FINANCIAL FEASIBILITY

U.S. Department of Energy
Solar Decathlon 2021

Our actual client Joe cutting cement board for the bathroom tiling.

INTRODUCTION

Homeownership is a significant step towards generating wealth for one's family and creating a stable, prosperous life. The SPARC House provides affordable and efficient options for homeowners through progressive measures to increase density and reduce overall costs. The five fundamental pillars that drove the design and methodology throughout the competition (Sustainability, Performance, Attainability, Resilience, and Community) lead the financial feasibility of the SPARC House to meet the target market needs within mountain communities.

Sustainability

Through the addition of an Accessory Dwelling Unit, cost burdens are substantially reduced, and flexible financing through FHA loans allow young homeowners to purchase this home within mountain communities.

Performance

Through thoughtful and data driven design, high performance systems like the PV array, HVAC and passive cooling strategies substantially reduce operating costs for the SPARC homeowners.

Attainability

The addition of the ADU makes this home both a private property and an investment property, allowing homeowners to use their capital in a progressive, smart manner to make the property more affordable in an already expensive market, for year-round residents to make a difference within their community.

Resilience

High performing systems and exterior finishes, make the house resilient to the increasing likelihood of significant natural disasters that can cause extreme damage to houses, requiring significant capital investments to correct the functionally or retrofit the home to withstand these events.

Community

Mountain communities continue to see increases in housing shortages, primarily affecting locals and seasonal workers. The Accessory Dwelling Unit provides affordable housing to these affected people, while reducing the overall costs for the homeowner. A stable and affordable rental unit fosters community connection and opportunities for growth in mountain towns.

AFFORDABILITY

Mountain towns across the nation continue to see population growth out pace housing growth, creating more demand and raising the cost of homes in mountain towns. The average price per square foot for homes across the United States was just under $119 in 2019, yet for Grand, Garfield, and Eagle County the average price per square foot was $356, $246, and $500, respectively (Figure 1). While construction costs across the nation have risen recently due to the rising costs of labor and materials, mountain communities face unique challenges. The remote locations cause supply chain issues and shortage in labor markets.

Specifically in Colorado, materials must be transported along the I-70 corridor, adding additional transportation costs. Many times, during the construction period, contractors either commute from the Front Range or rent within the community further complicating the construction process. During the winter months construction can be suspended and new construction must wait until the spring and summer months to pour foundations and begin the structural work of the buildings. Combining all these factors causes dramatic price increases, logistical challenges, and construction delays for these mountain communities.

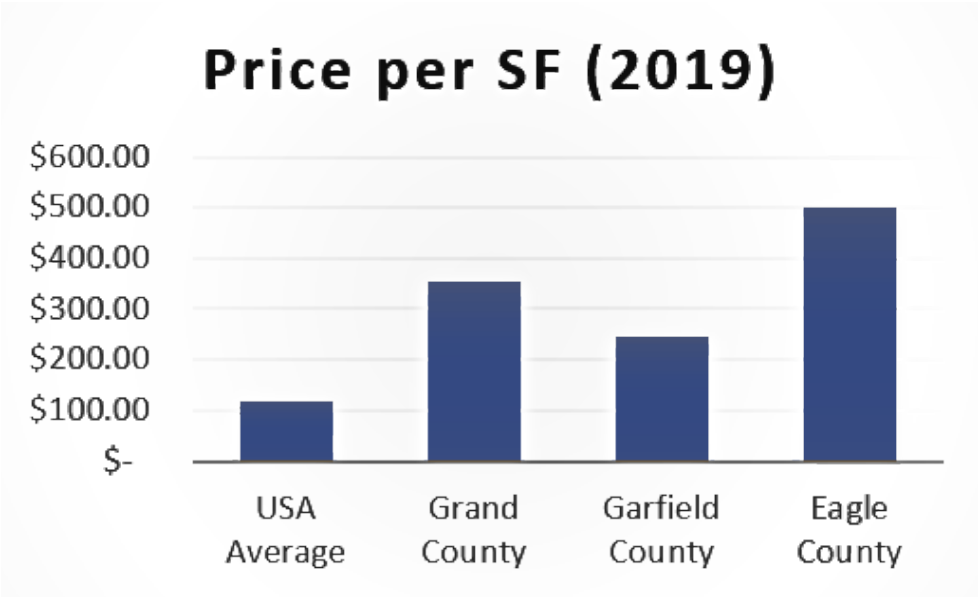

Figure 1: Average residential cost per square foot in the US vs in mountain towns

Mountain towns over the last two decades have become the hottest secondary home markets in the nation. As wealthy individuals look to purchase vacation homes, they increase affordability issues for young homeowners and seasonal workers. Since 2010, more than 90% of the homes sold in Vail were unoccupied homes (Figure 2). Due to the high demand for secondary homes, home builders within the region prioritize large high-end homes, due to the profit margins and extreme appreciation within the market.

Secondary home markets, labor shortages, logistical challenges, and rising construction costs cause mountain communities to become disjointed and represent significant challenges for a stable, healthy economy. These challenges and the need for affordable homes were the guiding principles to the design and application of the SPARC House. To combat weather changes, the SPARC House uses prefab panels, built in Denver, Colorado, taking advantage of the labor market and a climate-controlled warehouse. After the home is constructed on site and sealed from outside variables, interior finishes and systems can be completed without worries of weather delays. High performing systems throughout the home reduce the overall operating costs for the homeowner, especially in extreme climates of mountain communities. To increase supply of affordable housing options in mountain towns, local city councils and Board of Trustees are adopting progressive measures, like ADUs, zoning changes, or subsidies for new construction. In Fraser, the City Council just adopted special provisions allowing ADUs in single family homes:

"Sec. 19-2-470. - Accessory dwelling units.
An accessory dwelling unit (ADU) may be approved as listed on the Schedule of Uses in Section 19-2-340, provided that an ADU complies with the following criteria:
(1) The size of the ADU shall be subject to the following limitations:
a. The ADU shall contain at least two hundred (200) square feet of floor area;
b. The ADU shall be no larger than fifty percent (50%) of the square footage of the principal dwelling unit or twelve hundred (1,200) square feet of floor area, whichever is less; however, an accessory dwelling unit may have up to one hundred twenty (120) additional square feet of attached, unheated, uninhabitable outside storage.
c. An ADU may be attached to a principal dwelling unit, located in a detached unit or located in an attached or detached garage.
d. No ADU shall be separated by ownership from the principal dwelling unit."[1]

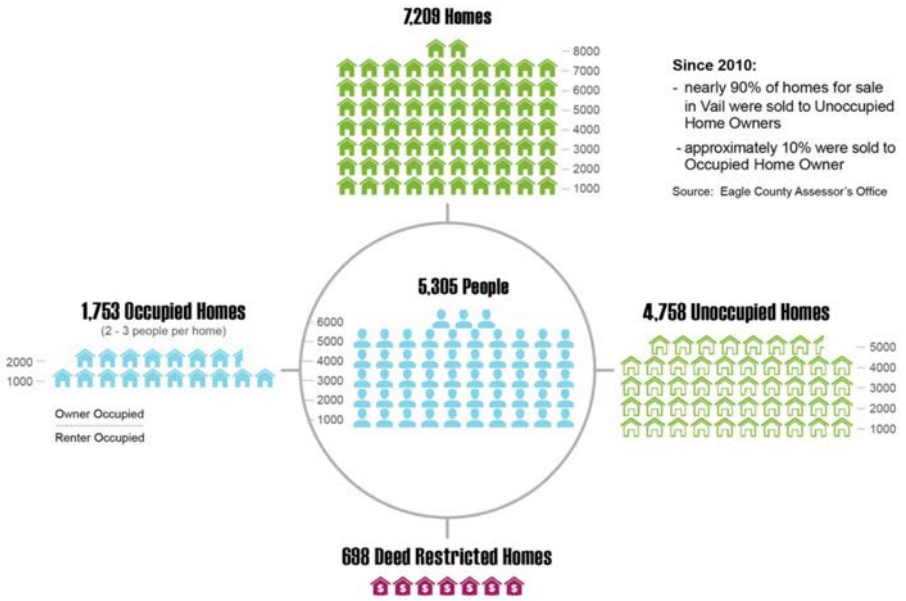

Figure 2: Distribution of homes in Vail since 2010

Accessory dwelling units create opportunities for both homeowners and residents to reduce the overall cost of housing and provide needed density to the community. The SPARC House follows the specific language provided in the Fraser zoning code.

The use of high performance systems, resilient exterior finishes, and the addition of an ADU, does raise the up-front costs of the SPARC House; however, the rental income and significant reduction of operating costs make the home a much more affordable option for homeowners long-term. While the down payment of $87,800 for a conventional loan of 20% at a purchase price of $439,000 may be out of the price range for young couples looking to purchase the SPARC House, alternative financing options exist like FHA Loans. FHA Loans require a minimum of 3.5% down payment, which would be only $15,365 for the SPARC House. While there are other expenses with an FHA loan like a mortgage insurance premium, the rental income provided from the ADU offset these costs.

Because of the high performance systems and upgraded exterior finishes, home buyers have up-

front costs that are 5% higher for purchasing the SPARC House compared to an average priced house in Fraser based on price per square foot. However, after analysis of predicted costs and generated income from the ADU, either option to purchase the SPARC House through a conventional loan or an FHA loan saves the homeowner 37% or 18%, respectively, in annual housing expenses.

The median household income for Colorado in 2019 was $77,127.[2] This makes both options for the SPARC House fall within the range of affordability, allowing SPARC residents to spend less than 40% of their annual income on housing.

While price per square foot may not accurately represent the true costs of the home because the homeowners forgo some square footage for the ADU area, price per square foot remains the best way to measure construction costs within the region; especially, with the complications of construction with the remote location, logistical challenges, and weather considerations when constructing in mountain towns. Furthermore, the average home list price in Fraser, CO in December of 2020 was $699,000, well above the build cost of the SPARC House at $439,000.[2]

	SPARC House(80% LTV)	SPARC House (FHA)	Fraser House(80%)
Square Footage	1,176.00	1,176.00	1,176.00
Up-Front Price per SF	373.30	373.30	356.00
Down Payment	87,800.00	15,365.00	83,731.20
Up-Front Costs	439,000.00	439,000.00	418,656.00
Annual Mortgage (80% LTV)	21,353.75	25,757.96	20,364.18
Mortgage Insurance Premium	-	1,836.00	-
Annual Taxes	2,835.98	2,835.98	2,704.53
Annual Insurance	3,056.00	3,056.00	2,709.00
Annual Utilities	397.20	397.20	3,536.11
Annual Maintenance	2,195.00	2,195.00	4,186.56
Less ADU Rental Income	(8,800.00)	(8,800.00)	-
Total Annual Expenses	21,037.93	27,278.14	33,500.37
Necessary income (33%)	63,751.30	82,661.03	101,516.27

Figure 3: Necessary income to live in the SPARC House through different financing options

COST EFFECTIVENESS

As the climate continues to change, the severity and frequency of extreme weather events continue to increase, thus new construction must increase their resiliency needed to withstand climate changes. While the SPARC House has higher up-front costs, because of high performing systems, resilient finishes, and no complex active systems. Through a metal roof, EV array, pine tar treated siding, zone-based HVAC, and well-designed systems, operating costs are significantly reduced and greater home appreciation. Mountain communities continue to see rising costs and home prices well above the normal median home price in the United States.[5] In Fraser as of February 24th, 2020, there were only 2 market listings for homes within city limits with an average price per square foot of $616.[6] Inventory in the state of Colorado and in Fraser, CO are at an all time low and there are currently zero active listings of

houses that would be defined as affordable in the town.

Mountain community housing stock is unlike most communities across the nation. Currently, in Grand County 73% of the homes are for seasonal, recreational or occasional use.[3] This community struggles to find year-round residents, who contribute to the local economy.

While the SPARC House has a $373.30 price per square foot, the rental income and annual savings, reduce the cost to well below the average cost of homes in Grand County currently, and based on median income, affordable for families in the community.

COST ESTIMATE

As-Built Cost Estimate

Over the course of the project, challenges to cost estimates dramatically changed due to design changes, system changes, construction methodology, and the impacts of COVID-19. However, with this all being said the SPARC House price of $439,000 is an accurate estimate of the market rate of all design, material, labor, and government fees for the total construction of the SPARC House. Because of the panelized construction method, the SPARC House construction costs will have much less variance in price compared to standard construction within mountain communities, due to labor and material supply and demand. The final occupants of the SPARC House will add a garage. Yet for another SPARC House, the as-built costs will remain similar to the predicted $439,000,

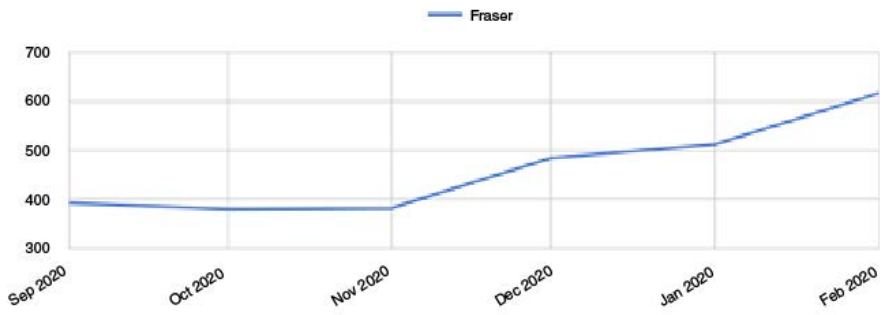

Figure 4: Average price per square foot in Fraser, Colorado[3]

with the exception of the included costs of land which varies depending on the mountain community and distance from the city center.

Operational Cost Estimates

Based on models of PV production and energy consumption, the house will use 8,858 kWh compared to a standard mountain house of the same size using 14,317 kWh annually, representing a reduction of 40% energy consumption. The PV array is expected to produce 9,025 kWh. Depending on annual snowfall, for most of the year the home will produce more electricity than consumed, a significant savings to the homeowner. With water saving measures and the education of water consumption to the ADU tenant, water savings are expected to be 50% less than that of a standard house. With the difficulty some mountain communities have with natural gas supply, the SPARC House has eliminated the need for natural gas. Due to the effective design and high-efficiency systems, the SPARC House will cost the homeowner 11% in utilities expenses versus a standard house.
Other operational costs include maintenance, insurance, and taxes, which may vary from house to house. Below are the listed estimates for annual costs for the SPARC House. The annual property tax assessment for the state of Colorado is 7.96%.[4]

Calculating property taxes can be found through:

Tax Assessment X Assessment Rate X Mill Levy = Property Tax Amount Due [6]

Thus, for the SPARC House annual Taxes will be:

$489,000 X 7.96% X .081156 = $3,158.99 (reflected in the above charts)

Insurance also varies based on property assessment, homeowner credit, and coverage amount. A homeowner, with modest credit, and an industry standard coverage, should expect an annual cost of $3,056 for property insurance.

Annual maintenance for homes is usually 1% of the property value, yet can vary significantly, due to the age and condition of the home. The SPARC House is specially designed to withstand the harsh winter climate of Fraser, Colorado. With high performing windows, pine tar treated siding, metal roofs, roof slopes for snow load, and no gutters, the house will perform more efficiently and

eliminate some of the necessary maintenance. While it is hard to determine the exact amount of maintenance needed due to the variability of general wear and tear and weather events, the SPARC House reduces required maintenance by 50%. On average homeowners should allocate around $2,445 annually for home maintenance.

Endnotes

1. Municode library. (n.d.). Retrieved February, from https://library.municode.com/co/fraser/ordinances/municipal_code?nodeId=885441
2. Fraser, Colorado (CO) INCOME MAP, earnings map, and wages data. (n.d.). Retrieved February, from https://www.city-data.com/income/income-Fraser-Colorado.html
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