EA 3.2**	3	*0*	*0*		***0***
4. Windows		4,1	Good Windows		Prereq				
		4,2	Enhanced Windows		2	*0*	*0*		***0***
		4,3	Exceptional Windows	**EA 4.2**	3	*0*	*0*		***0***
5. Heating and Cooling Distribution System		5,1	Reduced Distribution Losses		Prereq				
		5,2	Greatly Reduced Distribution Losses		2	*0*	*0*		***0***
		5,3	Minimal Distribution Losses	**EA 5.2**	3	*0*	*0*		***0***
6. Space Heating and Cooling Equipment		6,1	Good HVAC Design and Installation		Prereq				
		6,2	High-Efficiency HVAC		2	*0*	*0*		***0***
		6,3	Very High Efficiency HVAC	**EA 6.2**	4	*0*	*0*		***0***
7. Water Heating		7,1	Efficient Hot Water Distribution		2	*0*	*0*		***0***
		7,2	Pipe Insulation		1	*0*	*0*		***0***
		7,3	Efficient Domestic Hot Water Equipment		3	*0*	*0*		***0***
8. Lighting		8,1	ENERGY STAR Lights		Prereq				
		8,2	Improved Lighting		2	*0*	*0*		***0***
		8,3	Advanced Lighting Package	**EA 8.2**	3	*0*	*0*		***0***
9. Appliances		9,1	High-Efficiency Appliances		2	*0*	*0*		***0***
		9,2	Water-Efficient Clothes Washer		1	*0*	*0*		***0***
10. Renewable Energy		10	Renewable Energy System		10	*0*	*0*		***0***
11. Residential Refrigerant Management		11,1	Refrigerant Charge Test		Prereq				
		11,2	Appropriate HVAC Refrigerants		1	*0*	*0*		***0***
				Sub-Total for EA Category:	***38***	*0*	*0*		***0***

FOX unit #10

HERS 0 - designed to net zero performance

LEED for Homes Simplified Project Checklist

for Homes

Builder Name:	***R+O Construction***
Project Team Leader (if different):	***Roger Durst, Elliott Workgroup Architecture***
Home Address (Street/City/State):	***2061 Park Avenue, Salt Lake City, Utah***

Project Description:

Building type: ***Single detached*** Project type: ***Multi-family Dev***

# of bedrooms: ***2*** Floor area: ***1261***

Adjusted Certification Thresholds

Certified: ***42,5*** Silver: ***57,5*** Gold: ***72,5*** Platinum: ***87,5***

Project Point Total

Prelim: ***34 + 0 maybe pts*** Final: ***81***

Certification Level

Prelim: ***Not Certified*** Final: ***Not Certified***

Final Credit Category Total Points

ID: 8 ***SS: 13*** ***EA: 37*** ***EQ: 3***

LL: 5 ***WE: 3*** ***MR: 9*** ***AE: 3***

Min. Point Thresholds Not Met for Prelim. OR Final Rating

date last updated :

last updated by :

					Max Points	Project Points Preliminary			Final
Innovation and Design Process (ID)			(No Minimum Points Required)		Max	Y/Pts	Maybe	No	Y/Pts
1. Integrated Project Planning		1,1	Preliminary Rating		Prereq				
		1,2	Integrated Project Team		1	0	0		1
		1,3	Professional Credentialed with Respect to LEED for Homes		1	0	0		1
		1,4	Design Charrette		1	0	0		1
		1,5	Building Orientation for Solar Design		1	0	0		1
2. Durability Management Process		2,1	Durability Planning		Prereq				
		2,2	Durability Management		Prereq				
		2,3	Third-Party Durability Management Verification		3	0	0		3
3.Innovative or Regional Design	⊘	3,1	Innovation #1 ***Passive House Design***		1	0	0		1
	⊘	3,2	Innovation #2		1	0	0		0
	⊘	3,3	Innovation #3		1	0	0		0
	⊘	3,4	Innovation #4		1	0	0		0
				Sub-Total for ID Category:	**11**	0	0		**8**
Location and Linkages (LL)			(No Minimum Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. LEED ND		1	LEED for Neighborhood Development	**LL2-6**	10	0	0		**5**
2. Site Selection	⊘	2	Site Selection		2	0	0		0
3. Preferred Locations		3,1	Edge Development	**LL 3.2**	1	0	0		0
		3,2	Infill		2	0	0		1
		3,3	Previously Developed		1	0	0		0
4. Infrastructure		4	Existing Infrastructure		1	0	0		0
5. Community Resources/ Transit		5,1	Basic Community Resources / Transit	**LL 5.2, 5.3**	1	0	0		0
		5,2	Extensive Community Resources / Transit	**LL 5.3**	2	0	0		2
		5,3	Outstanding Community Resources / Transit		3	0	0		0
6. Access to Open Space		6	Access to Open Space		1	0	0		1
				Sub-Total for LL Category:	**10**	0	0		**5**
Sustainable Sites (SS)			(Minimum of 5 SS Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Site Stewardship		1,1	Erosion Controls During Construction		Prereq				
		1,2	Minimize Disturbed Area of Site		1	0	0		1
2. Landscaping	⊘	2,1	No Invasive Plants		Prereq				
	⊘	2,2	Basic Landscape Design	**SS 2.5**	2	0	0		2
	⊘	2,3	Limit Conventional Turf	**SS 2.5**	3	0	0		2
	⊘	2,4	Drought Tolerant Plants	**SS 2.5**	2	0	0		2
	⊘	2,5	Reduce Overall Irrigation Demand by at Least 20%		6	0	0		6
3. Local Heat Island Effects	⊘	3	Reduce Local Heat Island Effects		1	0	0		0
4. Surface Water Management	⊘	4,1	Permeable Lot		4	0	0		4
		4,2	Permanent Erosion Controls		1	0	0		1
	⊘	4,3	Management of Run-off from Roof		2	0	0		0
5. Nontoxic Pest Control		5	Pest Control Alternatives		2	0	0		0
6. Compact Development		6,1	Moderate Density	**SS 6.2, 6.3**	2	0	0		1
		6,2	High Density	**SS 6.3**	3	0	0		0
		6,3	Very High Density		4	0	0		0
				Sub-Total for SS Category:	**22**	0	0		**13**

FOX unit #10

HERS 0 - designed to net zero performance

LEED for Homes Simplified Project Checklist (continued)

					Max Points	Project Points Preliminary			Final
Water Efficiency (WE)			(Minimum of 3 WE Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Water Reuse		1,1	Rainwater Harvesting System	**WE 1.3**	4	0	0		0
		1,2	Graywater Reuse System	**WE 1.3**	1	0	0		0
		1,3	Use of Municipal Recycled Water System		3	0	0		0
2. Irrigation System	✎	2,1	High Efficiency Irrigation System	**WE 2.3**	3	0	0		0
		2,2	Third Party Inspection	**WE 2.3**	1	0	0		0
	✎	2,3	Reduce Overall Irrigation Demand by at Least 45%		4	0	0		0
3. Indoor Water Use		3,1	High-Efficiency Fixtures and Fittings		3	0	0		3
		3,2	Very High Efficiency Fixtures and Fittings		6	0	0		0
				Sub-Total for WE Category:	**15**	0	0		3
Energy and Atmosphere (EA)			(Minimum of 0 EA Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Optimize Energy Performance		1,1	Performance of ENERGY STAR for Homes		Prereq				
		1,2	Exceptional Energy Performance		34	34	0		34
7. Water Heating	✎	7,1	Efficient Hot Water Distribution		2	0	0		2
		7,2	Pipe Insulation		1	0	0		1
11. Residential Refrigerant Management		11,1	Refrigerant Charge Test		Prereq				
		11,2	Appropriate HVAC Refrigerants		1	0	0		0
				Sub-Total for EA Category:	**38**	34	0		37
Materials and Resources (MR)			(Minimum of 2 MR Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Material-Efficient Framing		1,1	Framing Order Waste Factor Limit		Prereq				
		1,2	Detailed Framing Documents	**MR 1.5**	1	0	0		1
		1,3	Detailed Cut List and Lumber Order	**MR 1.5**	1	0	0		1
		1,4	Framing Efficiencies	**MR 1.5**	3	0	0		3
		1,5	Off-site Fabrication		4	0	0		2
2. Environmentally Preferable Products	✎	2,1	FSC Certified Tropical Wood		Prereq				
	✎	2,2	Environmentally Preferable Products		8	0	0		2
3. Waste Management		3,1	Construction Waste Management Planning		Prereq				
		3,2	Construction Waste Reduction		3	0	0		2
				Sub-Total for MR Category:	**16**	0	0		9
Indoor Environmental Quality (EQ)			(Minimum of 6 EQ Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. ENERGY STAR with IAP		1	ENERGY STAR with Indoor Air Package		13	0	0		0
2. Combustion Venting		2,1	Basic Combustion Venting Measures	**EQ 1**	Prereq				
		2,2	Enhanced Combustion Venting Measures	**EQ 1**	2	0	0		0
3. Moisture Control		3	Moisture Load Control	**EQ 1**	1	0	0		1
4. Outdoor Air Ventilation	✎	4,1	Basic Outdoor Air Ventilation	**EQ 1**	Prereq				
	✎	4,2	Enhanced Outdoor Air Ventilation		2	0	0		2
		4,3	Third-Party Performance Testing	**EQ 1**	1	0	0		0
5. Local Exhaust	✎	5,1	Basic Local Exhaust	**EQ 1**	Prereq				
		5,2	Enhanced Local Exhaust		1	0	0		0
		5,3	Third-Party Performance Testing		1	0	0		0
6. Distribution of Space Heating and Cooling	✎	6,1	Room-by-Room Load Calculations	**EQ 1**	Prereq				
		6,2	Return Air Flow / Room by Room Controls	**EQ 1**	1	0	0		0
		6,3	Third-Party Performance Test / Multiple Zones	**EQ 1**	2	0	0		0
7. Air Filtering		7,1	Good Filters	**EQ 1**	Prereq				
		7,2	Better Filters	**EQ 7.3**	1	0	0		0
		7,3	Best Filters		2	0	0		0
8. Contaminant Control	✎	8,1	Indoor Contaminant Control during Construction	**EQ 1**	1	0	0		0
		8,2	Indoor Contaminant Control		2	0	0		0
	✎	8,3	Preoccupancy Flush	**EQ 1**	1	0	0		0
9. Radon Protection	✎	9,1	Radon-Resistant Construction in High-Risk Areas	**EQ 1**	Prereq				
	✎	9,2	Radon-Resistant Construction in Moderate-Risk Areas	**EQ 1**	1	0	0		0
10. Garage Pollutant Protection		10,1	No HVAC in Garage	**EQ 1**	Prereq				
		10,2	Minimize Pollutants from Garage	**EQ 1, 10.4**	2	0	0		0
		10,3	Exhaust Fan in Garage	**EQ 1, 10.4**	1	0	0		0
		10,4	Detached Garage or No Garage	**EQ 1**	3	0	0		0
				Sub-Total for EQ Category:	**21**	0	0		3
Awareness and Education (AE)			(Minimum of 0 AE Points Required)		Max	Y/Pts	Maybe	No	Y/Pts
1. Education of the Homeowner or Tenant	✎	1,1	Basic Operations Training		Prereq				
	✎	1,2	Enhanced Training		1	0	0		1
		1,3	Public Awareness		1	0	0		1
2. Education of Building Manager	✎	2	Education of Building Manager		1	0	0		1
				Sub-Total for AE Category:	**3**	0	0		3

FOX unit #10

HERS 0 - designed to net zero performance

LEED for Homes Simplified Project Checklist

Addendum: Prescriptive Approach for Energy and Atmosphere (EA) Credits

Points cannot be earned in both the Prescriptive (below) and the Performance Approach (pg 2) of the EA section.

Energy and Atmosphere (EA) (No Minimum Points Required)				OR	Max Points	Project Points Preliminary			Final
					Max	Y/Pts	Maybe	No	Y/Pts
2. Insulation		2,1	Basic Insulation		Prereq				
		2,2	Enhanced Insulation		2	*0*	*0*		***0***
3. Air Infiltration		3,1	Reduced Envelope Leakage		Prereq				
		3,2	Greatly Reduced Envelope Leakage		2	*0*	*0*		***0***
		3,3	Minimal Envelope Leakage	**EA 3.2**	3	*0*	*0*		***0***
4. Windows		4,1	Good Windows		Prereq				
		4,2	Enhanced Windows		2	*0*	*0*		***0***
		4,3	Exceptional Windows	**EA 4.2**	3	*0*	*0*		***0***
5. Heating and Cooling Distribution System		5,1	Reduced Distribution Losses		Prereq				
		5,2	Greatly Reduced Distribution Losses		2	*0*	*0*		***0***
		5,3	Minimal Distribution Losses	**EA 5.2**	3	*0*	*0*		***0***
6. Space Heating and Cooling Equipment		6,1	Good HVAC Design and Installation		Prereq				
		6,2	High-Efficiency HVAC		2	*0*	*0*		***0***
		6,3	Very High Efficiency HVAC	**EA 6.2**	4	*0*	*0*		***0***
7. Water Heating		7,1	Efficient Hot Water Distribution		2	*0*	*0*		***0***
		7,2	Pipe Insulation		1	*0*	*0*		***0***
		7,3	Efficient Domestic Hot Water Equipment		3	*0*	*0*		***0***
8. Lighting		8,1	ENERGY STAR Lights		Prereq				
		8,2	Improved Lighting		2	*0*	*0*		***0***
		8,3	Advanced Lighting Package	**EA 8.2**	3	*0*	*0*		***0***
9. Appliances		9,1	High-Efficiency Appliances		2	*0*	*0*		***0***
		9,2	Water-Efficient Clothes Washer		1	*0*	*0*		***0***
10. Renewable Energy		10	Renewable Energy System		10	*0*	*0*		***0***
11. Residential Refrigerant Management		11,1	Refrigerant Charge Test		Prereq				
		11,2	Appropriate HVAC Refrigerants		1	*0*	*0*		***0***
				Sub-Total for EA Category:	***38***	*34*	*0*		***37***

DEER unit #11

HERS 47 - built as-is

LEED for Homes Simplified Project Checklist

for Homes

Builder Name:	***R+O Construction***
Project Team Leader (if different):	***Roger Durst, Elliott Workgroup Architecture***
Home Address (Street/City/State):	***2061 Park Avenue, Salt Lake City, Utah***

Project Description:

Building type: ***Single detached***
# of bedrooms: ***3***
Project type: ***Multi-family Dev***
Floor area: ***1917***

Adjusted Certification Thresholds

Certified: ***45,0***
Silver: ***60,0***
Gold: ***75,0***
Platinum: ***90,0***

Project Point Total

Prelim: ***23,5 + 0 maybe pts***
Final: ***64,5***

Certification Level

Prelim: ***Not Certified***
Final: ***Not Certified***

Final Credit Category Total Points

ID: 6 ***SS: 13*** ***EA: 23,5*** ***EQ: 2***
LL: 5 ***WE: 3*** ***MR: 9*** ***AE: 3***

Min. Point Thresholds Not Met for Prelim. OR Final Rating

date last updated :
last updated by :

					Max Points	Project Points Preliminary			Final
Innovation and Design Process (ID)			(No Minimum Points Required)		Max	Y/Pts	Maybe	No	Y/Pts
1. Integrated Project Planning		1,1	Preliminary Rating		Prereq				
		1,2	Integrated Project Team		1	0	0		1
		1,3	Professional Credentialed with Respect to LEED for Homes		1	0	0		1
		1,4	Design Charrette		1	0	0		1
		1,5	Building Orientation for Solar Design		1	0	0		0
2. Durability Management Process		2,1	Durability Planning		Prereq				
		2,2	Durability Management		Prereq				
		2,3	Third-Party Durability Management Verification		3	0	0		3
3.Innovative or Regional Design		3,1	Innovation #1		1	0	0		0
		3,2	Innovation #2		1	0	0		0
		3,3	Innovation #3		1	0	0		0
		3,4	Innovation #4		1	0	0		0
				Sub-Total for ID Category:	**11**	0	0		6
Location and Linkages (LL)			(No Minimum Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. LEED ND		1	LEED for Neighborhood Development	**LL2-6**	10	0	0		5
2. Site Selection		2	Site Selection		2	0	0		0
3. Preferred Locations		3,1	Edge Development	**LL 3.2**	1	0	0		0
		3,2	Infill		2	0	0		1
		3,3	Previously Developed		1	0	0		0
4. Infrastructure		4	Existing Infrastructure		1	0	0		0
5. Community Resources/ Transit		5,1	Basic Community Resources / Transit	**LL 5.2, 5.3**	1	0	0		0
		5,2	Extensive Community Resources / Transit	**LL 5.3**	2	0	0		2
		5,3	Outstanding Community Resources / Transit		3	0	0		0
6. Access to Open Space		6	Access to Open Space		1	0	0		1
				Sub-Total for LL Category:	**10**	0	0		5
Sustainable Sites (SS)			(Minimum of 5 SS Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Site Stewardship		1,1	Erosion Controls During Construction		Prereq				
		1,2	Minimize Disturbed Area of Site		1	0	0		1
2. Landscaping		2,1	No Invasive Plants		Prereq				
		2,2	Basic Landscape Design	**SS 2.5**	2	0	0		2
		2,3	Limit Conventional Turf	**SS 2.5**	3	0	0		2
		2,4	Drought Tolerant Plants	**SS 2.5**	2	0	0		2
		2,5	Reduce Overall Irrigation Demand by at Least 20%		6	0	0		6
3. Local Heat Island Effects		3	Reduce Local Heat Island Effects		1	0	0		0
4. Surface Water Management		4,1	Permeable Lot		4	0	0		4
		4,2	Permanent Erosion Controls		1	0	0		1
		4,3	Management of Run-off from Roof		2	0	0		0
5. Nontoxic Pest Control		5	Pest Control Alternatives		2	0	0		0
6. Compact Development		6,1	Moderate Density	**SS 6.2, 6.3**	2	0	0		1
		6,2	High Density	**SS 6.3**	3	0	0		0
		6,3	Very High Density		4	0	0		0
				Sub-Total for SS Category:	**22**	0	0		13

DEER unit #11

HERS 47 - built as-is

LEED for Homes Simplified Project Checklist (continued)

					Max Points	Project Points Preliminary			Final
Water Efficiency (WE)			(Minimum of 3 WE Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Water Reuse		1,1	Rainwater Harvesting System	**WE 1.3**	4	0	0		0
		1,2	Graywater Reuse System	**WE 1.3**	1	0	0		0
		1,3	Use of Municipal Recycled Water System		3	0	0		0
2. Irrigation System	✎	2,1	High Efficiency Irrigation System	**WE 2.3**	3	0	0		0
		2,2	Third Party Inspection	**WE 2.3**	1	0	0		0
	✎	2,3	Reduce Overall Irrigation Demand by at Least 45%		4	0	0		0
3. Indoor Water Use		3,1	High-Efficiency Fixtures and Fittings		3	0	0		3
		3,2	Very High Efficiency Fixtures and Fittings		6	0	0		0
				Sub-Total for WE Category:	**15**	0	0		3
Energy and Atmosphere (EA)			(Minimum of 0 EA Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Optimize Energy Performance		1,1	Performance of ENERGY STAR for Homes		Prereq				
		1,2	Exceptional Energy Performance		34	23,5	0		23,5
7. Water Heating	✎	7,1	Efficient Hot Water Distribution		2	0	0		0
		7,2	Pipe Insulation		1	0	0		0
11. Residential Refrigerant Management		11,1	Refrigerant Charge Test		Prereq				
		11,2	Appropriate HVAC Refrigerants		1	0	0		0
				Sub-Total for EA Category:	**38**	23,5	0		23,5
Materials and Resources (MR)			(Minimum of 2 MR Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Material-Efficient Framing		1,1	Framing Order Waste Factor Limit		Prereq				
		1,2	Detailed Framing Documents	**MR 1.5**	1	0	0		1
		1,3	Detailed Cut List and Lumber Order	**MR 1.5**	1	0	0		1
		1,4	Framing Efficiencies	**MR 1.5**	3	0	0		3
		1,5	Off-site Fabrication		4	0	0		2
2. Environmentally Preferable Products	✎	2,1	FSC Certified Tropical Wood		Prereq				
	✎	2,2	Environmentally Preferable Products		8	0	0		2
3. Waste Management		3,1	Construction Waste Management Planning		Prereq				
		3,2	Construction Waste Reduction		3	0	0		2
				Sub-Total for MR Category:	**16**	0	0		9
Indoor Environmental Quality (EQ)			(Minimum of 6 EQ Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. ENERGY STAR with IAP		1	ENERGY STAR with Indoor Air Package		13	0	0		0
2. Combustion Venting		2,1	Basic Combustion Venting Measures	**EQ 1**	Prereq				
		2,2	Enhanced Combustion Venting Measures	**EQ 1**	2	0	0		0
3. Moisture Control		3	Moisture Load Control	**EQ 1**	1	0	0		0
4. Outdoor Air Ventilation	✎	4,1	Basic Outdoor Air Ventilation	**EQ 1**	Prereq				
	✎	4,2	Enhanced Outdoor Air Ventilation		2	0	0		2
		4,3	Third-Party Performance Testing	**EQ 1**	1	0	0		0
5. Local Exhaust	✎	5,1	Basic Local Exhaust	**EQ 1**	Prereq				
		5,2	Enhanced Local Exhaust		1	0	0		0
		5,3	Third-Party Performance Testing		1	0	0		0
6. Distribution of Space Heating and Cooling	✎	6,1	Room-by-Room Load Calculations	**EQ 1**	Prereq				
		6,2	Return Air Flow / Room by Room Controls	**EQ 1**	1	0	0		0
		6,3	Third-Party Performance Test / Multiple Zones	**EQ 1**	2	0	0		0
7. Air Filtering		7,1	Good Filters	**EQ 1**	Prereq				
		7,2	Better Filters	**EQ 7.3**	1	0	0		0
		7,3	Best Filters		2	0	0		0
8. Contaminant Control	✎	8,1	Indoor Contaminant Control during Construction	**EQ 1**	1	0	0		0
		8,2	Indoor Contaminant Control		2	0	0		0
	✎	8,3	Preoccupancy Flush	**EQ 1**	1	0	0		0
9. Radon Protection	✎	9,1	Radon-Resistant Construction in High-Risk Areas	**EQ 1**	Prereq				
	✎	9,2	Radon-Resistant Construction in Moderate-Risk Areas	**EQ 1**	1	0	0		0
10. Garage Pollutant Protection		10,1	No HVAC in Garage	**EQ 1**	Prereq				
		10,2	Minimize Pollutants from Garage	**EQ 1, 10.4**	2	0	0		0
		10,3	Exhaust Fan in Garage	**EQ 1, 10.4**	1	0	0		0
		10,4	Detached Garage or No Garage	**EQ 1**	3	0	0		0
				Sub-Total for EQ Category:	**21**	0	0		2
Awareness and Education (AE)			(Minimum of 0 AE Points Required)		Max	Y/Pts	Maybe	No	Y/Pts
1. Education of the Homeowner or Tenant	✎	1,1	Basic Operations Training		Prereq				
	✎	1,2	Enhanced Training		1	0	0		1
		1,3	Public Awareness		1	0	0		1
2. Education of Building Manager	✎	2	Education of Building Manager		1	0	0		1
				Sub-Total for AE Category:	**3**	0	0		3

DEER unit #11

HERS 47 - built as-is

LEED for Homes Simplified Project Checklist

Addendum: Prescriptive Approach for Energy and Atmosphere (EA) Credits

Points cannot be earned in both the Prescriptive (below) and the Performance Approach (pg 2) of the EA section.

Energy and Atmosphere (EA) (No Minimum Points Required)				OR	Max Points	Project Points Preliminary			Final
					Max	Y/Pts	Maybe	No	Y/Pts
2. Insulation		2,1	Basic Insulation		Prereq				
		2,2	Enhanced Insulation		2	*0*	*0*		***0***
3. Air Infiltration		3,1	Reduced Envelope Leakage		Prereq				
		3,2	Greatly Reduced Envelope Leakage		2	*0*	*0*		***0***
		3,3	Minimal Envelope Leakage	**EA 3.2**	3	*0*	*0*		***0***
4. Windows		4,1	Good Windows		Prereq				
		4,2	Enhanced Windows		2	*0*	*0*		***0***
		4,3	Exceptional Windows	**EA 4.2**	3	*0*	*0*		***0***
5. Heating and Cooling Distribution System		5,1	Reduced Distribution Losses		Prereq				
		5,2	Greatly Reduced Distribution Losses		2	*0*	*0*		***0***
		5,3	Minimal Distribution Losses	**EA 5.2**	3	*0*	*0*		***0***
6. Space Heating and Cooling Equipment		6,1	Good HVAC Design and Installation		Prereq				
		6,2	High-Efficiency HVAC		2	*0*	*0*		***0***
		6,3	Very High Efficiency HVAC	**EA 6.2**	4	*0*	*0*		***0***
7. Water Heating		7,1	Efficient Hot Water Distribution		2	*0*	*0*		***0***
		7,2	Pipe Insulation		1	*0*	*0*		***0***
		7,3	Efficient Domestic Hot Water Equipment		3	*0*	*0*		***0***
8. Lighting		8,1	ENERGY STAR Lights		Prereq				
		8,2	Improved Lighting		2	*0*	*0*		***0***
		8,3	Advanced Lighting Package	**EA 8.2**	3	*0*	*0*		***0***
9. Appliances		9,1	High-Efficiency Appliances		2	*0*	*0*		***0***
		9,2	Water-Efficient Clothes Washer		1	*0*	*0*		***0***
10. Renewable Energy		10	Renewable Energy System		10	*0*	*0*		***0***
11. Residential Refrigerant Management		11,1	Refrigerant Charge Test		Prereq				
		11,2	Appropriate HVAC Refrigerants		1	*0*	*0*		***0***
				Sub-Total for EA Category:	***38***	*23,5*	*0*		***23,5***

DEER unit #11

HERS 100 - built to benchmark

LEED for Homes Simplified Project Checklist

for Homes

Builder Name:	***R+O Construction***
Project Team Leader (if different):	***Roger Durst, Elliott Workgroup Architecture***
Home Address (Street/City/State):	***2061 Park Avenue, Salt Lake City, Utah***

Project Description:

Building type: ***Single detached***
# of bedrooms: ***3***
Project type: ***Multi-family Dev***
Floor area: ***1917***

Adjusted Certification Thresholds

Certified: ***45,0***
Silver: ***60,0***
Gold: ***75,0***
Platinum: ***90,0***

Project Point Total

Prelim: ***0 + 0 maybe pts***
Final: ***40***

Final Credit Category Total Points

ID: 6 ***SS: 14*** ***EA: 0*** ***EQ: 2***
LL: 5 ***WE: 3*** ***MR: 7*** ***AE: 3***

Certification Level

Prelim: ***Not Certified***
Final: ***Not Certified***

Min. Point Thresholds Not Met for Prelim. OR Final Rating

date last updated :
last updated by :

					Max Points	Project Points Preliminary			Final
Innovation and Design Process (ID)			(No Minimum Points Required)		Max	Y/Pts	Maybe	No	Y/Pts
1. Integrated Project Planning		1,1	Preliminary Rating		Prereq				
		1,2	Integrated Project Team		1	0	0		1
		1,3	Professional Credentialed with Respect to LEED for Homes		1	0	0		1
		1,4	Design Charrette		1	0	0		1
		1,5	Building Orientation for Solar Design		1	0	0		0
2. Durability Management Process		2,1	Durability Planning		Prereq				
		2,2	Durability Management		Prereq				
		2,3	Third-Party Durability Management Verification		3	0	0		3
3.Innovative or Regional Design	⊘	3,1	Innovation #1 _____		1	0	0		0
	⊘	3,2	Innovation #2 _____		1	0	0		0
	⊘	3,3	Innovation #3 _____		1	0	0		0
	⊘	3,4	Innovation #4		1	0	0		0
				Sub-Total for ID Category:	**11**	0	0		**6**
Location and Linkages (LL)			(No Minimum Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. LEED ND		1	LEED for Neighborhood Development	**LL2-6**	10	0	0		**5**
2. Site Selection	⊘	2	Site Selection		2	0	0		0
3. Preferred Locations		3,1	Edge Development	**LL 3.2**	1	0	0		0
		3,2	Infill		2	0	0		0
		3,3	Previously Developed		1	0	0		0
4. Infrastructure		4	Existing Infrastructure		1	0	0		0
5. Community Resources/ Transit		5,1	Basic Community Resources / Transit	**LL 5.2, 5.3**	1	0	0		0
		5,2	Extensive Community Resources / Transit	**LL 5.3**	2	0	0		2
		5,3	Outstanding Community Resources / Transit		3	0	0		0
6. Access to Open Space		6	Access to Open Space		1	0	0		1
				Sub-Total for LL Category:	**10**	0	0		**5**
Sustainable Sites (SS)			(Minimum of 5 SS Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Site Stewardship		1,1	Erosion Controls During Construction		Prereq				
		1,2	Minimize Disturbed Area of Site		1	0	0		1
2. Landscaping	⊘	2,1	No Invasive Plants		Prereq				
	⊘	2,2	Basic Landscape Design	**SS 2.5**	2	0	0		2
	⊘	2,3	Limit Conventional Turf	**SS 2.5**	3	0	0		2
	⊘	2,4	Drought Tolerant Plants	**SS 2.5**	2	0	0		2
	⊘	2,5	Reduce Overall Irrigation Demand by at Least 20%		6	0	0		6
3. Local Heat Island Effects	⊘	3	Reduce Local Heat Island Effects		1	0	0		0
4. Surface Water Management	⊘	4,1	Permeable Lot		4	0	0		4
		4,2	Permanent Erosion Controls		1	0	0		1
	⊘	4,3	Management of Run-off from Roof		2	0	0		0
5. Nontoxic Pest Control		5	Pest Control Alternatives		2	0	0		0
6. Compact Development		6,1	Moderate Density	**SS 6.2, 6.3**	2	0	0		2
		6,2	High Density	**SS 6.3**	3	0	0		0
		6,3	Very High Density		4	0	0		0
				Sub-Total for SS Category:	**22**	0	0		**14**

DEER unit #11

HERS 100 - built to benchmark

LEED for Homes Simplified Project Checklist (continued)

					Max Points	Project Points Preliminary			Final
Water Efficiency (WE)			(Minimum of 3 WE Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Water Reuse		1,1	Rainwater Harvesting System	**WE 1.3**	4	0	0		0
		1,2	Graywater Reuse System	**WE 1.3**	1	0	0		0
		1,3	Use of Municipal Recycled Water System		3	0	0		0
2. Irrigation System	✎	2,1	High Efficiency Irrigation System	**WE 2.3**	3	0	0		0
		2,2	Third Party Inspection	**WE 2.3**	1	0	0		0
	✎	2,3	Reduce Overall Irrigation Demand by at Least 45%		4	0	0		0
3. Indoor Water Use		3,1	High-Efficiency Fixtures and Fittings		3	0	0		3
		3,2	Very High Efficiency Fixtures and Fittings		6	0	0		0
				Sub-Total for WE Category:	**15**	0	0		3
Energy and Atmosphere (EA)			(Minimum of 0 EA Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Optimize Energy Performance		1,1	Performance of ENERGY STAR for Homes		Prereq				
		1,2	Exceptional Energy Performance		34	0	0		0
7. Water Heating	✎	7,1	Efficient Hot Water Distribution		2	0	0		0
		7,2	Pipe Insulation		1	0	0		0
11. Residential Refrigerant Management		11,1	Refrigerant Charge Test		Prereq				
		11,2	Appropriate HVAC Refrigerants		1	0	0		0
				Sub-Total for EA Category:	**38**	0	0		0
Materials and Resources (MR)			(Minimum of 2 MR Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Material-Efficient Framing		1,1	Framing Order Waste Factor Limit		Prereq				
		1,2	Detailed Framing Documents	**MR 1.5**	1	0	0		1
		1,3	Detailed Cut List and Lumber Order	**MR 1.5**	1	0	0		1
		1,4	Framing Efficiencies	**MR 1.5**	3	0	0		3
		1,5	Off-site Fabrication		4	0	0		2
2. Environmentally Preferable Products	✎	2,1	FSC Certified Tropical Wood		Prereq				
	✎	2,2	Environmentally Preferable Products		8	0	0		0
3. Waste Management		3,1	Construction Waste Management Planning		Prereq				
		3,2	Construction Waste Reduction		3	0	0		2
				Sub-Total for MR Category:	**16**	0	0		7
Indoor Environmental Quality (EQ)			(Minimum of 6 EQ Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. ENERGY STAR with IAP		1	ENERGY STAR with Indoor Air Package		13	0	0		0
2. Combustion Venting		2,1	Basic Combustion Venting Measures	**EQ 1**	Prereq				
		2,2	Enhanced Combustion Venting Measures	**EQ 1**	2	0	0		0
3. Moisture Control		3	Moisture Load Control	**EQ 1**	1	0	0		0
4. Outdoor Air Ventilation	✎	4,1	Basic Outdoor Air Ventilation	**EQ 1**	Prereq				
	✎	4,2	Enhanced Outdoor Air Ventilation		2	0	0		2
		4,3	Third-Party Performance Testing	**EQ 1**	1	0	0		0
5. Local Exhaust	✎	5,1	Basic Local Exhaust	**EQ 1**	Prereq				
		5,2	Enhanced Local Exhaust		1	0	0		0
		5,3	Third-Party Performance Testing		1	0	0		0
6. Distribution of Space Heating and Cooling	✎	6,1	Room-by-Room Load Calculations	**EQ 1**	Prereq				
		6,2	Return Air Flow / Room by Room Controls	**EQ 1**	1	0	0		0
		6,3	Third-Party Performance Test / Multiple Zones	**EQ 1**	2	0	0		0
7. Air Filtering		7,1	Good Filters	**EQ 1**	Prereq				
		7,2	Better Filters	**EQ 7.3**	1	0	0		0
		7,3	Best Filters		2	0	0		0
8. Contaminant Control	✎	8,1	Indoor Contaminant Control during Construction	**EQ 1**	1	0	0		0
		8,2	Indoor Contaminant Control		2	0	0		0
	✎	8,3	Preoccupancy Flush	**EQ 1**	1	0	0		0
9. Radon Protection	✎	9,1	Radon-Resistant Construction in High-Risk Areas	**EQ 1**	Prereq				
	✎	9,2	Radon-Resistant Construction in Moderate-Risk Areas	**EQ 1**	1	0	0		0
10. Garage Pollutant Protection		10,1	No HVAC in Garage	**EQ 1**	Prereq				
		10,2	Minimize Pollutants from Garage	**EQ 1, 10.4**	2	0	0		0
		10,3	Exhaust Fan in Garage	**EQ 1, 10.4**	1	0	0		0
		10,4	Detached Garage or No Garage	**EQ 1**	3	0	0		0
				Sub-Total for EQ Category:	**21**	0	0		2
Awareness and Education (AE)			(Minimum of 0 AE Points Required)		Max	Y/Pts	Maybe	No	Y/Pts
1. Education of the Homeowner or Tenant	✎	1,1	Basic Operations Training		Prereq				
	✎	1,2	Enhanced Training		1	0	0		1
		1,3	Public Awareness		1	0	0		1
2. Education of Building Manager	✎	2	Education of Building Manager		1	0	0		1
				Sub-Total for AE Category:	**3**	0	0		3

DEER unit #11

HERS 100 - built to benchmark

LEED for Homes Simplified Project Checklist

Addendum: Prescriptive Approach for Energy and Atmosphere (EA) Credits

Points cannot be earned in both the Prescriptive (below) and the Performance Approach (pg 2) of the EA section.

Energy and Atmosphere (EA) (No Minimum Points Required)				OR	Max Points Max	Project Points Preliminary Y/Pts	Preliminary Maybe	Preliminary No	Final Y/Pts
2. Insulation		2,1	Basic Insulation		Prereq				
		2,2	Enhanced Insulation		2	*0*	*0*		***0***
3. Air Infiltration		3,1	Reduced Envelope Leakage		Prereq				
		3,2	Greatly Reduced Envelope Leakage		2	*0*	*0*		***0***
		3,3	Minimal Envelope Leakage	**EA 3.2**	3	*0*	*0*		***0***
4. Windows		4,1	Good Windows		Prereq				
		4,2	Enhanced Windows		2	*0*	*0*		***0***
		4,3	Exceptional Windows	**EA 4.2**	3	*0*	*0*		***0***
5. Heating and Cooling Distribution System		5,1	Reduced Distribution Losses		Prereq				
		5,2	Greatly Reduced Distribution Losses		2	*0*	*0*		***0***
		5,3	Minimal Distribution Losses	**EA 5.2**	3	*0*	*0*		***0***
6. Space Heating and Cooling Equipment		6,1	Good HVAC Design and Installation		Prereq				
		6,2	High-Efficiency HVAC		2	*0*	*0*		***0***
		6,3	Very High Efficiency HVAC	**EA 6.2**	4	*0*	*0*		***0***
7. Water Heating		7,1	Efficient Hot Water Distribution		2	*0*	*0*		***0***
		7,2	Pipe Insulation		1	*0*	*0*		***0***
		7,3	Efficient Domestic Hot Water Equipment		3	*0*	*0*		***0***
8. Lighting		8,1	ENERGY STAR Lights		Prereq				
		8,2	Improved Lighting		2	*0*	*0*		***0***
		8,3	Advanced Lighting Package	**EA 8.2**	3	*0*	*0*		***0***
9. Appliances		9,1	High-Efficiency Appliances		2	*0*	*0*		***0***
		9,2	Water-Efficient Clothes Washer		1	*0*	*0*		***0***
10. Renewable Energy		10	Renewable Energy System		10	*0*	*0*		***0***
11. Residential Refrigerant Management		11,1	Refrigerant Charge Test		Prereq				
		11,2	Appropriate HVAC Refrigerants		1	*0*	*0*		***0***
				Sub-Total for EA Category:	***38***	*0*	*0*		***0***

DEER unit #11

HERS 0 - designed to net zero performance

LEED for Homes Simplified Project Checklist

for Homes

Builder Name:	***R+O Construction***
Project Team Leader (if different):	***Roger Durst, Elliott Workgroup Architecture***
Home Address (Street/City/State):	***2061 Park Avenue, Salt Lake City, Utah***

Project Description:

Building type: ***Single detached*** Project type: ***Multi-family Dev*** Floor area: ***1917*** # of bedrooms: ***3***

Adjusted Certification Thresholds

Certified: ***45,0*** Silver: ***60,0*** Gold: ***75,0*** Platinum: ***90,0***

Project Point Total

Prelim: ***34 + 0 maybe pts*** Final: ***81***

Certification Level

Prelim: ***Not Certified*** Final: ***Not Certified***

Final Credit Category Total Points

ID: 8 ***SS: 13*** ***EA: 37*** ***EQ: 3***

LL: 5 ***WE: 3*** ***MR: 9*** ***AE: 3***

Min. Point Thresholds Not Met for Prelim. OR Final Rating

date last updated :
last updated by :

					Max Points	Project Points Preliminary			Final
Innovation and Design Process (ID)			(No Minimum Points Required)		Max	Y/Pts	Maybe	No	Y/Pts
1. Integrated Project Planning		1,1	Preliminary Rating		Prereq				
		1,2	Integrated Project Team		1	0	0		1
		1,3	Professional Credentialed with Respect to LEED for Homes		1	0	0		1
		1,4	Design Charrette		1	0	0		1
		1,5	Building Orientation for Solar Design		1	0	0		1
2. Durability Management Process		2,1	Durability Planning		Prereq				
		2,2	Durability Management		Prereq				
		2,3	Third-Party Durability Management Verification		3	0	0		3
3.Innovative or Regional Design	⊘	3,1	Innovation #1 ***Passive House Design***		1	0	0		1
	⊘	3,2	Innovation #2		1	0	0		0
	⊘	3,3	Innovation #3		1	0	0		0
	⊘	3,4	Innovation #4		1	0	0		0
				Sub-Total for ID Category:	***11***	0	0		***8***
Location and Linkages (LL)			(No Minimum Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. LEED ND		1	LEED for Neighborhood Development	**LL2-6**	10	0	0		5
2. Site Selection	⊘	2	Site Selection		2	0	0		0
3. Preferred Locations		3,1	Edge Development	**LL 3.2**	1	0	0		0
		3,2	Infill		2	0	0		1
		3,3	Previously Developed		1	0	0		0
4. Infrastructure		4	Existing Infrastructure		1	0	0		0
5. Community Resources/ Transit		5,1	Basic Community Resources / Transit	**LL 5.2, 5.3**	1	0	0		0
		5,2	Extensive Community Resources / Transit	**LL 5.3**	2	0	0		2
		5,3	Outstanding Community Resources / Transit		3	0	0		0
6. Access to Open Space		6	Access to Open Space		1	0	0		1
				Sub-Total for LL Category:	***10***	0	0		***5***
Sustainable Sites (SS)			(Minimum of 5 SS Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Site Stewardship		1,1	Erosion Controls During Construction		Prereq				
		1,2	Minimize Disturbed Area of Site		1	0	0		1
2. Landscaping	⊘	2,1	No Invasive Plants		Prereq				
	⊘	2,2	Basic Landscape Design	**SS 2.5**	2	0	0		2
	⊘	2,3	Limit Conventional Turf	**SS 2.5**	3	0	0		2
	⊘	2,4	Drought Tolerant Plants	**SS 2.5**	2	0	0		2
	⊘	2,5	Reduce Overall Irrigation Demand by at Least 20%		6	0	0		6
3. Local Heat Island Effects	⊘	3	Reduce Local Heat Island Effects		1	0	0		0
4. Surface Water Management	⊘	4,1	Permeable Lot		4	0	0		4
		4,2	Permanent Erosion Controls		1	0	0		1
	⊘	4,3	Management of Run-off from Roof		2	0	0		0
5. Nontoxic Pest Control		5	Pest Control Alternatives		2	0	0		0
6. Compact Development		6,1	Moderate Density	**SS 6.2, 6.3**	2	0	0		1
		6,2	High Density	**SS 6.3**	3	0	0		0
		6,3	Very High Density		4	0	0		0
				Sub-Total for SS Category:	***22***	0	0		***13***

DEER unit #11

HERS 0 - designed to net zero performance

LEED for Homes Simplified Project Checklist (continued)

					Max Points	Project Points Preliminary			Final
Water Efficiency (WE)			(Minimum of 3 WE Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Water Reuse		1,1	Rainwater Harvesting System	**WE 1.3**	4	0	0		0
		1,2	Graywater Reuse System	**WE 1.3**	1	0	0		0
		1,3	Use of Municipal Recycled Water System		3	0	0		0
2. Irrigation System	✎	2,1	High Efficiency Irrigation System	**WE 2.3**	3	0	0		0
		2,2	Third Party Inspection	**WE 2.3**	1	0	0		0
	✎	2,3	Reduce Overall Irrigation Demand by at Least 45%		4	0	0		0
3. Indoor Water Use		3,1	High-Efficiency Fixtures and Fittings		3	0	0		3
		3,2	Very High Efficiency Fixtures and Fittings		6	0	0		0
				Sub-Total for WE Category:	**15**	0	0		3
Energy and Atmosphere (EA)			(Minimum of 0 EA Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Optimize Energy Performance		1,1	Performance of ENERGY STAR for Homes		Prereq				
		1,2	Exceptional Energy Performance		34	34	0		34
7. Water Heating	✎	7,1	Efficient Hot Water Distribution		2	0	0		2
		7,2	Pipe Insulation		1	0	0		1
11. Residential Refrigerant Management		11,1	Refrigerant Charge Test		Prereq				
		11,2	Appropriate HVAC Refrigerants		1	0	0		0
				Sub-Total for EA Category:	**38**	34	0		37
Materials and Resources (MR)			(Minimum of 2 MR Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. Material-Efficient Framing		1,1	Framing Order Waste Factor Limit		Prereq				
		1,2	Detailed Framing Documents	**MR 1.5**	1	0	0		1
		1,3	Detailed Cut List and Lumber Order	**MR 1.5**	1	0	0		1
		1,4	Framing Efficiencies	**MR 1.5**	3	0	0		3
		1,5	Off-site Fabrication		4	0	0		2
2. Environmentally Preferable Products	✎	2,1	FSC Certified Tropical Wood		Prereq				
	✎	2,2	Environmentally Preferable Products		8	0	0		2
3. Waste Management		3,1	Construction Waste Management Planning		Prereq				
		3,2	Construction Waste Reduction		3	0	0		2
				Sub-Total for MR Category:	**16**	0	0		9
Indoor Environmental Quality (EQ)			(Minimum of 6 EQ Points Required)	*OR*	Max	Y/Pts	Maybe	No	Y/Pts
1. ENERGY STAR with IAP		1	ENERGY STAR with Indoor Air Package		13	0	0		0
2. Combustion Venting		2,1	Basic Combustion Venting Measures	**EQ 1**	Prereq				
		2,2	Enhanced Combustion Venting Measures	**EQ 1**	2	0	0		0
3. Moisture Control		3	Moisture Load Control	**EQ 1**	1	0	0		1
4. Outdoor Air Ventilation	✎	4,1	Basic Outdoor Air Ventilation	**EQ 1**	Prereq				
	✎	4,2	Enhanced Outdoor Air Ventilation		2	0	0		2
		4,3	Third-Party Performance Testing	**EQ 1**	1	0	0		0
5. Local Exhaust	✎	5,1	Basic Local Exhaust	**EQ 1**	Prereq				
		5,2	Enhanced Local Exhaust		1	0	0		0
		5,3	Third-Party Performance Testing		1	0	0		0
6. Distribution of Space Heating and Cooling	✎	6,1	Room-by-Room Load Calculations	**EQ 1**	Prereq				
		6,2	Return Air Flow / Room by Room Controls	**EQ 1**	1	0	0		0
		6,3	Third-Party Performance Test / Multiple Zones	**EQ 1**	2	0	0		0
7. Air Filtering		7,1	Good Filters	**EQ 1**	Prereq				
		7,2	Better Filters	**EQ 7.3**	1	0	0		0
		7,3	Best Filters		2	0	0		0
8. Contaminant Control	✎	8,1	Indoor Contaminant Control during Construction	**EQ 1**	1	0	0		0
		8,2	Indoor Contaminant Control		2	0	0		0
	✎	8,3	Preoccupancy Flush	**EQ 1**	1	0	0		0
9. Radon Protection	✎	9,1	Radon-Resistant Construction in High-Risk Areas	**EQ 1**	Prereq				
	✎	9,2	Radon-Resistant Construction in Moderate-Risk Areas	**EQ 1**	1	0	0		0
10. Garage Pollutant Protection		10,1	No HVAC in Garage	**EQ 1**	Prereq				
		10,2	Minimize Pollutants from Garage	**EQ 1, 10.4**	2	0	0		0
		10,3	Exhaust Fan in Garage	**EQ 1, 10.4**	1	0	0		0
		10,4	Detached Garage or No Garage	**EQ 1**	3	0	0		0
				Sub-Total for EQ Category:	**21**	0	0		3
Awareness and Education (AE)			(Minimum of 0 AE Points Required)		Max	Y/Pts	Maybe	No	Y/Pts
1. Education of the Homeowner or Tenant	✎	1,1	Basic Operations Training		Prereq				
	✎	1,2	Enhanced Training		1	0	0		1
		1,3	Public Awareness		1	0	0		1
2. Education of Building Manager	✎	2	Education of Building Manager		1	0	0		1
				Sub-Total for AE Category:	**3**	0	0		3

DEER unit #11

HERS 0 - designed to net zero performance

LEED for Homes Simplified Project Checklist

Addendum: Prescriptive Approach for Energy and Atmosphere (EA) Credits

Points cannot be earned in both the Prescriptive (below) and the Performance Approach (pg 2) of the EA section.

Energy and Atmosphere (EA) (No Minimum Points Required)				OR	Max Points	Project Points Preliminary			Final
					Max	Y/Pts	Maybe	No	Y/Pts
2. Insulation		2,1	Basic Insulation		Prereq				
		2,2	Enhanced Insulation		2	*0*	*0*		***0***
3. Air Infiltration		3,1	Reduced Envelope Leakage		Prereq				
		3,2	Greatly Reduced Envelope Leakage		2	*0*	*0*		***0***
		3,3	Minimal Envelope Leakage	**EA 3.2**	3	*0*	*0*		***0***
4. Windows		4,1	Good Windows		Prereq				
		4,2	Enhanced Windows		2	*0*	*0*		***0***
		4,3	Exceptional Windows	**EA 4.2**	3	*0*	*0*		***0***
5. Heating and Cooling Distribution System		5,1	Reduced Distribution Losses		Prereq				
		5,2	Greatly Reduced Distribution Losses		2	*0*	*0*		***0***
		5,3	Minimal Distribution Losses	**EA 5.2**	3	*0*	*0*		***0***
6. Space Heating and Cooling Equipment		6,1	Good HVAC Design and Installation		Prereq				
		6,2	High-Efficiency HVAC		2	*0*	*0*		***0***
		6,3	Very High Efficiency HVAC	**EA 6.2**	4	*0*	*0*		***0***
7. Water Heating		7,1	Efficient Hot Water Distribution		2	*0*	*0*		***0***
		7,2	Pipe Insulation		1	*0*	*0*		***0***
		7,3	Efficient Domestic Hot Water Equipment		3	*0*	*0*		***0***
8. Lighting		8,1	ENERGY STAR Lights		Prereq				
		8,2	Improved Lighting		2	*0*	*0*		***0***
		8,3	Advanced Lighting Package	**EA 8.2**	3	*0*	*0*		***0***
9. Appliances		9,1	High-Efficiency Appliances		2	*0*	*0*		***0***
		9,2	Water-Efficient Clothes Washer		1	*0*	*0*		***0***
10. Renewable Energy		10	Renewable Energy System		10	*0*	*0*		***0***
11. Residential Refrigerant Management		11,1	Refrigerant Charge Test		Prereq				
		11,2	Appropriate HVAC Refrigerants		1	*0*	*0*		***0***
				Sub-Total for EA Category:	***38***	*34*	*0*		***37***

Addendum D

PHPP Passive House Planning Package Performance Ratings for Snow Creek DEER Unit 11, built-as-is, with different component and performance modifications

April 30, 2011

Authors:

Integrated Technology in Architecture Center
University of Utah

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DEER unit #11

PHPP - built as-is

Passive House Verification

Photo or Drawing

Building:	Deer Unit #10 Snow Creek Cottage					
Location and Climate:	PARK CITY, UT		Salt Lake City UT*			
Street Address:	598 SNOW CREEK COURT					
City, State, Zip:	PARK CITY, UT 84068					
Country:	USA					
Building Type:	Single Family Residence					
Home Owner(s) / Client(s):	Mac + Bridgitte Macaalay / PARK CITY					
Street Address:	598 SNOW CREEK COURT					
City, State, Zip:	PARK CITY, UT 84068					
Architect:	ELLIOTT WORKGROUP					
Street:	440 MAIN ST PO BOX 3419					
City, State, Zip:	PARK CITY, UT 84060					
Mechanical System:						
Street Address:						
City, State, Zip:						
Year of Construction:	2010					
Number of Dwelling Units:	1		Interior Temperature:	68,0	°F	
Gross Enclosed Volume V_e:	13773	ft^3	Internal Heat Gains:	0,7	BTU/hr.ft^2	
Number of Occupants:	3,8					

Energy Demands with Reference to the Treated Floor Area

Treated Floor Area: 1424 ft^2

	Applied:	Monthly Method		PH Certificate:	Fulfilled?
Specific Space Heat Demand:	**49,24**	**kBTU/(ft^2yr)**	**4,75**	**kBTU/(ft^2yr)**	**No**
Pressurization Test Result:	**2,89**	**ACH_{50}**	0,6	ACH_{50}	**No**
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		**kBTU/(ft^2yr)**	38,0	kBTU/(ft^2yr)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		**kBTU/(ft^2yr)**			
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	**92,7**	**kBTU/(ft^2yr)**			
Heating Load:	**17,12**	**BTU/(ft^2hr)**			
Frequency of Overheating:		**%**	over 32,0	°F	
Specific Useful Cooling Energy Demand:		**kBTU/(ft^2yr)**	4,75	kBTU/(ft^2yr)	
Cooling Load:	**11,59**	**BTU/(ft^2hr)**			

We confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The calculations with PHPP are attached to this application.

Issued on:

signed:

DEER unit #11

PHPP - Single Modification 01: 12” SIPs in all walls

Passive House Verification

Photo or Drawing

Building:	Deer Unit #10 Snow Creek Cottage					
Location and Climate:	PARK CITY, UT	Salt Lake City UT*				
Street Address:	598 SNOW CREEK COURT					
City, State, Zip:	PARK CITY, UT 84068					
Country:	USA					
Building Type:	Single Family Residence					
Home Owner(s) / Client(s):	Mac + Bridgitte Macaalay / PARK CITY					
Street Address:	598 SNOW CREEK COURT					
City, State, Zip:	PARK CITY, UT 84068					
Architect:	ELLIOTT WORKGROUP					
Street:	440 MAIN ST PO BOX 3419					
City, State, Zip:	PARK CITY, UT 84060					
Mechanical System:						
Street Address:						
City, State, Zip:						
Year of Construction:	2010					
Number of Dwelling Units:	1		Interior Temperature:	68,0	°F	
Gross Enclosed Volume V_e:	13773	ft^3	Internal Heat Gains:	0,7	BTU/hr.ft^2	
Number of Occupants:	3,8					

Energy Demands with Reference to the Treated Floor Area

Treated Floor Area: 1424 ft^2

	Applied:	Monthly Method		PH Certificate:	Fulfilled?
Specific Space Heat Demand:	**43,58**	**kBTU/(ft^2yr)**	**4,75**	**kBTU/(ft^2yr)**	**No**
Pressurization Test Result:	**2,89**	**ACH_{50}**	0,6	ACH_{50}	**No**
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		**kBTU/(ft^2yr)**	38,0	kBTU/(ft^2yr)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		**kBTU/(ft^2yr)**			
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	**92,7**	**kBTU/(ft^2yr)**			
Heating Load:	**15,39**	**BTU/(ft^2hr)**			
Frequency of Overheating:		**%**	over 32,0	°F	
Specific Useful Cooling Energy Demand:		**kBTU/(ft^2yr)**	4,75	kBTU/(ft^2yr)	
Cooling Load:	**10,25**	**BTU/(ft^2hr)**			

We confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The calculations with PHPP are attached to this application.

Issued on:

signed:

DEER unit #11

PHPP - Single Modification 02: High Performance Glazing
(U-values: Glazing from 0.09 - 0.15, frames 0.29)

Passive House Verification

Photo or Drawing

Building:	Deer Unit #10 Snow Creek Cottage					
Location and Climate:	PARK CITY, UT	Salt Lake City UT*				
Street Address:	598 SNOW CREEK COURT					
City, State, Zip:	PARK CITY, UT 84068					
Country:	USA					
Building Type:	Single Family Residence					
Home Owner(s) / Client(s):	Mac + Bridgitte Macaalay / PARK CITY					
Street Address:	598 SNOW CREEK COURT					
City, State, Zip:	PARK CITY, UT 84068					
Architect:	ELLIOTT WORKGROUP					
Street:	440 MAIN ST PO BOX 3419					
City, State, Zip:	PARK CITY, UT 84060					
Mechanical System:						
Street Address:						
City, State, Zip:						

Year of Construction:	2010				
Number of Dwelling Units:	1		Interior Temperature:	68,0	°F
Gross Enclosed Volume V_e:	13773	ft^3	Internal Heat Gains:	0,7	BTU/hr.ft²
Number of Occupants:	3,8				

Energy Demands with Reference to the Treated Floor Area

Treated Floor Area: 1424 ft^2

	Applied:	Monthly Method			PH Certificate:	Fulfilled?
Specific Space Heat Demand:	**42,06**	**kBTU/(ft²yr)**		4,75	**kBTU/(ft²yr)**	**No**
Pressurization Test Result:	**2,89**	**ACH_{50}**		0,6	ACH_{50}	**No**
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		**kBTU/(ft²yr)**		38,0	kBTU/(ft²yr)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		**kBTU/(ft²yr)**				
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	**92,7**	**kBTU/(ft²yr)**				
Heating Load:	**14,93**	**BTU/(ft²hr)**				
Frequency of Overheating:		**%**	over	32,0	°F	
Specific Useful Cooling Energy Demand:		**kBTU/(ft²yr)**		4,75	kBTU/(ft²yr)	
Cooling Load:	**9,87**	**BTU/(ft²hr)**				

We confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The calculations with PHPP are attached to this application.

Issued on:

signed:

DEER unit #11

PHPP - Single Modification 03: ACH50 to Passive House Standard (0.60)

Passive House Verification

Photo or Drawing

Building:	Deer Unit #10 Snow Creek Cottage					
Location and Climate:	PARK CITY, UT	Salt Lake City UT*				
Street Address:	598 SNOW CREEK COURT					
City, State, Zip:	PARK CITY, UT 84068					
Country:	USA					
Building Type:	Single Family Residence					
Home Owner(s) / Client(s):	Mac + Bridgitte Macaalay / PARK CITY					
Street Address:	598 SNOW CREEK COURT					
City, State, Zip:	PARK CITY, UT 84068					
Architect:	ELLIOTT WORKGROUP					
Street:	440 MAIN ST PO BOX 3419					
City, State, Zip:	PARK CITY, UT 84060					
Mechanical System:						
Street Address:						
City, State, Zip:						

Year of Construction:	2010				
Number of Dwelling Units:	1		Interior Temperature:	68,0	°F
Gross Enclosed Volume V_e:	13773	ft³	Internal Heat Gains:	0,7	BTU/hr.ft²
Number of Occupants:	3,8				

Energy Demands with Reference to the Treated Floor Area

Treated Floor Area: 1424 ft²

	Applied:	Monthly Method		PH Certificate:	Fulfilled?
Specific Space Heat Demand:	**45,31**	**kBTU/(ft²yr)**	**4,75**	**kBTU/(ft²yr)**	**No**
Pressurization Test Result:	**0,60**	**ACH_{50}**	0,6	ACH_{50}	**Yes**
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		**kBTU/(ft²yr)**	38,0	kBTU/(ft²yr)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		**kBTU/(ft²yr)**			
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	**92,7**	**kBTU/(ft²yr)**			
Heating Load:	**14,12**	**BTU/(ft²hr)**			
Frequency of Overheating:		**%**	over 32,0	°F	
Specific Useful Cooling Energy Demand:		**kBTU/(ft²yr)**	4,75	kBTU/(ft²yr)	
Cooling Load:	**10,65**	**BTU/(ft²hr)**			

We confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The calculations with PHPP are attached to this application.

Issued on:

signed:

DEER unit #11

PHPP - Modification 04: All measures above applied

Passive House Verification

Photo or Drawing

Building:	Deer Unit #10 Snow Creek Cottage					
Location and Climate:	PARK CITY, UT	Salt Lake City UT*				
Street Address:	598 SNOW CREEK COURT					
City, State, Zip:	PARK CITY, UT 84068					
Country:	USA					
Building Type:	Single Family Residence					
Home Owner(s) / Client(s):	Mac + Bridgitte Macaalay / PARK CITY					
Street Address:	598 SNOW CREEK COURT					
City, State, Zip:	PARK CITY, UT 84068					
Architect:	ELLIOTT WORKGROUP					
Street:	440 MAIN ST PO BOX 3419					
City, State, Zip:	PARK CITY, UT 84060					
Mechanical System:						
Street Address:						
City, State, Zip:						

Year of Construction:	2010				
Number of Dwelling Units:	1		Interior Temperature:	68,0	°F
Gross Enclosed Volume V_e:	13773	ft^3	Internal Heat Gains:	0,7	BTU/hr.ft²
Number of Occupants:	3,8				

Energy Demands with Reference to the Treated Floor Area

Treated Floor Area: 1424 ft^2

	Applied:	Monthly Method		PH Certificate:	Fulfilled?
Specific Space Heat Demand:	**20,47**	**kBTU/(ft²yr)**	4,75	**kBTU/(ft²yr)**	**No**
Pressurization Test Result:	**0,60**	**ACH_{50}**	0,6	ACH_{50}	**Yes**
Specific Primary Energy Demand (DHW, Heating, Cooling, Auxiliary and Household Electricity):		**kBTU/(ft²yr)**	38,0	kBTU/(ft²yr)	
Specific Primary Energy Demand (DHW, Heating and Auxiliary Electricity):		**kBTU/(ft²yr)**			
Specific Primary Energy Demand Energy Conservation by Solar Electricity:	**92,7**	**kBTU/(ft²yr)**			
Heating Load:	**7,21**	**BTU/(ft²hr)**			
Frequency of Overheating:		**%**	over 32,0	°F	
Specific Useful Cooling Energy Demand:		**kBTU/(ft²yr)**	4,75	kBTU/(ft²yr)	
Cooling Load:	**6,38**	**BTU/(ft²hr)**			

We confirm that the values given herein have been determined following the PHPP methodology and based on the characteristic values of the building. The calculations with PHPP are attached to this application.

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signed:

Addendum E

Cost Analysis of Snow Creek FOX Unit 10 and DEER Unit 11 as-built versus Building America Benchmark Definition Simulated Standard Structures

April 30, 2011

Authors:

Integrated Technology in Architecture Center
University of Utah

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Co-PI: Ryan Smith
Director I-TAC, Associate Professor
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RESIDENTIAL | Custom | 1-1/2 Story

- A distinct residence from designer's plans
- Single family — 1 full bath, 1 half bath, 1 kitchen
- No basement
- Asphalt shingles on roof
- Forced hot air heat/air conditioning
- Gypsum wallboard interior finishes
- Materials and workmanship are above average

Note: The illustration shown may contain some optional components (for example: garages and/or fireplaces) whose costs are shown in the modifications, adjustments, & alternatives below or at the end of the square foot section.

1,305 SF → Difference of $7.15 / 2 = $3.58

131.35 + 3.58 = $134.93 / SF

Base cost per square foot of living area

Exterior Wall	Living Area 1000	1200	1400	1600	1800	2000	2400	2800	3200	3600	4000
Wood Siding - Wood Frame	148.70	138.50	131.35	122.50	117.55	112.60	103.25	99.00	95.10	92.10	87.75
Brick Veneer - Wood Frame	157.90	147.20	139.60	130.00	124.65	119.35	109.20	104.65	100.35	97.10	92.45
Stone Veneer - Wood Frame	161.00	150.05	142.30	132.45	127.00	121.55	111.20	106.50	102.05	98.80	94.00
Solid Masonry	166.90	155.60	147.55	137.30	131.55	125.90	114.95	110.10	105.35	102.00	96.95
Finished Basement, Add	33.80	34.10	33.20	31.85	31.10	30.40	29.10	28.50	27.80	27.40	26.80
Unfinished Basement, Add	14.35	13.75	13.25	12.60	12.25	11.85	11.15	10.85	10.50	10.30	9.95

Modifications

Add to the total cost

Upgrade Kitchen Cabinets	$ + 1102
Solid Surface Countertops (Included)	
Full Bath - including plumbing, wall and floor finishes	+ 6543
Half Bath - including plumbing, wall and floor finishes	+ 4048
Two Car Attached Garage	+ 24,917
Two Car Detached Garage	+ 28,578
Fireplace & Chimney	+ 5465

Adjustments

For multi family - add to total cost

Additional Kitchen	$ + 14,107
Additional Full Bath & Half Bath	+ 10,591
Additional Entry & Exit	+ 1622
Separate Heating & Air Conditioning	+ 6091
Separate Electric	+ 1870

For Townhouse/Rowhouse - Multiply cost per square foot by

Inner Unit	+ .90
End Unit	+ .95

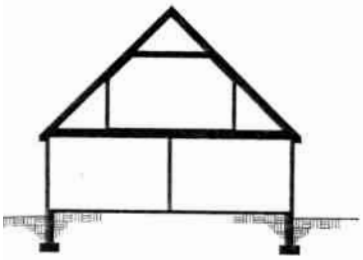
Alternatives

Add to or deduct from the cost per square foot of living area

Cedar Shake Roof	+ 2.
Clay Tile Roof	+ 3.
Slate Roof	+ 4.
Upgrade Ceilings to Textured Finish	+ .
Air Conditioning, in Heating Ductwork	Base Syste
Heating Systems, Hot Water	+ 1.
Heat Pump	+ 2.
Electric Heat	– 2.
Not Heated	– 3.

Additional upgrades or components

Kitchen Cabinets & Countertops	Page
Bathroom Vanities	
Fireplaces & Chimneys	
Windows, Skylights & Dormers	
Appliances	
Breezeways & Porches	
Finished Attic	
Garages	
Site Improvements	
Wings & Ells	

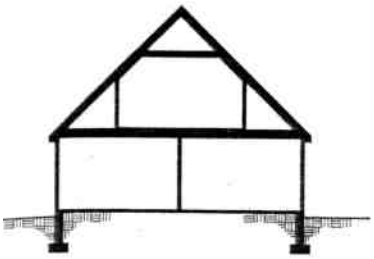


Custom 1-1/2 Story

Living Area - 2800 S.F.
Perimeter - 175 L.F.

		Labor-Hours	Cost Per Square Foot Of Living Area		
			Mat.	Labor	Tot
1 Site Work	Site preparation for slab; 4' deep trench excavation for foundation wall.	.028		.56	.56
2 Foundation	Continuous reinforced concrete footing 8" deep x 18" wide; dampproofed and insulated reinforced concrete foundation wall, 8" thick, 4' deep; 4" concrete slab on 4" crushed stone base and polyethylene vapor barrier, trowel finish.	.065	4.14	4.61	8.75
3 Framing	Exterior walls - 2" x 6" wood studs, 16" O.C.; 1/2" plywood sheathing; 2" x 8" rafters 16" O.C. with 1/2" plywood sheathing, 8 in 12 pitch; 2" x 10" floor joists 16" O.C. with 5/8" plywood subfloor; 5/8" plywood subfloor on 1" x 3" wood sleepers 16" O.C.	.192	4.55	6.35	10.89
4 Exterior Walls	Horizontal beveled wood siding; building paper; 6" batt insulation; wood double hung windows; 3 solid core wood exterior doors; storms and screens. **Estimated lower value: Hardiboard, Vinyl Windows**	.064	9.79	3.12	12.91 **-2.00** *
5 Roofing	30 year asphalt shingles; #15 felt building paper; aluminum gutters, downspouts and drip edge; copper flashings. **Estimated higher value: partial Aluminum Roofing**	.048	3.43	1.97	5.39 **+1.00** *
6 Interiors	Walls and ceilings - 5/8" gypsum wallboard, skim coat plaster, painted with primer and 2 coats; hardwood baseboard and trim, sanded and finished; hardwood floor 70%, ceramic tile with underlayment 20%, vinyl tile with underlayment 10%; wood panel interior doors, primed and painted with 2 coats. **Lower value based on avergae construction (see page 13)**	.259	15.68	12.43	~~28.13~~ **26.84** **-1.29** *
7 Specialties	Custom grade kitchen cabinets - 20 L.F. wall and base with solid surface counter top and kitchen sink; 4 L.F. bathroom vanity; 75 gallon electric water heater, medicine cabinet. **Average quality kitchen and bathroom vanities**	.030	4.37	.96	5.34 **-1.00** *
8 Mechanical	Gas fired warm air heat/air conditioning; one full bath including: bathtub, corner shower, built in lavatory and water closet; one 1/2 bath including: built in lavatory and water closet.	.084	5.13	2.68	7.81
9 Electrical	200 Amp. service; romex wiring; fluorescent and incandescent lighting fixtures, switches, receptacles.	.038	1.22	1.52	2.74
10 Overhead	Contractor's overhead and profit and design.		9.64	6.85	16.48
		Total	57.95	41.05	**99.00**

*** Reflected in Cost Estimate Sheet**



Average 1-1/2 Story

Living Area - 1800 S.F.
Perimeter - 144 L.F.

		Labor-Hours	Cost Per Square Foot Of Living Area		
			Mat.	Labor	Tot
1 Site Work	Site preparation for slab; 4' deep trench excavation for foundation wall.	.037		.73	.73
2 Foundation	Continuous reinforced concrete footing 8" deep x 18" wide; dampproofed and insulated reinforced concrete foundation wall, 8" thick, 4' deep; 4" concrete slab on 4" crushed stone base and polyethylene vapor barrier, trowel finish.	.073	3.75	4.29	8.04
3 Framing	Exterior walls - 2" x 4" wood studs, 16" O.C.; 1/2" plywood sheathing; 2" x 6" rafters 16" O.C. with 1/2" plywood sheathing, 8 in 12 pitch; 2" x 8" floor joists 16" O.C. with 5/8" plywood subfloor; 1/2" plywood subfloor on 1" x 2" wood sleepers 16" O.C.	.098	5.56	7.74	13.31
4 Exterior Walls	Beveled wood siding and building paper on insulated wood frame walls; 6" attic insulation; double hung windows; 3 flush solid core wood exterior doors with storms.	.078	10.97	4.72	15.70
5 Roofing	25 year asphalt shingles; #15 felt building paper; aluminum gutters, downspouts, drip edge and flashings.	.029	.97	1.36	2.32
6 Interiors	Walls and ceilings, 1/2" taped and finished gypsum wallboard, primed and painted with 2 coats; painted baseboard and trim, finished hardwood floor 40%, carpet with 1/2" underlayment 40%, vinyl tile with 1/2" underlayment 15%, ceramic tile with 1/2" underlayment 5%; hollow core and louvered doors.	.225	13.81	13.02	26.84
7 Specialties	Average grade kitchen cabinets - 14 L.F. wall and base with solid surface counter top and kitchen sink; 40 gallon electric water heater.	.022	2.28	.88	3.16
8 Mechanical	1 lavatory, white, wall hung; 1 water closet, white; 1 bathtub with shower, enameled steel, white; gas fired warm air heat.	.049	3.17	2.68	5.87
9 Electrical	200 Amp. service; romex wiring; incandescent lighting fixtures, switches, receptacles.	.039	1.26	1.55	2.81
10 Overhead	Contractor's overhead and profit and plans.		7.08	6.28	13.32
		Total	48.85	43.25	**92.10**

RESIDENTIAL | Custom | 2-1/2 Story

- A distinct residence from designer's plans
- Single family – 1 full bath, 1 half bath, 1 kitchen
- No basement
- Asphalt shingles on roof
- Forced hot air heat/air conditioning
- Gypsum wallboard interior finishes
- Materials and workmanship are above average

Note: The illustration shown may contain some optional components (for example: garages and/or fireplaces) whose costs are shown in the modifications, adjustments, & alternatives below or at the end of the square foot section.

1,932 SF → Difference of $7.85 / 2 = $3.92

115.55 + 3.92 = $119.47 / SF

Base cost per square foot of living area

Exterior Wall	Living Area 1500	1800	2100	2400	2800	3200	3600	4000	4500	5000	5500
Wood Siding - Wood Frame	136.90	123.40	115.55	110.75	104.65	98.80	95.55	90.40	87.70	85.30	82.85
Brick Veneer - Wood Frame	147.10	132.85	124.00	118.85	112.30	105.75	102.10	96.50	93.50	90.85	88.10
Stone Veneer - Wood Frame	150.50	135.95	126.80	121.40	114.80	108.05	104.30	98.50	95.40	92.60	89.85
Solid Masonry	157.10	142.00	132.20	126.60	119.70	112.50	108.50	102.45	99.15	96.20	93.20
Finished Basement, Add	21.55	21.55	20.45	19.95	19.50	18.70	18.30	17.85	17.50	17.20	16.95
Unfinished Basement, Add	9.25	8.75	8.20	7.90	7.70	7.30	7.10	6.85	6.65	6.50	6.35

Modifications

Add to the total cost

Upgrade Kitchen Cabinets	$ + 1102
Solid Surface Countertops (Included)	
Full Bath - including plumbing, wall and floor finishes	+ 6543
Half Bath - including plumbing, wall and floor finishes	+ 4048
Two Car Attached Garage	+ 24,917
Two Car Detached Garage	+ 28,578
Fireplace & Chimney	+ 6964

Adjustments

For multi family - add to total cost

Additional Kitchen	$ + 14,107
Additional Full Bath & Half Bath	+ 10,591
Additional Entry & Exit	+ 1622
Separate Heating & Air Conditioning	+ 6091
Separate Electric	+ 1870

For Townhouse/Rowhouse - Multiply cost per square foot by

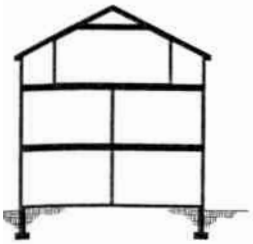
Inner Unit	+ .87
End Unit	+ .94

Alternatives

Add to or deduct from the cost per square foot of living area

Cedar Shake Roof	+ 1.70
Clay Tile Roof	+ 1.85
Slate Roof	+ 2.70
Upgrade Ceilings to Textured Finish	+ .47
Air Conditioning, in Heating Ductwork	Base System
Heating Systems, Hot Water	+ 1.49
Heat Pump	+ 2.57
Electric Heat	– 3.67
Not Heated	– 3.35

Additional upgrades or components

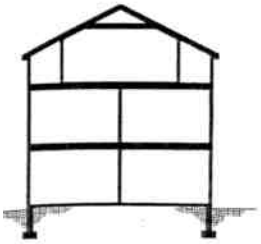


Custom 2-1/2 Story

Living Area - 3200 S.F.
Perimeter - 150 L.F.

		Labor-Hours	Cost Per Square Foot Of Living Area			
			Mat.	Labor	Tot	
1 Site Work	Site preparation for slab; 4' deep trench excavation for foundation wall.	.048		.49	.49	
2 Foundation	Continuous reinforced concrete footing 8" deep x 18" wide; dampproofed and insulated reinforced concrete foundation wall, 8" thick, 4' deep; 4" concrete slab on 4" crushed stone base and polyethylene vapor barrier, trowel finish.	.063	2.88	3.29	6.17	
3 Framing	Exterior walls - 2" x 6" wood studs, 16" O.C.; 1/2" plywood sheathing; 2" x 8" rafters 16" O.C. with 1/2" plywood sheathing, 6 in 12 pitch; 2" x 8" ceiling joists 16" O.C.; 2" x 10" floor joists 16" O.C. with 5/8" plywood subfloor; 5/8" plywood subfloor on 1" x 3" wood sleepers 16" O.C.	.177	5.42	6.82	12.23	
4 Exterior Walls	Horizontal beveled wood siding; building paper; 6" batt insulation; wood double hung windows; 3 solid core wood exterior doors; storms and screens. **Estimated lower value: Hardiboard, Vinyl Windows**	.134	11.57	3.70	15.27 **-2.00**	 *
5 Roofing	30 year asphalt shingles; #15 felt building paper; aluminum gutters, downspouts and drip edge; copper flashings. **Estimated higher value: partial Aluminum Roofing**	.032	2.11	1.21	3.32 **+1.00**	 *
6 Interiors	Walls and ceilings - 5/8" gypsum wallboard, skim coat plaster, painted with primer and 2 coats; hardwood baseboard and trim, sanded and finished; hardwood floor 70%, ceramic tile with underlayment 20%, vinyl tile with underlayment 10%; wood panel interior doors, primed and painted with 2 coats. **Lower value based on avergae construction (see page 18)**	.354	16.62	13.46	~~30.11~~ **25.92** **-4.19**	 *
7 Specialties	Custom grade kitchen cabinets - 20 L.F. wall and base with solid surface counter top and kitchen sink; 4 L.F. bathroom vanity; 75 gallon electric water heater, medicine cabinet. **Average quality kitchen and bathroom vanities**	.053	3.84	.84	4.69 **-1.00**	 *
8 Mechanical	Gas fired warm air heat/air conditioning; one full bath including: bathtub, corner shower; built in lavatory and water closet; one 1/2 bath including: built in lavatory and water closet.	.104	4.79	2.64	7.43	
9 Electrical	200 Amp. service; romex wiring; fluorescent and incandescent lighting fixtures, switches, receptacles.	.048	1.19	1.47	2.67	
10 Overhead	Contractor's overhead and profit and design.		9.68	6.78	16.42	
		Total	58.10	40.70	**98.80**	

*** Reflected in Cost Estimate Sheet**



Average 2-1/2 Story

Living Area - 3200 S.F.
Perimeter - 150 L.F.

		Labor-Hours	Cost Per Square Foot Of Living Area		
			Mat.	Labor	Tot
1 Site Work	Site preparation for slab; 4' deep trench excavation for foundation wall.	.046		.41	.41
2 Foundation	Continuous reinforced concrete footing 8" deep x 18" wide, dampproofed and insulated reinforced concrete foundation wall, 8" thick, 4' deep; 4" concrete slab on 4" crushed stone base and polyethylene vapor barrier, trowel finish.	.061	2.23	2.56	4.78
3 Framing	Exterior walls - 2" x 4" wood studs, 16" O.C.; 1/2" plywood sheathing; 2" x 6" rafters 16" O.C. with 1/2" plywood sheathing, 4 in 12 pitch; 2" x 6" ceiling joists 16" O.C.; 2" x 8" floor joists 16" O.C. with 5/8" plywood subfloor; 1/2" plywood subfloor on 1" x 2" wood sleepers 16" O.C.	.127	5.92	7.84	13.74
4 Exterior Walls	Beveled wood siding and building paper on insulated wood frame walls; 6" attic insulation; double hung windows; 3 flush solid core wood exterior doors with storms.	.136	10.10	4.30	14.41
5 Roofing	25 year asphalt shingles; #15 felt building paper; aluminum gutters, downspouts, drip edge and flashings.	.018	.60	.83	1.43
6 Interiors	Walls and ceilings, 1/2" taped and finished gypsum wallboard, primed and painted with 2 coats; painted baseboard and trim, finished hardwood floor 40%, carpet with 1/2" underlayment 40%, vinyl tile with 1/2" underlayment 15%, ceramic tile with 1/2" underlayment 5%; hollow core and louvered doors.	.286	13.35	12.57	25.92
7 Specialties	Average grade kitchen cabinets - 14 L.F. wall and base with solid surface counter top and kitchen sink; 40 gallon electric water heater.	.030	1.29	.50	1.80
8 Mechanical	1 lavatory, white, wall hung; 1 water closet, white; 1 bathtub with shower, enameled steel, white; gas fired warm air heat.	.072	2.32	2.30	4.63
9 Electrical	200 Amp. service; romex wiring; incandescent lighting fixtures, switches, receptacles.	.046	1.05	1.30	2.35
10 Overhead	Contractor's overhead and profit and plans.		6.29	5.54	11.83
		Total	43.15	38.15	**81.30**

Cost Summary

Residential Cost Estimate
Summary DEER and FOX units

OWNER'S NAME:	**Park City Municipal Corporation**	APPRAISER:	**Jörg Rügemer**
RESIDENCE ADDRESS:	594 + 598 Snow Creek Court	PROJECT:	Snow Creek Cottages / **Deer + Fox Unit Cost**
CITY, STATE, ZIP CODE:	Park City, Utah 84098	DATE:	**10.05.10**

Average square footage cost for both units

Overall cost construction only Deer unit	**201.342,56**
Gross SF with Garage	1.932,00
Cost/SF	**104,21**

Overall cost construction only Fox unit	**154.062,03**
Gross SF with Garage	1.305,00
Cost/SF	**118,06**

Overall cost construction only Deer and Fox unit	**355.404,59**
Gross SF with Garage Deer and Fox	3.237,00
Cost/SF	**109,79**

Supporting tables
from the RSMeans Cost Data Book

Kitchen cabinets - Base units, hardwood *(Cost per Unit)*

	Economy	Average	Custom	Luxury
24" deep, 35" high,				
One top drawer,				
One door below				
12" wide	$ 210	$ 281	$ 373	$ 491
15" wide	247	330	438	577
18" wide	270	360	478	630
21" wide	247	330	438	577
24" wide	326	435	578	761
Four drawers				
12" wide	296	395	525	691
15" wide	322	430	571	752
18" wide	341	455	605	796
24" wide	363	485	645	848
Two top drawers,				
Two doors below				
27" wide	333	445	591	778
30" wide	382	510	678	892
33" wide	337	450	598	787
36" wide	348	465	618	813
42" wide	375	500	665	875
48" wide	401	535	711	936
Range or sink base				
(Cost per unit)				
Two doors below				
30" wide	273	365	485	638
33" wide	292	390	518	682
36" wide	303	405	538	708
42" wide	330	440	585	770
48" wide	341	455	605	796
Corner Base Cabinet				
(Cost per unit)				
36" wide	547	730	970	1277
Lazy Susan *(Cost per unit)*				
With revolving door	480	640	851	1120

Kitchen cabinets - Wall cabinets, hardwood *(Cost per Unit)*

	Economy	Average	Custom	Luxury
12" deep, 2 doors				
12" high				
30" wide	$ 186	$ 248	$ 329	$ 434
36" wide	212	283	376	495
15" high				
30" wide	187	250	332	437
33" wide	208	278	369	486
36" wide	225	300	399	525
24" high				
30" wide	281	375	498	656
36" wide	311	415	551	726
42" wide	300	400	532	700
30" high, 1 door				
12" wide	184	246	327	430
15" wide	200	267	355	467
18" wide	220	294	391	514
24" wide	251	335	445	586
30" high, 2 doors				
27" wide	270	360	478	630
30" wide	292	390	518	682
36" wide	326	435	578	761
42" wide	348	465	618	813
48" wide	360	480	638	840
Corner wall, 30" high				
24" wide	204	272	361	476
30" wide	247	330	438	577
36" wide	222	297	395	519
Broom closet				
84" high, 24" deep				
18" wide	480	640	851	1120
Oven Cabinet				
84" high, 24" deep				
27" wide	716	955	1270	1671

Kitchen countertops *(Cost per L.F.)*

	Economy	Average	Custom	Luxury
Solid Surface				
24" wide, no backsplash	91	122	162	213
with backsplash	99	132	175	231
Stock plastic laminate, 24" wide				
with backsplash	16	22	29	38
Custom plastic laminate, no splash				
7/8" thick, alum. molding	25	34	45	60
1-1/4" thick, no splash	34	46	61	80
Marble				
1/2" - 3/4" thick w/splash	46	62	82	108
Maple, laminated				
1-1/2" thick w/splash	68	91	121	159
Stainless steel				
(per S.F.)	124	166	220	290
Cutting blocks, recessed				
16" x 20" x 1" (each)	93	124	164	217

Vanity bases *(Cost per Unit)*

	Economy	Average	Custom	Luxury
2 door, 30" high, 21" deep				
24" wide	258	345	458	603
30" wide	300	400	532	700
36" wide	326	435	578	761
48" wide	401	535	711	936

Solid surface vanity tops *(Cost Each)*

	Economy	Average	Custom	Luxury
Center bowl				
22" x 25"	$ 260	$ 280	$ 303	$ 327
22" x 31"	297	320	346	374
22" x 37"	340	367	396	428
22" x 49"	420	453	489	529

Fireplaces & Chimneys *(Cost per Unit)*

	1-1/2 Story	2 Story	3 Story
Economy (prefab metal)			
Exterior chimney & 1 fireplace	$ 4995	$ 5520	$ 6054
Interior chimney & 1 fireplace	4787	5322	5568
Average (masonry)			
Exterior chimney & 1 fireplace	4964	5535	6292
Interior chimney & 1 fireplace	4650	5220	5684
For more than 1 flue, add	357	607	1018
For more than 1 fireplace, add	3519	3519	3519
Custom (masonry)			
Exterior chimney & 1 fireplace	5463	6166	6963
Interior chimney & 1 fireplace	5122	5798	6249
For more than 1 flue, add	428	742	1005
For more than 1 fireplace, add	3924	3924	3924
Luxury (masonry)			
Exterior chimney & 1 fireplace	7721	8464	9262
Interior chimney & 1 fireplace	7366	8054	8525
For more than 1 flue, add	637	1064	1485
For more than 1 fireplace, add	6086	6086	6086

Windows and Skylights *(Cost Each)*

	Economy	Average	Custom	Luxury
Fixed Picture Windows				
3'-6" x 4'-0"	$ 505	$ 546	$ 595	$ 637
4'-0" x 6'-0"	921	995	1075	1161
5'-0" x 6'-0"	1007	1087	1200	1269
6'-0" x 6'-0"	1028	1111	1200	1296
Bay/Bow Windows				
8'-0" x 5'-0"	1264	1365	1525	1593
10'-0" x 5'-0"	1478	1597	1625	1863
10'-0" x 6'-0"	2314	2500	2575	2916
12'-0" x 6'-0"	2936	3171	3350	3699
Palladian Windows				
3'-2" x 6'-4"		1782	2000	2079
4'-0" x 6'-0"		2106	2275	2457
5'-5" x 6'-10"		2523	2975	2943
8'-0" x 6'-0"		3032	3525	3537
Skylights				
46" x 21-1/2"	416	450	590	637
46" x 28"	453	490	625	675
57" x 44"	550	595	735	793

Dormers *(Cost/S.F. of plan area)*

	Economy	Average	Custom	Luxury
Framing and Roofing Only				
Gable dormer, 2" x 6" roof frame	$ 25	$ 28	$ 32	$ 52
2" x 8" roof frame	26	29	33	55
Shed dormer, 2" x 6" roof frame	15	17	21	34
2" x 8" roof frame	17	19	22	35
2" x 10" roof frame	18	21	23	36

Appliances *(Cost per Unit)*

	Economy	Average	Custom	Luxury
Range				
30" free standing, 1 oven	$ 405	$ 1252	$ 1676	$ 2100
2 oven	1650	1750	1800	1850
30" built-in, 1 oven	830	1365	1632	1900
2 oven	1675	1912	2043	2175
21" free standing				
1 oven	400	450	475	500
Counter Top Ranges				
4 burner standard	335	557	668	780
As above with griddle	1925	2875	3350	3825
Microwave Oven	217	458	579	700
Compactor				
4 to 1 compaction	605	647	668	690
Deep Freeze				
15 to 23 C.F.	540	662	723	785
30 C.F.	955	1065	1120	1175
Dehumidifier, portable, auto.				
15 pint	165	189	202	214
30 pint	197	226	241	256
Washing Machine, automatic	485	1055	1340	1625
Water Heater				
Electric, glass lined				
30 gal.	570	695	757	820
80 gal.	1100	1387	1531	1675
Water Heater, Gas, glass lined				
30 gal.	790	970	1060	1150
50 gal.	1275	1562	1706	1850
Dishwasher, built-in				
2 cycles	360	482	543	605
4 or more cycles	470	580	990	1400
Dryer, automatic	500	1187	1531	1875
Garage Door Opener	495	597	648	700
Garbage Disposal	126	195	229	264
Heater, Electric, built-in				
1250 watt ceiling type	208	259	284	310
1250 watt wall type	260	282	293	305
Wall type w/blower				
1500 watt	260	299	318	338
3000 watt	455	523	557	591
Hood For Range, 2 speed				
30" wide	154	602	826	1050
42" wide	370	1210	1630	2050
Humidifier, portable				
7 gal. per day	176	202	215	228
15 gal. per day	212	243	259	275
Ice Maker, automatic				
13 lb. per day	995	1144	1218	1293
51 lb. per day	1500	1725	1837	1950
Refrigerator, no frost				
10-12 C.F.	545	607	638	670
14-16 C.F.	565	680	737	795
18-20 C.F.	705	977	1113	1250
21-29 C.F.	1025	2225	2825	3425
Sump Pump, 1/3 H.P.	272	386	443	500

Breezeway *(Cost per S.F.)*

Class	Type	Area (S.F.)			
		50	100	150	200
Economy	Open	$ 22.73	$ 19.31	$ 16.21	$ 15.94
	Enclosed	109.01	84.19	69.91	61.24
Average	Open	30.49	26.89	23.52	21.37
	Enclosed	119.08	88.74	72.58	63.89
Custom	Open	42.27	37.21	32.37	29.63
	Enclosed	173.63	129.17	105.59	92.83
Luxury	Open	44.01	38.58	34.76	33.76
	Enclosed	177.22	131.43	106.32	95.18

Porches *(Cost per S.F.)*

Class	Type	Area (S.F.)				
		25	50	100	200	300
Economy	Open	$ 65.15	$ 43.59	$ 34.07	$ 28.83	$ 24.60
	Enclosed	130.19	90.72	68.57	53.49	45.79
Average	Open	85.84	54.65	41.93	34.85	34.85
	Enclosed	155.77	105.54	79.83	61.81	52.37
Custom	Open	107.95	71.62	53.92	47.10	42.21
	Enclosed	214.63	146.64	111.58	86.90	74.86
Luxury	Open	116.52	76.16	56.26	50.55	45.07
	Enclosed	228.10	160.20	118.85	92.35	79.49

Finished attic *(Cost per S.F.)*

Class	Area (S.F.)				
	400	500	600	800	1000
Economy	$ 17.38	$ 16.80	$ 16.10	$ 15.83	$ 15.24
Average	26.66	26.08	25.44	25.12	24.42
Custom	34.41	33.64	32.87	32.37	31.71
Luxury	43.74	42.68	41.68	40.69	40.02

Alarm system *(Cost per System)*

	Burglar Alarm	Smoke Detector
Economy	$ 400	$ 69
Average	460	83
Custom	783	194
Luxury	1150	178

Sauna, prefabricated

(Cost per unit, including heater and controls—7' high)

Size	Cost
6' x 4'	$ 5225
6' x 5'	5825
6' x 6'	6200
6' x 9'	7600
8' x 10'	10,000
8' x 12'	11,700
10' x 12'	12,200

Garages *

(Costs include exterior wall systems comparable with the quality of the residence. Included in the cost is an allowance for one personnel door, manual overhead door(s) and electrical fixture.)

Class	Type									
	Detached			Attached			Built-in		Basement	
Economy	One Car	Two Car	Three Car	One Car	Two Car	Three Car	One Car	Two Car	One Car	Two Car
Wood	$14,483	$22,007	$29,531	$11,166	$19,141	$26,665	$-1575	$-3149	$1307	$1680
Masonry	19,665	28,492	37,318	14,408	23,686	32,513	-2211	-4421		
Average										
Wood	16,766	24,864	32,962	12,594	21,144	29,242	-1855	-3709	1498	2063
Masonry	21,019	30,186	39,354	15,255	24,874	34,042	-2377	-4008		
Custom										
Wood	18,734	28,578	38,422	14,451	24,917	34,761	-2985	-2712	2617	4295
Masonry	23,146	34,099	45,053	17,212	28,787	39,740	-3527	-3795		
Luxury										
Wood	21,971	34,187	46,403	17,256	30,094	42,310	-3127	-2995	3600	5811
Masonry	26,552	39,920	53,288	20,122	34,113	47,481	-3689	-4121		

*See the Introduction to this section for definitions of garage types.

Swimming pools *(Cost per S.F.)*

Residential	
Inground	$23.00–61.00
Deck equipment	1.30
Paint pool, preparation & 3 coats (epoxy)	4.34
Rubber base paint	3.72
Pool Cover	.86
Swimming Pool Heaters	
(not including wiring, external piping, base or pad)	
Gas	
155 MBH	$ 2500.00
190 MBH	2975.00
500 MBH	10,700.
Electric	
15 KW 7200 gallon pool	2625.00
24 KW 9600 gallon pool	3000.00
54 KW 24,000 gallon pool	4625.00

Wood and coal stoves

Wood Only	
Free Standing (minimum)	$ 1825
Fireplace Insert (minimum)	1839
Coal Only	
Free Standing	$ 2078
Fireplace Insert	2275
Wood and Coal	
Free Standing	$ 4275
Fireplace Insert	4381

Sidewalks *(Cost per S.F.)*

Concrete, 3000 psi with wire mesh	4" thick	$ 3.52
	5" thick	4.31
	6" thick	4.84
Precast concrete patio blocks (natural)	2" thick	10.45
Precast concrete patio blocks (colors)	2" thick	11.10
Flagstone, bluestone	1" thick	14.90
Flagstone, bluestone	1-1/2" thick	19.85
Slate (natural, irregular)	3/4" thick	15.00
Slate (random rectangular)	1/2" thick	23.00
Seeding		
Fine grading & seeding includes lime, fertilizer & seed	per S.Y.	2.30
Lawn Sprinkler System	per S.F.	.91

Fencing *(Cost per L.F.)*

Chain Link, 4' high, galvanized	$ 16.75
Gate, 4' high (each)	155.00
Cedar Picket, 3' high, 2 rail	11.85
Gate (each)	175.00
3 Rail, 4' high	14.55
Gate (each)	186.00
Cedar Stockade, 3 Rail, 6' high	14.75
Gate (each)	185.00
Board & Battens, 2 sides 6' high, pine	21.00
6' high, cedar	29.50
No. 1 Cedar, basketweave, 6' high	16.70
Gate, 6' high (each)	217.00

Carport *(Cost per S.F.)*

Economy	$ 8.08
Average	12.26
Custom	18.78
Luxury	21.50

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Location Factors

Costs shown in *RSMeans Residential Cost Data* are based on national averages for materials and installation. To adjust these costs to a specific location, simply multiply the base cost by the factor for that city. The data is arranged alphabetically by state and postal zip code numbers. For a city not listed, use the factor for a nearby city with similar economic characteristics.

STATE	CITY	Residential
ALABAMA		
350-352	Birmingham	.87
354	Tuscaloosa	.78
355	Jasper	.72
356	Decatur	.78
357-358	Huntsville	.84
359	Gadsden	.75
360-361	Montgomery	.77
362	Anniston	.73
363	Dothan	.76
364	Evergreen	.74
365-366	Mobile	.82
367	Selma	.74
368	Phenix City	.75
369	Butler	.75
ALASKA		
995-996	Anchorage	1.25
997	Fairbanks	1.28
998	Juneau	1.24
999	Ketchikan	1.28
ARIZONA		
850,853	Phoenix	.85
852	Mesa/Tempe	.82
855	Globe	.78
856-857	Tucson	.83
859	Show Low	.80
860	Flagstaff	.85
863	Prescott	.79
864	Kingman	.83
865	Chambers	.79
ARKANSAS		
716	Pine Bluff	.80
717	Camden	.68
718	Texarkana	.73
719	Hot Springs	.69
720-722	Little Rock	.84
723	West Memphis	.79
724	Jonesboro	.77
725	Batesville	.74
726	Harrison	.76
727	Fayetteville	.71
728	Russellville	.76
729	Fort Smith	.77
CALIFORNIA		
900-902	Los Angeles	1.08
903-905	Inglewood	1.03
906-908	Long Beach	1.02
910-912	Pasadena	1.02
913-916	Van Nuys	1.05
917-918	Alhambra	1.06
919-921	San Diego	1.04
922	Palm Springs	1.02
923-924	San Bernardino	1.03
925	Riverside	1.07
926-927	Santa Ana	1.04
928	Anaheim	1.07
930	Oxnard	1.08
931	Santa Barbara	1.07
932-933	Bakersfield	1.06
934	San Luis Obispo	1.05
935	Mojave	1.03
936-938	Fresno	1.09
939	Salinas	1.11
940-941	San Francisco	1.26
942,956-958	Sacramento	1.12
943	Palo Alto	1.16
944	San Mateo	1.23
945	Vallejo	1.15
946	Oakland	1.22
947	Berkeley	1.22
948	Richmond	1.24
949	San Rafael	1.22
950	Santa Cruz	1.14
951	San Jose	1.21
952	Stockton	1.08
953	Modesto	1.08

STATE	CITY	Residential
CALIFORNIA (CONT'D)		
954	Santa Rosa	1.16
955	Eureka	1.11
959	Marysville	1.09
960	Redding	1.09
961	Susanville	1.09
COLORADO		
800-802	Denver	.93
803	Boulder	.92
804	Golden	.90
805	Fort Collins	.88
806	Greeley	.78
807	Fort Morgan	.91
808-809	Colorado Springs	.89
810	Pueblo	.90
811	Alamosa	.86
812	Salida	.89
813	Durango	.89
814	Montrose	.86
815	Grand Junction	.90
816	Glenwood Springs	.88
CONNECTICUT		
060	New Britain	1.09
061	Hartford	1.09
062	Willimantic	1.10
063	New London	1.09
064	Meriden	1.09
065	New Haven	1.10
066	Bridgeport	1.10
067	Waterbury	1.10
068	Norwalk	1.10
069	Stamford	1.11
D.C.		
200-205	Washington	.96
DELAWARE		
197	Newark	1.02
198	Wilmington	1.03
199	Dover	1.02
FLORIDA		
320,322	Jacksonville	.80
321	Daytona Beach	.89
323	Tallahassee	.77
324	Panama City	.74
325	Pensacola	.81
326,344	Gainesville	.80
327-328,347	Orlando	.89
329	Melbourne	.90
330-332,340	Miami	.86
333	Fort Lauderdale	.84
334,349	West Palm Beach	.84
335-336,346	Tampa	.91
337	St. Petersburg	.78
338	Lakeland	.88
339,341	Fort Myers	.86
342	Sarasota	.89
GEORGIA		
300-303,399	Atlanta	.90
304	Statesboro	.71
305	Gainesville	.78
306	Athens	.78
307	Dalton	.74
308-309	Augusta	.80
310-312	Macon	.81
313-314	Savannah	.81
315	Waycross	.74
316	Valdosta	.72
317,398	Albany	.77
318-319	Columbus	.82
HAWAII		
967	Hilo	1.19
968	Honolulu	1.21

Location Factors

STATE	CITY	Residential
NORTH DAKOTA (CONT'D)		
586	Dickinson	.76
587	Minot	.81
588	Williston	.76
OHIO		
430-432	Columbus	.93
433	Marion	.89
434-436	Toledo	1.00
437-438	Zanesville	.88
439	Steubenville	.93
440	Lorain	.98
441	Cleveland	1.01
442-443	Akron	.98
444-445	Youngstown	.95
446-447	Canton	.93
448-449	Mansfield	.93
450	Hamilton	.92
451-452	Cincinnati	.92
453-454	Dayton	.91
455	Springfield	.92
456	Chillicothe	.94
457	Athens	.87
458	Lima	.90
OKLAHOMA		
730-731	Oklahoma City	.79
734	Ardmore	.78
735	Lawton	.80
736	Clinton	.76
737	Enid	.76
738	Woodward	.76
739	Guymon	.67
740-741	Tulsa	.77
743	Miami	.81
744	Muskogee	.71
745	Mcalester	.73
746	Ponca City	.77
747	Durant	.77
748	Shawnee	.75
749	Poteau	.77
OREGON		
970-972	Portland	1.00
973	Salem	.98
974	Eugene	.99
975	Medford	.98
976	Klamath Falls	.98
977	Bend	1.00
978	Pendleton	.98
979	Vale	.97
PENNSYLVANIA		
150-152	Pittsburgh	.96
153	Washington	.93
154	Uniontown	.90
155	Bedford	.87
156	Greensburg	.93
157	Indiana	.90
158	Dubois	.89
159	Johnstown	.89
160	Butler	.91
161	New Castle	.91
162	Kittanning	.93
163	Oil City	.89
164-165	Erie	.93
166	Altoona	.87
167	Bradford	.89
168	State College	.90
169	Wellsboro	.90
170-171	Harrisburg	.94
172	Chambersburg	.89
173-174	York	.91
175-176	Lancaster	.91
177	Williamsport	.85
178	Sunbury	.91
179	Pottsville	.91
180	Lehigh Valley	1.01
181	Allentown	1.03
182	Hazleton	.90
183	Stroudsburg	.91
184-185	Scranton	.95
186-187	Wilkes-Barre	.92
188	Montrose	.90
189	Doylestown	1.05

STATE	CITY	Residential
PENNSYLVANIA (CONT'D)		
190-191	Philadelphia	1.16
193	Westchester	1.10
194	Norristown	1.09
195-196	Reading	.97
PUERTO RICO		
009	San Juan	.75
RHODE ISLAND		
028	Newport	1.06
029	Providence	1.06
SOUTH CAROLINA		
290-292	Columbia	.84
293	Spartanburg	.84
294	Charleston	.87
295	Florence	.80
296	Greenville	.83
297	Rock Hill	.82
298	Aiken	.97
299	Beaufort	.82
SOUTH DAKOTA		
570-571	Sioux Falls	.79
572	Watertown	.75
573	Mitchell	.77
574	Aberdeen	.77
575	Pierre	.77
576	Mobridge	.75
577	Rapid City	.78
TENNESSEE		
370-372	Nashville	.84
373-374	Chattanooga	.75
375,380-381	Memphis	.81
376	Johnson City	.70
377-379	Knoxville	.72
382	McKenzie	.72
383	Jackson	.70
384	Columbia	.71
385	Cookeville	.71
TEXAS		
750	McKinney	.73
751	Waxahackie	.74
752-753	Dallas	.83
754	Greenville	.68
755	Texarkana	.72
756	Longview	.67
757	Tyler	.73
758	Palestine	.66
759	Lufkin	.70
760-761	Fort Worth	.81
762	Denton	.75
763	Wichita Falls	.78
764	Eastland	.71
765	Temple	.74
766-767	Waco	.76
768	Brownwood	.68
769	San Angelo	.71
770-772	Houston	.85
773	Huntsville	.68
774	Wharton	.69
775	Galveston	.83
776-777	Beaumont	.80
778	Bryan	.73
779	Victoria	.73
780	Laredo	.72
781-782	San Antonio	.80
783-784	Corpus Christi	.77
785	McAllen	.75
786-787	Austin	.79
788	Del Rio	.66
789	Giddings	.69
790-791	Amarillo	.76
792	Childress	.74
793-794	Lubbock	.74
795-796	Abilene	.74
797	Midland	.75
798-799,885	El Paso	.73
UTAH		
840-841	Salt Lake City	.81
842,844	Ogden	.78
843	Logan	.79

Location Factors

STATE	CITY	Residential
UTAH (CONT'D)		
845	Price	.70
846-847	Provo	.80
VERMONT		
050	White River Jct.	.76
051	Bellows Falls	.78
052	Bennington	.80
053	Brattleboro	.80
054	Burlington	.81
056	Montpelier	.82
057	Rutland	.81
058	St. Johnsbury	.78
059	Guildhall	.77
VIRGINIA		
220-221	Fairfax	1.02
222	Arlington	1.03
223	Alexandria	1.07
224-225	Fredericksburg	.94
226	Winchester	.91
227	Culpeper	.99
228	Harrisonburg	.89
229	Charlottesville	.90
230-232	Richmond	.98
233-235	Norfolk	1.00
236	Newport News	.99
237	Portsmouth	.92
238	Petersburg	.96
239	Farmville	.88
240-241	Roanoke	.97
242	Bristol	.85
243	Pulaski	.83
244	Staunton	.90
245	Lynchburg	.95
246	Grundy	.83
WASHINGTON		
980-981,987	Seattle	1.02
982	Everett	1.04
983-984	Tacoma	1.02
985	Olympia	1.01
986	Vancouver	.97
988	Wenatchee	.92
989	Yakima	.96
990-992	Spokane	.99
993	Richland	.97
994	Clarkston	.96
WEST VIRGINIA		
247-248	Bluefield	.88
249	Lewisburg	.90
250-253	Charleston	.95
254	Martinsburg	.86
255-257	Huntington	.96
258-259	Beckley	.90
260	Wheeling	.92
261	Parkersburg	.91
262	Buckhannon	.91
263-264	Clarksburg	.91
265	Morgantown	.92
266	Gassaway	.91
267	Romney	.89
268	Petersburg	.91
WISCONSIN		
530,532	Milwaukee	1.07
531	Kenosha	1.03
534	Racine	1.02
535	Beloit	.98
537	Madison	.98
538	Lancaster	.97
539	Portage	.96
540	New Richmond	.99
541-543	Green Bay	1.00
544	Wausau	.94
545	Rhinelander	.94
546	La Crosse	.94
547	Eau Claire	.97
548	Superior	.98
549	Oshkosh	.94
WYOMING		
820	Cheyenne	.82
821	Yellowstone Nat. Pk.	.74
822	Wheatland	.74

STATE	CITY	Residential
WYOMING (CONT'D)		
823	Rawlins	.75
824	Worland	.74
825	Riverton	.73
826	Casper	.76
827	Newcastle	.74
828	Sheridan	.79
829-831	Rock Springs	.78
CANADIAN FACTORS (reflect Canadian currency)		
ALBERTA		
	Calgary	1.14
	Edmonton	1.13
	Fort McMurray	1.14
	Lethbridge	1.11
	Lloydminster	1.06
	Medicine Hat	1.07
	Red Deer	1.07
BRITISH COLUMBIA		
	Kamloops	1.05
	Prince George	1.05
	Vancouver	1.06
	Victoria	.99
MANITOBA		
	Brandon	1.02
	Portage la Prairie	1.02
	Winnipeg	1.02
NEW BRUNSWICK		
	Bathurst	.94
	Dalhousie	.94
	Fredericton	1.01
	Moncton	.95
	Newcastle	.94
	St. John	1.01
NEWFOUNDLAND		
	Corner Brook	.96
	St. Johns	.98
NORTHWEST TERRITORIES		
	Yellowknife	1.07
NOVA SCOTIA		
	Bridgewater	.97
	Dartmouth	.98
	Halifax	1.00
	New Glasgow	.97
	Sydney	.96
	Truro	.97
	Yarmouth	.97
ONTARIO		
	Barrie	1.13
	Brantford	1.14
	Cornwall	1.14
	Hamilton	1.16
	Kingston	1.14
	Kitchener	1.09
	London	1.14
	North Bay	1.11
	Oshawa	1.13
	Ottawa	1.16
	Owen Sound	1.11
	Peterborough	1.12
	Sarnia	1.14
	Sault Ste Marie	1.07
	St. Catharines	1.10
	Sudbury	1.07
	Thunder Bay	1.12
	Timmins	1.11
	Toronto	1.17
	Windsor	1.11
PRINCE EDWARD ISLAND		
	Charlottetown	.92
	Summerside	.92
QUEBEC		
	Cap-de-la-Madeleine	1.13
	Charlesbourg	1.13
	Chicoutimi	1.16
	Gatineau	1.12
	Granby	1.12