EPA Brownfields
Sustainability Pilot

Energy Efficiency for Affordable Housing at a Brownfield Redevelopment Anvil Mountain Site, Silverton, CO

September 2009

TETRA TECH, INC.

ANVIL MOUNTAIN SITE, SILVERTON, CO
ENERGY EFFICIENCY FOR AFFORDABLE HOUSING
AT A BROWNFIELD REDEVELOPMENT

BROWNFIELDS SUSTAINABILITY PILOT
TECHNICAL MEMORANDUM

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1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) Brownfields Program empowers states, communities, and other stakeholders to work together to prevent, assess, safely clean up, and sustainably reuse brownfields. Under this program, EPA's Brownfields Sustainability Pilots are providing technical assistance to support communities in achieving greener, more sustainable assessment, cleanup, and redevelopment at their brownfields projects. EPA selected the Anvil Mountain Site, Silverton, Colorado, for a Brownfields sustainability pilot. As part of this pilot, Tetra Tech EM Inc., (Tetra Tech), through a subcontract to SRA International, Inc., provided technical assistance to the Town of Silverton (the Town) to support site redevelopment efforts for Anvil Mountain. Milestone Associates, Inc. (Milestone), a firm that specializes in affordable housing financing and development, also provided technical assistance through a subcontract to SRA International, Inc.

The purpose of this pilot was to develop options for sustainable site design and buildings for the Anvil Mountain site. Participants in this effort included (in alphabetical order):

- Marcie Bidwell, SWCA Environmental Consultants
- Sabrina Forrest, United State Environmental Protection Agency (EPA) Region 8, Site Assessment Manager
- Karen Hoskin, San Juan 2000
- Sven-Erik Kaiser, EPA Headquarters (HQ), Brownfields Program
- Tim Rehder, EPA Region 8
- Adam Sickmiller, Planning Director, Silverton and San Juan County
- Willy Tookey, San Juan County Administrator
- Otto Van Geet, P.E., National Renewable Energy Laboratory (NREL), Golden, Colorado

The team discussed two sustainable design priority areas identified by the participants during initial scoping calls. First, the site redevelopment should include affordable or renewable energy and energy efficiency options for the targeted, low-income homeowners. For example, the project would consider technologies such as high efficiency insulation, roofing, windows; solar energy (passive and active), and

geothermal exchange heat pumps. Second, the project design and individual structures should encourage historic preservation and architecture design that reflects existing Silverton neighborhoods and honors Silverton's mining heritage as well as the Rose Walsh Smelter that previously operated on the site. For the pilot project, the team focused on evaluating site conditions and plans, identifying and evaluating energy efficiency options, and providing recommendations regarding these options and potential additional considerations, resources, and funding approaches the town may pursue.

2.0 BACKGROUND

The 12-acre Rose Walsh Smelter site is a mine-scarred Brownfield site located in southwestern Colorado, adjacent to Silverton. Silverton is the county seat and the only municipality in San Juan County. The site is owned by San Juan County and two non-profit housing agencies. Beginning in the fall of 2008, San Juan County began preparing to redevelop the land using a U.S. Environmental Protection Agency (EPA) Brownfield Cleanup Grant and other matching and leveraged funds. Site investigations and site remediation of contaminated soil have been implemented. The phased development, now referred to as Anvil Mountain, will include as many as 49 units of housing constructed with the dual goals of (1) providing affordable and low-income attainable housing and (2) integrating green and sustainable design and construction concepts into the project. The houses will be built on lots with relatively good southern exposure and the size of each house will likely range from 1,800 to 2,200 square feet, although some individual units may be significantly smaller. While site remediation was anticipated to be completed earlier, additional soil removal was required during the Summer of 2009. This has delayed housing construction from 2009 to an estimated 2010.

The Town of Silverton is at an elevation of approximately 9,400 feet and depends heavily on tourism during the short summer, when the Durango and Silverton Narrow Gauge Railroad Train brings visitors to the town. However, the town has a relatively harsh, cold climate. Therefore, a major consideration in housing design is to identify appropriate, energy conserving design options to the designers and builders of the new housing development. This supports sustainability and ties directly to making housing attainable and affordable for year-round residents. This is critical because Silverton is isolated during snowy months. The town enjoys only two to three frost-free weeks annually and the residents of Silverton and San Juan County often pay as much for heat and basic utilities as they do for housing. Building affordable housing that is energy conserving will reduce utility bills efficient houses and will help make it possible for low- to median-income Silverton residents to transition from renters to homeowners. In the long term, this will strengthen and stabilize the community.

On October 28, 2008, project participants gathered in Silverton for a day of site reconnaissance and meetings to discuss project goals for the grant and identify action items to reach these goals. All participating stakeholders contributed to the discussion and the following project focus areas were identified: housing energy, systems efficiency, land planning to support sustainability, and architecture standards. During the meetings, results from brainstorming exercises were used to identify a number of specific activities to support these focus areas. Over the life of the project, these options were used to develop the energy modeling, design options, financial and development recommendations, and other information presented in this report. Section 3.0 presents the results of NREL energy modeling for the Anvil Mountain project, including recommended design options, cost outputs developed from the modeling conclusions, and descriptions of recommended design options. Section 4.0 presents financial and development recommendations prepared by Milestone.

3.0 ENERGY MODELING DESIGN OPTIONS AND COST ASSUMPTIONS

NREL is supporting the Town of Silverton through a Technical Assistance Project funded through the U.S. Department of Energy, Energy Efficiency and Renewable Energy, Weather and Intergovernmental Program, which provides funding for sustainable and renewable efforts by state and local entities. During the site visit, the team helped focus on appropriate technical assistance that NREL could provide. Based on this meeting, NREL implemented energy modeling using its Building Energy Optimization 0.9 (BEopt) energy modeling software to analyze various energy conserving design options for the Anvil Mountain housing project. BEopt is a residential energy modeling program developed at NREL to identify optimal building designs at various energy-savings levels on the path to zero net energy. BEopt uses a combination of two other models, DOE2 and Transient Energy System Simulation (TRNSYS), to perform hour-by-hour simulations and uses a sequential search technique to identify optimal building designs.

3.1 MODELING INPUTS

Table 1 lists the general characteristics that NREL used to model the Anvil Mountain project. NREL used Energy Plus weather data, which is generated through weather simulation software developed by DOE (http://apps1.eere.energy.gov/buildings/energyplus/about.cfm). EnergyPlus weather data for Leadville, CO is shown Table 1 because EnergyPlus data for Silverton, CO is not available. Even though Leadville is not geographically the closest location for which EnergyPlus data exists, NREL selected Leadville data for use in the energy simulations because its climate is most similar to that of Silverton.

The International Energy Conservation Code (2006) was used as the Building Code for modeling because this standard had recently been adopted by San Juan County.

Table 1: Anvil Mountain Housing Project General Characteristics

Project Name	Anvil Mountain, Colorado Housing Project (formerly the Rose Walsh Smelter Brownfields Cleanup Site)
Site	Silverton, Colorado
Elevation	9,400 feet
Weather Statistics	Heating Degree Days 65° (HDD) = 10,817 & Cooling Degree Days 55° (CDD) = 85
Climate Zone	7
Electricity Rate	$ 0.10/kWh
Natural Gas Rate	$1.00/therm
Building Code	International Energy Conservation Code (IECC) 2006
Energy Modeling Software	BEopt 0.9 (developed by NREL)
Weather File Used in Simulations	Leadville, Colorado, EnergyPlus Weather HDD 65 = 10,915 & CDD55 = 108
House Floor Area	1,800 to 2,200 square feet

Notes: kWh = kilowatt hour

During a subsequent site visit, a Solmetric SunEye™ was placed to collect data on the solar potential for the Anvil Mountain site. Results from the Solmetric SunEye™ were used to generate Figure 1 which shows a view of the sky at the site throughout the year. As shown, there is minimal shading at the site (the green regions indicate shading and the yellow regions indicate no shading), with most of the shading occurring in the very early morning and the late afternoon hours during the winter and fall months. This indicates that there is high solar potential at the site. In the figure, November is symmetric with January; October is symmetric with February, and so on.

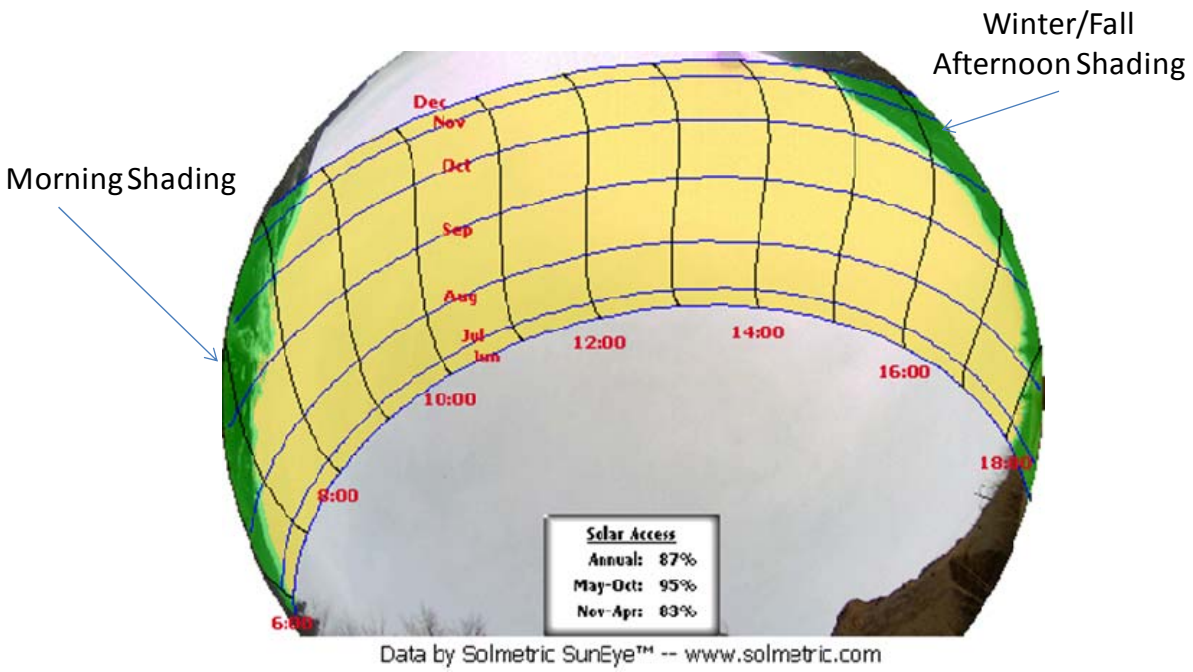

Figure 1: Solmetric View of the Site (Green = Shaded, Yellow = Non-shaded)

For modeling purposes, the *Kelsey House* (http://www.wardcraft.com/Plans/Story1/Kelsey/kelsey7.pdf) was used as a reference in developing the building geometry based on recommendations from the Town of Silverton. A picture of the *Kelsey House* and a graphical representation of the BEopt building geometry are shown in Figure 2.

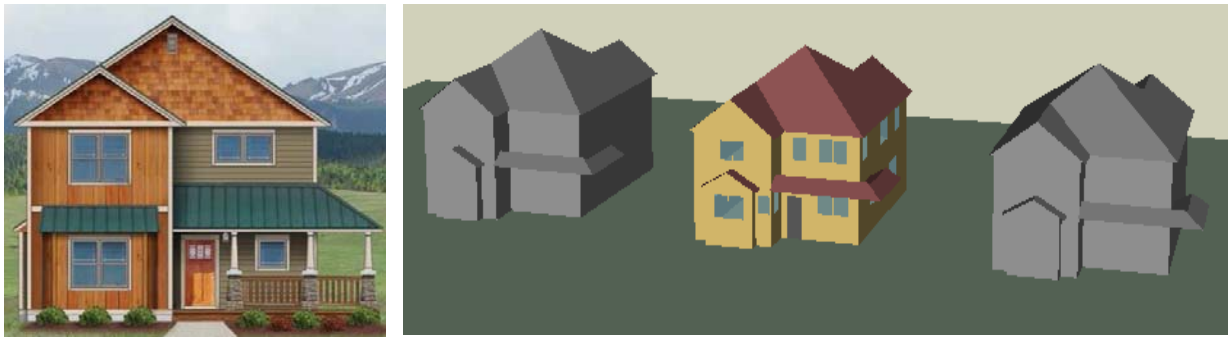

Figure 2: The *Kelsey House* and a Graphical Representation of the BEopt Building Geometry South Façade

Several design options were identified to improve energy efficiency with the most basic option being building orientation. Figure 3 shows the four orientations that were modeled using the BEopt 0.9 software optimization. Currently, the proposed housing orientation for the Anvil Mountain project is with

the front of each house facing south-southwest (SSW). However, early discussions during the site visit included a discussion of housing orientation and its potential impact on energy conservation; this allowed the Town of Silverton to plan ahead for housing orientation. As described in more detail in Section 3.2, modeling demonstrated that the ideal passive solar orientation for a house in Silverton is an orientation that includes the longest façade facing south, with a majority of the window area on that South façade. This means that the East or east-southeast (ESE) orientation (where the front of the house faces East or ESE) shown in Figure 3 is a better option for passive solar energy than the proposed SSW orientation. In addition to this re-orientation, another design option could be increasing the total window area of the house from 16% to 18-20%, preferably with the maximum window area facing south.

Figure 3: House Orientation Options Considered in the Optimization

As mentioned earlier, the stakeholders agreed to use the 2006 International Energy Conservation Code (IECC) for the Baseline Building Code for Anvil Mountain. This code has been adopted by the County. Therefore, various IECC design options were analyzed and the corresponding cost assumptions are displayed in Table 2. The default cost assumptions in BEopt are based on RSMeans, California's Database for Energy Efficient Resources (DEER), and retailer websites. In the future, these cost

assumptions can be revised if necessary and the energy model can be re-run to account for the updated cost information. For this baseline, the analysis period is 30 years, the inflation rate is estimatd at 3.0%, and the discount rate (nominal) is 5.0%. These values can also be modified in future iterations of energy modeling if needed. In some categories, more than one design option is provided. For example, five different window types and three types of furnace are presented in the table.

Table 2: Baseline Design Options and Cost Assumptions

Category	Design Option	Cost	Life
Orientation (azimuth)	Front faces South (0^o)	$0	-
	Front faces SSW (22.5^o)	*$0*	-
	Front faces East (270^o)	*$0*	-
	Front face ESE (292.5^o)	*$0*	-
Neighbors	20 feet	$0	-
Wood Studs Walls	R-21 Batts, 2x6, 24" oc (R-15.9 effective)	$3.97/$ft^2$	20 years
	R-19 Batts, 2x6, 24" oc + 2" foam (R-28.1 effective)	$4.08/$ft^2$	20 years
Double Studs Walls	R-45 Batts 2x4 staggered, 24" oc (R-32.6 effective)	$6.91/$ft^2$	20 years
SIP Walls	9.4" EPS core, OSB ext, gypsum int (R-33.7 effective)	$6.66/$ft^2$	20 years
ICF Walls	2" EPS, 8" concrete, 2" EPS (R-20.1 effective)	$9.48/$ft^2$	30 years
Ceiling	R-40 Fiberglass (R-39.7 effective)	$1.83/$ft^2$	30 years
	R-60 Fiberglass (R-59.6 effective)	$2.68/$ft^2$	30 years
Roof Material	Metal, medium (absorptivity 0.75)	$2.56/$ft^2$	30 years
	Metal, dark (absorptivity 0.90)	$2.56/$ft^2$	30 years
Radiant Barrier	None	$0	-
	Radiant barrier	$0.36/$ft^2$	30 years
Slab	4feet R-5 Perim, R-5 gap	$1.03/$ft^2$	30 years
	15feet R-10 Perim, R-5 gap	$1.66/$ft^2$	30 years
Wall Mass	Exterior and partition, 1/2" drywall	$1.17/$ft^2$	30 years
	Exterior and partition, 2x 5/8" drywall	$1.95/$ft^2$	30 years
Ceiling Mass	1/2" ceiling drywall	$1.38/$ft^2$	30 years
	2 x 5/8" ceiling drywall	$2.20/$ft^2$	30 years
Window Area	Total 16%: Front25%, Back25%, Left25%, Right25%	$0	-
	Total 16%: Front40%, Back25%, Left25%, Right25%	*$0*	-
	Total 16%: Front25%, Back25%, Left40%, Right25%	*$0*	-
Window Type	Low-e, U-0.325, SHGC 0.424	$16.00/$ft^2$	20 years
	Low-e, U-0.352, SHGC 0.511	$16.00/$ft^2$	20 years
	3 Pane Heat Mirror TC-88, U-0.260, SHGC 0.540	*$18.00/$ft^2$*	*11 years*
	3 Pane Heat Mirror TC-88, U-0.210, SHGC 0.480	*$18.00/$ft^2$*	*11 years*
	4 Pane Heat Mirror Superglass, U-0.197, SHGC 0.324	*$24.00/$ft^2$*	*11 years*
Infiltration	Tight, SLA 0.0003	$0.54/$ft^2$	11 years
	Tightest, SLA 0.00008	$1.62/$ft^2$	20 years
Furnace	Gas, AFUE 80.0%	$2,228	20 years
	Gas, AFUE 92.5%	$2,943	20 years
Air Conditioner	None	$0	-

Source: NREL.

Notes:
AFUE – Annual Fuel Utilization Efficiency
CFL – Compact Fluorescent Light bulb (CFL)
EPS – Expanded Polystyrene
Ft^2 – Square feet
ICF – Insulated Concrete Forms
OSB – Oriented Strand Board
SHGC – Solar Heat Gain Coefficient
SIP – Structural Insulated Panels
SLA – Specific Leakage Area

Table 2: Baseline Design Options and Cost Assumptions (Continued)

Category	Design Option	Cost	Life
Hydronic Heating	95.0% AFUE Boiler, Baseboards	$4,462	18 years
Water Heater	Gas Standard, Energy Factor 59.0%	$539	11 years
	Gas Premium, Energy Factor 62.0%	$642	11 years
	Gas Tankless, Energy Factor 77.0%	$1,211	20 years
Refrigerator	Standard	$972	15 years
	Energy Star	$1,150	15 years
Cooking Range	Electric	$1,367	13 years
	Gas	$1,367	15 years
Dishwasher	Standard	$259	11 years
	Energy Star	$329	11 years
Clothes Washer	Standard V-axis	$419	11 years
	Energy Star H-axis	$799	11 years
Clothes Dryer	Electric	$269	18 years
	Gas	$319	18 years
Hardwired Lighting	14% Fluorescent	$3.29/bulb	1.67 years
	50% Fluorescent	$3.29/bulb	6.06 years
Plug-in Lighting	0% Compact CFL	$0	-
	50% CFL	$3.29/bulb	6.97 years
	100% CFL	$3.29/bulb	11.84 years

Source: NREL.

Notes:
AFUE – Annual Fuel Utilization Efficiency
CFL – Compact Fluorescent Light bulb (CFL)
EPS – Expanded Polystyrene
Ft^2 – Square feet
ICF – Insulated Concrete Forms
OSB – Oriented Strand Board
SHGC – Solar Heat Gain Coefficient
SIP – Structural Insulated Panels
SLA – Specific Leakage Area

3.2 ENERGY MODELING RESULTS

For the Anvil Mountain modeling effort, NREL used the 2006 IECC to define the Baseline Building energy conditions. Approximately one thousand BEopt simulations were performed in order to optimize the building design with respect to cost and energy when considering the various design options listed in Table 2. The modeling iterations included variations in three important categories:

- Varying the house orientation including a case where the longest facade faces south
- Varying the glazing type options including Heat Mirror 3- and 4-pane glass
- Varying window area options including a case where the largest window area is on the south facade

The results of the BEopt optimization modeling are shown in Figure 4.

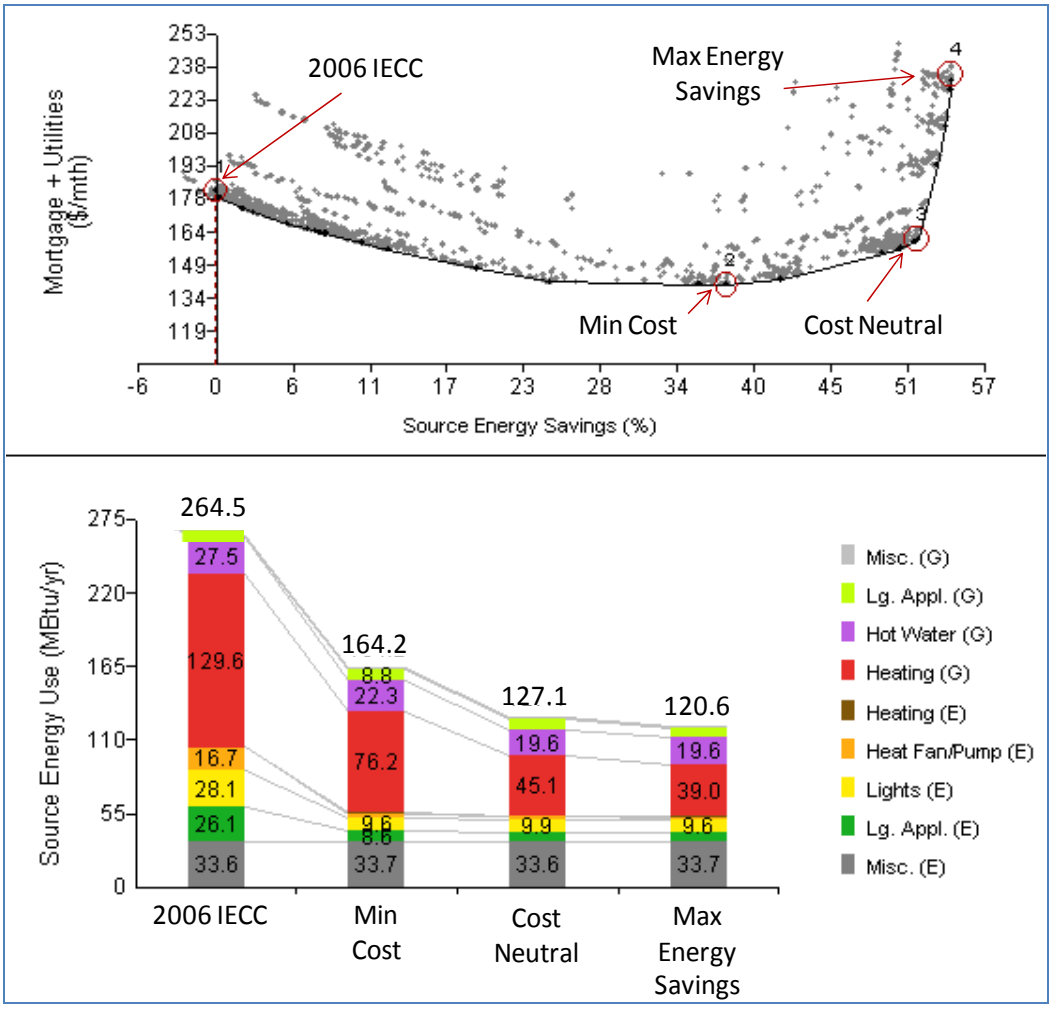

Figure 4: BEopt Optimization Results

The top chart shows the many data points that depict the relationships between the mortgage-plus-utility-monthly cost versus the percent source energy savings. In addition to the baseline IECC design scenario, three specific house design scenarios are labeled on this chart: Minimum Cost, Cost Neutral, and Maximum Energy Savings. The Minimum Cost scenario is the case where monthly mortgage plus utility costs are lowest for the homeowner. The most expensive monthly scenario is the Maximum Energy Savings scenario which assumes that home construction includes the best (and often most costly) energy conservation design elements available. The Cost Neutral scenario is found at the breakpoint of the cost versus energy savings curve. At this breakpoint, energy conservation strategies result in enough cost savings to pay for themselves when compared to the baseline IECC scenario.

The bottom chart in Figure 4 compares the annual source energy use for the 2006 IECC Baseline Building, the Minimum Cost scenario, Cost Neutral scenario, and the Maximum Energy Savings scenario. Energy sources in the chart are either propane gas (G) or electricity (E). Comparing the four scenarios shows that the largest reductions in energy use comes from strategies that reduce propane gas use for heating and reduce electricity use for lighting, heat fan pumps, and large appliances.

Comparing the various design scenarios will allow Anvil Mountain developers to select a collection of best energy design strategies that integrate sustainable design concepts, meet or exceed IECC standards, and integrate the financial parameters of the low-income buyers. Home design choices can be made anywhere along the cost/energy saving curve depending on the goals for the development. The design options that correspond to the four scenarios are shown in Table 3, but the strategies can be recombined to create a home design scenario unique to the Anvil Mountain development.

For example, a presumptive choice for a low-income development might be the Minimum Cost scenario. However, further evaluation shows that the Cost Neutral scenario saves considerably more energy than both the IECC Baseline and the Minimum Cost scenario at only a slightly higher incremental cost. The major differences between the Minimum Cost scenario and the Cost Neutral scenario are that the Cost Neutral scenario has more ceiling and slab insulation, a tighter construction, and uses all Energy Star appliances. If one or more of these strategies are within financial reach, the long-term energy savings for the householder may be worth the investment. As importantly, these strategies are likely candidates for grants or energy tax credits that can reduce their capital costs. The feasibility of applying for grants or credits was a goal of the project and opportunities for such support were investigated by team partners, as summarized in Section 4.0 of this report.

Table 3: Design Options for the Minimum Cost and Maximum Energy Savings Cases

Design Strategy	2006 IECC Baseline	Minimum Cost Case	Cost Neutral Case	Maximum Energy Savings Case
Orientation (S = 0°)	Front facing North (180°)	Front facing East (270°) The longest façade faces South	Front facing East (270°) The longest façade faces South	Front facing East (270°) The longest façade faces South
Neighbors	None	20 ft	20 ft	20 ft
Wood Studs Walls	Wood Stud, U-0.057 (R-17.5 effective)	R-19 Batts, 2x6, 24" oc + 2" foam (R-28.1 effective)	R-19 Batts, 2x6, 24" oc + 2" foam (R-28.1 effective)	None
Double Studs Walls	None	None	None	None
SIP Walls	None	None	None	9.4" EPS core, OSB ext, gypsum int (R-33.7 effective)
ICF Walls	None	None	None	None
Ceiling	U-0.026 (R-38.5 effective)	R-40 Fiberglass (R-39.7 effective)	R-60 Fiberglass (R-59.6 effective)	R-60 Fiberglass (R-59.6 effective)
Roof Material	Metal, medium (absorptivity 0.75)	Metal, dark (absorptivity 0.9)	Metal, dark (absorptivity 0.9)	Metal, dark (absorptivity 0.9)
Radiant Barrier	None	None	None	None
Slab	Unheated, 4ft R-10	4ft R-5 Perim, R-5 gap	15ft R-10 Perim, R-5 gap	15ft R-10 Perim, R-5 gap
Wall Mass	Exterior and partition, 1/2" drywall	Exterior and partition, 1/2" drywall	Exterior and partition, 1/2" drywall	Exterior and partition, 2x 5/8" drywall
Ceiling Mass	1/2" ceiling drywall	1/2 " ceiling drywall	1/2 " ceiling drywall	2x 5/8" ceiling drywall
Window Area	16% F25, B25, L25, R25	16% F20, B20, L40, R20 (A majority of glass is on the S façade)	16% F20, B20, L40, R20 (A majority of glass is on the S façade)	16% F20, B20, L40, R20 (A majority of glass is on the S façade)
Window Type	Low-e, U-0.35	Low-e, U-0.352, SHGC 0.511	Low-e, U-0.352, SHGC 0.511	4-pane Heat Mirror SGQ, U-0.197, SHGC 0.324
Infiltration	SLA 0.00036	Tight, SLA 0.0003	Tightest, SLA 0.00008	Tightest, SLA 0.00008
Furnace	Gas, AFUE 78.0%	None	None	None
Air Conditioner	None	None	None	None
Hydronic Heating	None	95.0% AFUE Boiler, Baseboards	95.0% AFUE Boiler, Baseboards	95.0% AFUE Boiler, Baseboards
Water Heater	Gas Standard, Energy Factor 59.4%	Gas Tankless, Energy Factor 77.0%	Gas Tankless, Energy Factor 77.0%	Gas Tankless, Energy Factor 77.0%
Refrigerator	Standard	Standard	Energy Star	Energy Star
Cooking Range	Electric	Gas	Gas	Gas
Dishwasher	Standard	Standard	Energy Star	Energy Star
Clothes Washer	Standard	Standard V-axis	Energy Star H-axis	Energy Star H-axis
Clothes Dryer	Electric	Gas	Gas	Gas
Hardwired Lighting	14% Fluorescent	50% Fluorescent	50% Fluorescent	50% Fluorescent
Plug-in Lighting	0% CFL	100% CFL	100% CFL	100% CFL

Source: NREL.

In contrast to the previous comparison, the difference between Cost Neutral and Maximum Energy Saving scenarios shows that the Maximum Energy Saving scenario includes typically higher-cost strategies such as structural insulated panel (SIP) walls, higher thermal mass on the interior walls and ceilings, and 4-pane Heat Mirror Superglass windows. These additional investments beyond the Cost Neutral scenario generate smaller incremental energy savings (primarily in propane gas heating) and may put mortgage-plus-utility-monthly costs out of reach of the targeted homebuyer for affordable housing.

3.3 POTENTIAL ENERGY DESIGN STRATEGIES FOR ANVIL MOUNTAIN

Based on the knowledge of the site visit participants and the results of the NREL modeling, several energy design strategies, including those in Table 4, are recommended for consideration in developing the final Anvil Mountain home design to reduce energy use and monthly utility costs. The strategies generally focus on passive solar strategies which the modeling shows would be appropriate for this site's needs, rather than photovoltaic (PV) technologies, which actively produce energy. As evidenced by the Solmetric SunEye™ results, solar potential in Silverton is high. By designing a passive solar home, the home is not built around a costly solar energy system that must be operated and maintained; rather, the home itself is part of the energy system. While PV technology could be an option in a climate such as Silverton's, the capital and maintenance costs are not sustainable for the affordable/low-income housing goal at Anvil Mountain.

This section presents additional information on the primary passive strategies that are recommended for consideration for Anvil Mountain, including:

- Solar Orientation
- Glazing
- Shading
- Thermal Mass
- Isolate Gain Passive Solar
- Building Envelope

Solar Orientation: Proper solar orientation is critical to effective passive solar design. By positioning structures in a manner that allows them to receive the greatest solar access, energy efficiency will be optimized. BEopt modeling, supported by the Solmetric SunEye™ data shows that for the Anvil Mountain site, the optimal structure position puts the south facing wall to within 15° east or west of due south. To the extent possible, the Anvil Mountain homes also should be constructed with a shallow floor plate and elongated east-west access. This orientation and structure will maximize both solar gain and daylighting in the home. An elongated east-west access turns the maximum building area (south façade)

toward the sun for the most heat gain and a shallow floor plate allows the sun's rays deeper penetration through the south-facing windows to the opposite wall. To maximize solar access, neighboring structures should be at least 20 feet away and nearby obstacles should be removed if they are over 10 feet high.

Glazing: Selecting appropriate glazing elements (that is, windows) is crucial to energy efficiency. Selecting glass with the proper balance between insulative value (U-value) and the window's ability to transmit solar heat, also known as the solar heat gain coefficient (SHGC), is key. Transmittance of solar heat into the home when the sun is shining (heat gain) can be negated if that heat is subsequently conducted outward by poorly insulated (high U-value) windows.

The IECC 2006 indexes its U-value and SHGC requirements to climate zones. Silverton is located in Climate Zone 7, making the U-value and SHGC requirements fairly stringent for this area. While the IECC 2006 requirements are a baseline guide for design, exceeding these requirements in some areas can improve energy performance at low incremental cost. The IECC 2006 requires that glazing for Climate Zone 7 have a U-value of no greater then 0.35; however, glazing with a U-value of less then 0.35 is available and would result in significant energy use reductions due to the insulative effect. Since overheating is not typically a primary concern in this climate zone, the IECC 2006 does not specify a SHGC. However, glazing with a SHGC of greater then 0.55 will provide the planned homes with the ability to retain solar heat and lower heating needs.

Heat-Mirror* windows (both 3-pane TC-88 and 4-pane Superglass Quad) *(http://www.southwall.com/southwall/Home/Commercial/Products/HeatMirrorInsulatingGlass.html) are examples of products with the lowest U-value combined with the highest SHGC, which is beneficial for a heating-dominated climate. NREL analyzed Heat-Mirror windows within the BEopt energy model and determined that these windows would perform less cost-effectively when compared with low U-value windows with a high SHGC. However, the modeling showed that the cost differential between the two window types was very slight, so products that perform similarly to Heat Mirror window products are appropriate for consideration for the Anvil Mountain project.

In addition to the type of glazing (window) used, the location and surface area of glazing are important factors in good energy design. To reduce heat loss, the north face of the building should have only minimal glazing for daylighting. Glazing on east and west walls also should be minimized. While having glass located on the east face of the home will allow for good solar gain in the morning, this factor will likely be negated by the amount of heat lost through east facing glazing throughout the day. IECC 2006 recommends that glazing on the south facing wall should equal approximately 7-12% of the heated square footage of the home, and glazing on the south wall should not take up more then 30-35% of the total wall area. However, the modeling performed by NREL for this location suggests that a glazing area up to 40%

of the total south wall area could increase passive solar heating if windows with an optimal U-value and SHGC are employed.

Shading: When using passive solar design, properly sized shading elements are crucial to preventing overheating during the summer months. The size of the overhang will dictate where the shadow line is generated. The appropriate size for a shading overhang will vary depending on the project's latitude as the sun's angle varies with latitude. Although there are no hard and fast guidelines that will work for every project, the DOE has released the following shading guidelines, the first of which would likely apply to the Silverton area:

1. **Cold Climates: above 6,000 heating degree days (at base 65°F):** Locate shadow line (from the building overhang) at mid-window using the June 21 sun angle.
2. **Moderate Climates: below 6,000 heating degree days (at base 65°F) and below 2,600 cooling degree days (at base 75°F):** Locate shadow line at window sill using the June 21 sun angle.
3. **Hot Climates: above 2,600 cooling degree days (at base 75°F):** Locate shadow line at window sill using March 21 sun angle.

Thermal Mass: Thermal mass elements capture and store the heat produced by sunlight during the day and then release that heat back into the home throughout the night. The volume and type of thermal mass will dictate how long heat is stored and how long it takes to release. Selecting appropriate thermal mass elements will have a significant effect on the passive solar effectiveness of the Anvil Mountain homes.

Thermal mass elements should be placed in a location where they will benefit from the greatest solar gain. If possible, masonry or concrete materials should be used to construct south facing walls of the homes. Concrete or slate flooring should be placed in rooms that are directly adjacent to south facing glass so that these flooring materials will absorb sunlight during the day. Likewise, concrete, masonry, or stone walls should be used for interior walls in rooms directly adjacent to south facing glass.

Water is another option for capturing heat because it is the most effective material for thermal mass applications. The innovative use of water tanks as thermal mass elements should be considered for rooms adjacent to south facing glass. Custom water tanks can be constructed to look quite attractive, but should be dark in color.

The sizing of thermal mass elements should follow general installation guidelines of approximately 3 square feet of 4-inch thick masonry or approximately 3 gallons of water for every square foot of glazing.

Isolated Gain Passive Solar: Another design option appropriate for the Anvil Mountain Project is the incorporation of isolated gain passive solar elements into the design. An isolated gain element can include a sunspace or solar green house. Incorporating an isolated gain sunspace into the design of the Anvil Mountain homes could provide a great deal of passive solar heating without the night time heat loss associated with large amounts of glazing on the home. An isolated gain sunspace is a heavily glazed room located along the south face of the main home structure, separated from the home by a thermal mass common wall and an insulated door. The floor of the sunspace will typically also consist of a thermal mass element. By opening the door between the sunspace and the home during the day, warm air circulates into the home. Once the sun goes down, the door can be shut; but the thermal mass wall joining the sunspace to the home will continue to radiate heat throughout the night. In order to maximize the heat gain of the shared, thermal mass wall, the floor plate of the sunspace should be relatively shallow to allow the majority of sun light to directly hit the wall. The following guidelines can help maximize the heat gain of a sunspace:

- Use slope glazing to offer the most direct solar exposure.
- Keep plants to a minimum in the sun space as the evaporation of water absorbs a great deal of solar energy (1 pound of evaporating water consumes roughly 1,000 British Thermal Units (btus)).
- Use insulated, non-glazed end walls to prevent heat loss from the sunspace.
- Minimize inoperable penetrations such as vents in the shared wall to prevent night time heat loss.

Building Envelope: To complement passive solar design, a highly-efficient building envelope will contribute to the overall efficiency of the Anvil Mountain homes. The majority of residential requirements under IECC 2006 pertain to the building envelope. This is because the design of the building envelope dictates the amount of energy used to heat or cool a building. For Climate Zone 7, the IECC building envelope requirements are as follows:

- Window U-Value – 0.35
- Ceiling R-Value – R-49
- Wood Frame Wall R-Value – R-21
- Mass Wall R-Value – R-19
- Floor R-Value – R-30

There are many options for meeting and achieving IECC requirements through building envelope design. One example of an envelope design that could meet and potentially exceed the IECC 2006 requirements, is the REMOTE Wall System (Residential Exterior Membrane Outside-insulation Technique) shown in Figure 5. REMOTE was developed by the Cold Climate Housing Research Center in Fairbanks, Alaska.

The REMOTE Wall System was designed to address issues related to vapor entering the wall system as well as to provide greater insulation values than conventional systems. Using the REMOTE system, the vapor barrier and approximately two thirds of the wall's insulating material are located on the outside of the structural members, while one third of the wall's insulation value remains in the wall cavity. This technique provides two distinct benefits over conventional construction:

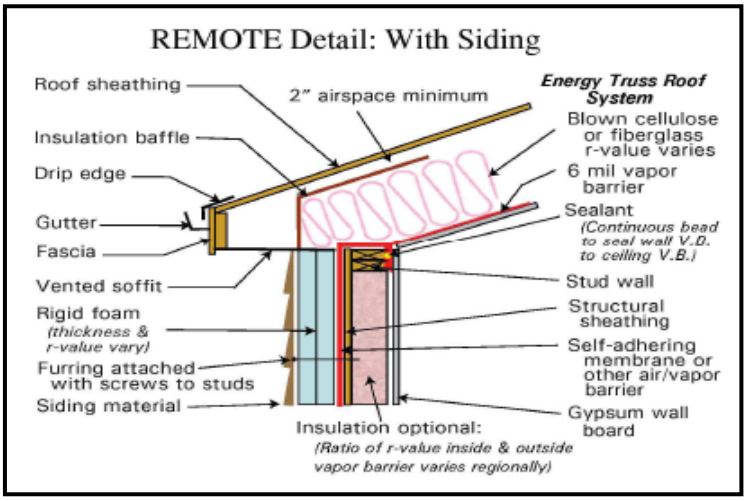

Figure 5: REMOTE Wall System

1. Condensation in the building envelope is eliminated because with the insulation moved to the outside of the structure, the dew point is moved outside of the moisture barrier.

2. Superior R-Values are achieved because of the elimination of thermal bridging through structural framing elements. Thermal bridging can account for a reduction in effective R-Value of 35-40%.

The Cold Climate Housing Research Center (CCHRC) conducted a study in Alaska comparing REMOTE wall systems to conventional wall systems. All of the homes used in this study were 2,000 square feet of living space with a 650-square foot garage and were equipped with an improved efficiency boiler that uses number two fuel oil (CCHRC, 2007). The results of the study are as follows:

- The REMOTE Wall System utilizing 4 inches of rigid foam and an effective wall R-Value of 23 saved $904.00 in annual fuel costs compared to the conventional structure built with 2 by 6 studs and R-19 batt insulation.
- The cost premium associated with the 4-inch REMOTE system was $5,250, yielding a pay back duration of 5.8 years.
- The REMOTE Wall System utilizing 6 inches of rigid foam and an effective wall R-Value of 26 saved $1,076 over the conventional assembly.
- The cost premium associated with the 6-inch REMOTE system was $7,875, yielding a pay back duration of 7.3 years.

This example demonstrates that wall systems similar to the REMOTE system can deliver financial paybacks consistent with expected residential time periods when compared to conventional wall construction.

4.0 FINANCIAL AND DEVELOPMENT CONSIDERATIONS

This section provides a an overview of financial and development considerations addressed for the Anvil Mountain Project, including recommendations for actions that San Juan County can take to enhance its chances of successfully moving to the construction phase at a future date. One key to that success will be to identify and secure funding for the project.

4.1 FINANCIAL AND DEVELOPMENT OVERVIEW

Initial plans for the Anvil site included beginning home construction in 2009. However, during the course of the pilot, the pilot partners indicated that development of housing would be delayed by at least a year due to additional remediation requirements that impacted the planning horizon. Therefore, some of the financial assistance with costing, grants and funding support planned for the project timeframe were no longer appropriate. However, Milestone, a pilot project partner funded by EPA under this pilot project, which specializes in financial analysis, funding sources, and development considerations for affordable housing projects/redevelopment efforts evaluated the project plans and identified options and recommendations with San Juan County and for integration into this pilot project report. In addition, Milestone and Tetra Tech identified resources and information that will support further grant applications and development planning as identified in Section 4.2.

Milestone performed an analysis of the initial project's anticipated sources and uses of funds, which revealed that a significant portion of the project funding was deemed to be speculative in nature. At the start of the assignment, the potential project funding shortfall was between $326,000 and $764,000. Up to half of the project's funding budget was not solidified at the beginning of the assignment, depending upon which funding sources are eventually realized.

San Juan County realizes that additional funding will need to be secured and requested support from the pilot project consultants to help identify likely avenues to pursue for funding. Recommendations for potential funding avenues, additional information sources, and recommendations for next steps to achieve successful funding and implementation of the development effort are summarized in Section 4.2.

4.2 FINANCIAL AND DEVELOPMENT RECOMMENDATIONS

In an effort to help with the existing project budget shortfall, Milestone contacted several financial institutions and foundations to gauge their level of interest in the project. Information from these

conversations and Milestone's additional input on the current and potential development are provided for San Juan County's consideration as they move forward to plan for, and implement housing development at a future date.

San Juan County Should Consider Utilizing an Experienced Developer: All of the private sector lenders that Milestone contacted stated that they would have problems having San Juan County serving as the developer for the project since the County has not had previous experience with building similar developments. The banking community prefers to lend for projects with developer entities that have a proven track record of development in a specified area. This is especially true in the challenging lending environment that currently exists. Should the County retain its desire to serve as developer, the project might be feasible if funded exclusively with grant funding. However, even the foundation sources that Milestone contacted indicated a preference to deal with an experienced developer entity (CDC or private developer) when considering grant requests.

Grant Applications Should be Submitted at least 180 days in Advance of Projected Construction Dates: The County needs to have a fairly accurate accounting of projected sources of funding prior to beginning its "final drive" to the construction phase. The County should able to identify all "firm" and "speculative" funding sources within six months of the projected construction start date in order to reasonably identify any budget shortfalls that may exist. Should the project require lender financing, a six-month window is appropriate when submitting construction loan applications.

San Juan County Should Play the Role of Investor for this Project: The County should put in its own money along with grant funding that can be secured and not expect to see that investment pay off for five or six years in a worst case scenario. The County should view its role as a "first in and last out" investor and realize that a few hundred thousand dollars of its investment may remain sunk in the development for some time. A central role for the County will be as a sound fiduciary to ensure that all monies are "well spent".

Issue an Request for Proposal (RFP) to the "Green" Housing Development Community: The County should issue an RFP or a Request for Quotes (RFQ) to determine the extent of interest by experienced developers in building the project. Issuance of the RFP should occur approximately 12 months before the projected construction start date to allow time for the County to thoroughly analyze candidates or research further potential developer options.

Have a Qualified Appraiser Value the Overall Project and Different Housing Unit Types: Most (if not all) funding sources will require that an appraisal be performed on the project. For a nominal fee (probably $2,000 - $5,000), the County can conduct a preliminary review to gain some level of comfort

that the housing units will have realistic price points based on market conditions. Additionally, the appraisal will help the County to determine appropriate "release prices" for the lots that will be based upon the actual cost of production and the land/infrastructure value.

Contact Potential Grant Sources Once the Construction Phase is Imminent: The following funding sources should be explored, among others, when remediation is complete and the County is ready to move forward with the construction phase: Enterprise Foundation's "Green Communities" Fund, the U.S. Department of Energy Weatherization Assistance Program, Rural LISC (Local Initiatives Support Corporation), and HUD's Home Investment Partnership and Self-Help Homeownership (SHOP) programs. The potential funding sources provided in Table 4 are a representative sample of available funding sources through governmental and non-governmental entities that provide a broad rage of opportunities and incentives to various applicant types. Several considerations should be taken into account when evaluating these funding sources or identifying other funding sources. These include:

- Many funding opportunities support only 501(c)(3) organizations (non-profit organizations). However, many sources allow the grantee or recipient to pass funds through to other parties; this approach could be used by the County if a collaborative partnership existed between the county and the 501(c)(3) grantee.

- Some funding opportunities are aimed to provide incentives or direct funds to individual households. Although the County cannot directly apply for these programs, the County could share this information with individuals and encourage and support potential home buyers to apply to for these programs. For example, home buyers that purchase Energy Star appliances could be eligible to take advantage of individual incentive programs such as Energy Star Tax Credit Program.

- Several organizations, which do not provide funding, offer other valuable resources such as technical, planning, design, and man-power support that could be leveraged to maximize the success of the Anvil Mountain home development. Some of these organizations are identified in Appendix A "Additional Resources."

In all cases, the funding agency programs should be carefully reviewed for requirements and applicability. Using a collaborative approach, the Anvil Mountain home development effort could maximize up-front funding and support opportunities.

Table 4: Potential Funding Sources

		Description of Organization or Specific Program	Who Can Apply	Funding or Information Description	Web site
Federal Programs	U.S. Department of Energy (DOE)	Office of Energy Efficiency and Renewable Energy (EERE) Financial Opportunities	• Business, industry, and universities Current solicitations and related requests from EERE • Consumers: Tax credits, financing, and low-income assistance • Federal energy managers: financing mechanisms for energy-related Federal projects • Inventors: Information	The EERE works with business, industry, universities, and others to increase the use of renewable energy and energy efficiency technologies. One way EERE encourages the growth of these technologies by offering financial assistance opportunities for their development and demonstration. Varying award cycles.	www1.eere.energy.gov/financing
		State Energy Program (SEP) – Formula Grants	States	Contractor training and certification, financial incentives, outreach and education, business equipment loans, low-interest consumer financing, building performance demonstrations and other activities in support of local energy-efficiency programs. Yearly awards.	www.eere.energy.gov/state_energy_program/funding_states.cfm#fg
		State Energy Program (SEP) – Special Project Grants	States	Market assessment, home inspections, diagnostic testing, best practices installations, marketing and outreach, financing and incentives, quality assurance and other activities in support of local energy-efficiency programs. Yearly awards.	www.eere.energy.gov/state_energy_program/funding_states.cfm#sp
		Weatherization Assistance Program	Individuals/families	Through this program, weatherization service providers install energy efficiency measures in the homes of qualifying homeowners free of charge. DOE provides funding and technical guidance to the states, but the states run their own programs and set rules for issues such as eligibility. They also select service providers, which are usually nonprofit agencies that serve families in their communities, and review their performance for quality. Varying award cycles.	http://apps1.eere.energy.gov/weatherization
	U.S. Department of Housing and Urban Development	Community Development Block Grants (CDBG) – Entitlement Grants	• Larger Cities (over 50,000 people) • Urban Counties (over 200,000 people) • Insular Areas Including American Samoa, Guam, Northern Mariana Islands, and U.S. Virgin Islands	Program design and implementation, training and certification, low-interest financing and incentives, marketing and outreach, and quality assurance activities. Efforts must be designed to improve living conditions for low- to moderate-income populations. Varying award cycles.	www.hud.gov/offices/cpd/communitydevelopment/programs/entitlement
		Community Development Block Grants (CDBG) – State Administered Grants	•Small Cities • Small Counties	Program design and implementation, training and certification, low-interest financing and incentives, marketing and outreach, and quality assurance activities. Efforts must be designed to improve living conditions for low- to moderate-income populations. Varying award cycles.	www.hud.gov/offices/cpd/communitydevelopment/programs/contacts/

		Description of Organization or Specific Program	Who Can Apply	Funding or Information Description	Web site
Federal Programs	U.S. Department of Housing and Urban Development (HUD)	Community Development Block Grant (CDBG) – Section 108 Loan Guarantee Program	• Cities • Small Cities • Urban Counties • Communities (with state assistance)	Projects designed to help communities implement large physical and economic revitalization projects for entire low- to moderate-income neighborhoods. Activities can include program design and implementation, training and certification, and low-interest finance. Varying award cycles.	www.hud.gov/offices/cpd/communitydevelopment/programs/108
		HOME Investment Partnership Program (HOME)	States • Units of Local Government • Consortiums of Communities	Program design and implementation, training and certification, low-interest financing, grants, direct loans, loan guarantees and incentives, marketing and outreach, and quality assurance activities. Efforts must target low- to moderate-income residents. Varying award cycles.	www.hud.gov/offices/cpd/affordablehousing/programs/home/
		Rural Housing and Economic Development (RHED)	Rural Non-profits • Community Development Corporations and Agencies in Rural Areas • Indian Tribes • State Housing Finance and Economic Development Agencies	Program design and implementation, purchase of materials, training, financing services and incentives, quality assurance activities and the establishment of lines of credit, revolving loan funds, microenterprises, and small business incubators. Annual awards.	www.hud.gov/offices/cpd/economicdevelopment/programs/rhed
		Energy-Efficient Mortgages Program (EEM)	Individuals/families	The Energy-Efficient Mortgages Program (EEM) helps homebuyers or homeowners save money on utility bills by enabling them to finance the cost of adding energy-efficiency features to new or existing housing as part of their FHA-insured home purchase or refinancing mortgage. Varying award cycles.	www.hud.gov/offices/hsg/sfh/eem/eem_prog.cfm
State Programs	Governor's Energy Office (Colorado)	Residential New Home Programs	Various public, private, and non-profit organizations	The Governor's Energy Office (GEO) is actively developing energy efficiency and renewable energy programs for new residential contraction. GEO will be working closely with local jurisdictions and homebuilders throughout Colorado to encourage implementation of ENERGY STAR New Homes programs, Built Green Colorado High Performance Homes, Design Assistance services and financing options for the installation of renewable energy technologies. Varying award cycles.	www.colorado.gov/energy/index.php?/residential/category/new-construction/

		Description of Organization or Specific Program	Who Can Apply	Funding or Information Description	Web site
Non-Profit Programs	Enterprise Green Communities	Green Communities is designed to help developers, investors, and builders make the transition to a greener future for affordable housing.	Various public, private, and non-profit organizations	•Grants: Enterprise offers Planning and Construction, Charrette and Sustainability grants to help cover the costs of planning and implementing green components of affordable housing developments, as well as tracking their costs and benefits. • Loans: Predevelopment, and Acquisition Loans to support the development of affordable rental and homeownership housing that adheres to Green Communities Criteria. • Low-Income Housing Tax Credit Equity: Competitively priced Low-Income Housing Tax Credit (LIHTC) equity) to nonprofit and for-profit developers for new construction and/or rehabilitation of affordable rental housing that generally adheres to the Green Communities Criteria. Various award cycles.	www.greencommunitiesonline.org
	The Kresge Foundation	Environment and Community Development Programs	Non-profits and Government entities that have financial statements prepared and certified by a certified public accountant in accordance with U.S. Generally Accepted Accounting Principles or Government Accounting Standards.	The Environment Program aspires to have tangible effects on the policies and practices associated with climate change and environmental sustainability. Creating opportunity for low-income, minority or disadvantaged residents of the community; Fostering community impact broader than the immediate reach of your organization or activity; Serving an underserved urban or rural geography, where high concentration of need and low financial capacity cripple the opportunities of residents; Elevating environmental conservation as a key consideration by incorporating "green" or environmentally sustainable features into your building project. Varying award cycles.	www.kresge.org/index.php/what/environment_program/
	The Partnership for Advancing Technology in Housing (PATH)	Works to accelerate the development and use of technologies that radically improve the quality, durability, energy efficiency, environmental performance, and affordability of America's housing.	Not applicable	PATH's goals are to • Identify and reduce barriers that impede innovation, including regulatory barriers by analyzing and prioritizing existing barriers to provide recommendations for overcoming them. • Disseminate information to speed the development and adoption of advanced building technologies. • Advance housing technology research and foster development of new technology	www.pathnet.org

		Description of Organization or Specific Program	Who Can Apply	Funding or Information Description	Web site
Non-Profit Programs	The Home Depot Foundation	Affordable Housing Built Responsibly grant program	Non-profits	The Home Depot Foundation administers millions of dollars in grants each year to nonprofit organizations whose missions align with the Foundation's interests in supporting the production and preservation of affordable, efficient and healthy housing. The program includes pass-through grants also. Yearly awards.	www.homedepotfoundation.org
	Energy Outreach Colorado	Energy Solutions Grants	Organizations or projects that build new single family or multi-family dwellings; Organizations or projects that serve single family households based on a request, referral, or crisis intervention, and multi-family housing providers	Energy Solutions Grants provide funds for energy efficiency upgrades that promote energy bill savings. The grants are available to low-income housing providers and organizations that serve low-income homeowners. Yearly awards.	www.energyoutreach.org/join-esg.asp
	Rural Community Assistance Corporation	Environmental Health Program	Various public, private, and non-profit organizations	RCAC's loan fund provides small communities and nonprofit organizations with suitable and innovative solutions to their financing needs. RCAC is certified as a Community Development Financial Institution (CDFI) by the United States Treasury. RCAC is also working with small communities and nonprofit organizations to assist in implementing: "Green Building" Technologies, Solid Waste Management Planning, and Viable Recycling Options. Various award cycles.	www.rcac.org/doc.aspx?211
	Rural Community Assistance Corporation	Loan Fund	Various public, private, and non-profit organizations	RCAC's Loan Fund is a financial resource for rural communities to fill financing gaps and serve those traditionally neglected by conventional markets. A certified Community Development Financial Institution (CDFI), the loan fund offers a comprehensive array of products for affordable housing development, environmental infrastructure and community facilities in rural locations. Each RCAC loan product is designed to meet the unique underwriting and structuring needs of nonprofit and local government borrowers. Varying award cycles.	www.rcac.org/doc.aspx?82

		Description of Organization or Specific Program	Who Can Apply	Funding or Information Description	Web site
Non-Profit Programs	Green Building/Healthy Homes Initiative	Housing Assistance Council (HAC)	Various public, private, and non-profit organizations	The HAC makes short-term loans at below market interest rates to local nonprofits, for-profits and government entities developing affordable housing for low-income, rural residents. HAC's loans enable borrowers to acquire land, pay architectural and environmental fees and cover other costs that arise before construction loans are available. HAC balances careful underwriting and meaningful collateral with flexibility and an understanding that a rural community's best potential housing developer may begin without significant housing development experience. Varying award cycles.	www.ruralhome.org/index.php
	San Juan Development Association	Workforce Housing Program	San Juan County residents	San Juan Development Association works directly with San Juan County, the Town of Silverton and a number of local and regional partners to play an active role in the vision, planning, design, development, funding, and sale of homes which are affordable and attainable to Silverton's workforce.	www.sanjuan2000.org/housing.htm
	The Development Fund	Affordable Housing Program	Various public, private, and non-profit organizations	The Development Fund develops financing programs to support affordable housing and related community development activities in disadvantaged communities. These community development financing entities generally provide equity or direct longer term debt financing, or complement other funding sources that promote community building and revitalization efforts. Varying award programs.	www.tdfsf.org/index.html

5.0 CONCLUSIONS

Given the delay in project implementation, the Anvil Mountain project will have time to use the information provided in this report to work to obtain additional funding, refine its development approach, and move from planning to design and implementation. This conclusion section provides a summary of findings and recommendations of this report for use by Anvil Mountain's project partners:

- Based on modeling and site location/affordable housing goals – passive solar design options should be planned for from the beginning of the design. In selecting architect/engineers for the project, those experienced with affordable housing design/green design should be evaluated.
- San Juan County should consider identifying a lead developer experienced in affordable housing/green design.
- In planning for funding, San Juan County can use the information sources identified in Section 4.2 to guide further exploration of promising funding sources and opportunities. As stated, some opportunities are for individual homeowners and some are for non-profits or municipalities. Creative collaboration should help maximize the benefits that can be achieved from available funding sources. The project partners understand that San Juan County is continuing to pursue and obtain funding for the housing development effort.
- As the project moves forward, San Juan County may wish to refine or update the cost assumptions included in the modeling effort. This could be coordinated with NREL or site-specific cost/benefit analyses could be performed once the home design has progressed to identify which passive and other options would be integrated. San Juan County plans to collect current and actual energy costs and this effort would feed into site-specific planning.
- Because the real estate market is in flux, San Juan County will want to revisit housing incentives for homeowners and market conditions as the project progresses to completion.

6.0 REFERENCES

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APPENDIX A

Additional Resources

Anvil Mountain Site

Additional Resources

Organization	Resource or Program	Description of Resource	Website
Built Green	Built Green Colorado is a voluntary green home building program of the Home Builders Association of Metro Denver. offered to builders across the state.	Built Green Colorado's purpose is to encourage home builders to use technologies, products and practices that result in homes that are better built and better for the environment. A certified home energy rating system/Built Green-approved rater, will conduct random verifications of homes using the Built Green Checklist. The goal of the program is to perform random verifications on 5% of the registered homes. Builders are required to participate in random verification, at their expense.	www.builtgreen.org
Database of State Incentives for Renewables & Efficiency (DSIRE)	Colorado and Federal Financial Incentives	DSIRE is a comprehensive source of information on state, local, utility, and federal incentives that promote renewable energy and energy efficiency. (Residential and Commercial)	www.dsireusa.org/incentives/index.cfm?CurrentPageID=1&State=CO&RE=1&EE=1
Global Green USA	United States arm of Green Cross, International	Global Green USA partners with housing developers and public agencies to 'green' select affordable housing projects. Establishes collaborative partnerships with local governments, affordable housing organizations, and other public and private entities to facilitate the development, adoption, and implementation of sustainable policies, programs, and practices.	www.globalgreen.org/greenurbanism/
Governor's Energy Office	"The Costs and Benefits of LEED-NC in Colorado" (article)	Owners and developers in Colorado are seeking LEED certification for their projects due to competition and the added value of more environmentally responsible and energy-efficient buildings. This paper gives owners and developers information on whether it is cost effective to pursue LEED-NC certification and what the additional costs are. To respond to these questions, 11 of the 20 LEED-NC certified buildings in Colorado were surveyed in this paper.	www.usgbccolorado.org/resources/documents/CostsBenefitsofLEEDNCinCOMarch2007.pdf
Smart Communities Network	National Center for Appropriate Technology	Provides information about other communities that have implemented sustainable development; Identifies technical and financial resources that can help communities plan and carry out sustainable development projects; and provides access model codes and ordinances communities have used to implement sustainable development.	www.smartcommunities.ncat.org

Organization	Resource or Program	Description of Resource	Website
U.S EPA	"American Recovery and Reinvestment Act of 2009: A Guide to Renewable Energy and Energy Efficiency Opportunities for Local and Tribal Governments"	Provides information on ARRA. Focuses on key funding opportunities, tax incentives and bond programs for local and tribal governments in clean energy. Local and tribal governments should refer to guidelines published by specific federal agency administering each funding stream for more detail about allowable activities.	www.epa.gov/cleanenergy/documents/local_guide_to_arra.pdf
United States Green Building Council (USGBC)	National association for the green building industry.	USGBC implements the Leadership in Energy and Environmental Design (LEED)® Green Building Rating System™ for rating the design, construction and operation of green buildings. Also provides quality educational programs on green design, construction, and operations for professionals from all sectors of the building industry.	www.usgbc.org