EXECUTIVE SUMMARY

GREEN AFFORDABLE HOUSING

Habitat for Humanity Roaring Fork Valley

URBAN & REGIONAL PLANNING CAPSTONE PROJECT REPORT ON

"WAPITI COMMONS AFFORDABLE HOUSING PROJECT"

FOR

HABITAT FOR HUMANITY ROARING FORK VALLEY

Capstone Project submitted in partial satisfaction of the requirements for the degree of
Master of Urban and Regional Planning,
College of Architecture and Planning, University of Colorado Denver

Master of Urban and Regional Planning
COLLEGE OF ARCHITECTURE AND PLANNING
UNIVERSITY OF COLORADO DENVER

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13th May, 2021

OVERVIEW

The City of Rifle, Colorado is a town in Garfield County of approximately 9,706 residents (United States Census Bureau, 2019). Garfield county has become the 12th most populous of Colorado's 64 counties as a result of the burgeoning natural gas extraction industry, expansion of tourism, healthcare, second home development and regional services.

According to the 2019 Greater Roaring Fork Housing study on Rifle, the city is expected to grow by 25,000 people in the next decade, with primary development among senior age groups 65 and over, as well as the workforce population of 25 to 44 years (Economic & Planning Systems & Associates, 2019). As a result, it is anticipated that by 2027 there will be shortfall of approximately 5,700 housing units affordable to households earning less than the area median income (AMI). Habitat for Humanity Roaring Fork Valley is working towards increasing long-term affordability and sustainability in their affordable housing project at Rifle—Wapiti Commons—by using passive solar design techniques. This Capstone project focuses on assessing means by which the project might achieve Net Zero emissions at minimal upfront cost by adopting passive solar design techniques.

GREEN AFFORDABLE HOUSING

Research has shown that households who must spend more than 10% of their income on energy-related costs such as electricity and natural gas are cost-burdened, resulting in housing insecurity and high risk of eviction (Marie, 2018). Energy savings and long-term affordability can be achieved by adopting green building concepts while achieving Net Zero emission.

Although over the past decade, green buildings have emerged as high-performance, energy-efficient structures that enhance occupant comfort and well-being, green building has not been involved in a large number of affordable housing developments for a variety of reasons. Among the causes are an almost exclusive emphasis on "first costs," legislative rigidity that restricts green creativity, the presence of per-unit cost controls, and a finance mechanism that fails to consider the long-term importance of green investments (Charron, n.d.). Recent reports have reported the costs and benefits of green building in the institutional and industrial sectors, reporting that although green buildings have a small initial cost premium, the long-term benefits greatly outweigh the marginal capital costs (Nalewaik & Venters, 2008).These results have enhanced green building activity in these fields, but their relevance to affordable housing construction has been met with skepticism.

To address the need for green affordable housing, Habitat for Humanity Roaring Fork Valley is launching Wapiti Commons, a new energy-efficient, affordable housing development. Wapiti Commons will provide 18 affordable for-sale units for the population earning about 80% AMI, consisting of 8 senior flats and 10 townhomes for working families. This development is working towards adopting passive solar design technology in their construction and photovoltaic roof installation to generate electricity, striving to be a zero-energy development in the future.

KEY FINDINGS

While county housing in 2021 grew by 10.3% for single-family homes and dropped by -31.9% for townhomes from the previous year, the Rifle housing industry attracted 55 of these new units (single-family homes and townhomes) that were built between 2016 and 2021(Garfield county Profile, n.d.).

Case study research revealed many significant results, including:

- In addition to CDCs, non-profit agencies, and other community-based organizations, private homeowners aim to convert their homes into green buildings by implementing low-cost, easy-to-install green technology, thus committing to green sustainable housing. Using a life-cycle approach, green affordable housing is more cost effective in net present value terms than conventional affordable housing developments.
- The case studies demonstrate that the benefits of green affordable housing are accurate and, in some cases, meaningful in terms of life-cycle net present value.
- In some of the case study projects, more durable components and equipment result in lower maintenance costs and additional life-cycle financial benefits. Furthermore, the importance of increased resident comfort, wellbeing and decreased environmental impacts is essential.
- Although often requiring higher initial investment, many low-cost methods can contribute to reducing energy consumption. Passive solar design uses site location, climate, sun movement, and locally available materials to reduce energy consumption for heating and cooling loads. Where passive solar design maximizes these natural elements, other green technologies have higher installation and maintenance costs, contradicting the purpose of energy efficient technologies.

RECOMMENDATION

Based on the advantages of passive solar affordable housing and the local context of Rifle, the City should consider enabling and promoting green affordable housing construction in the city and working to spur the development of underutilized land parcels, by implementing the goals of Garfield County's 2017 Energy Action Plan, along with existing collaboratives such as Garfield Clean Energy Collaborative (GCE). Among the most basic configuration and structural changes required to incorporate passive solar design in Wapiti Commons' current conceptual plan is an upgrade to the building compactness and orientation, along with working on an efficiency scenario that utilizes the principles of passive solar design and PV panels, and usage of suitable materials in compliance with passive solar design for the best outcome.

• The current optimal area to volume (A/V) ratio between townhomes and quadplex apartments on site is 1.3 m^2/ m^3, which is above the desired amount of 0.7 m^2/ m^3 required for passive solar design. With the higher area/volume ration between building structures when compared to the required amount, comes a lack in closeness, thus affecting compactness between buildings to promote insulation, which can be addressed by inducing green pockets that provide a healthy environment. Wapiti's building orientations although aligned from north to south, need to be displacement on the north-west corner to prevent overlapping of buildings obstructing ventilation and airflow.

• An energy efficiency scenario based solely on the sustainability metric of photovoltaic (PV) panels results in a HERS (Home Energy Rating System) score of 8, an annual energy bill of $290, and a lifetime energy savings cost of $39k, putting it close but not entirely on the path to being a NetZero building. An energy efficiency scenario that incorporates passive solar design elements such as housing orientation in the southeast or south-west direction, compact building envelopes, and photovoltaic (PV) panels results in a HERS (Home Energy Rating System) score of -2. It saves an additional 1 to 2% of energy usage, and results in a $124 annual energy bill, a $43k lifetime energy savings cost, and net-zero emissions. As a result, Wapiti Commons should be built with a building efficiency strategy that integrates passive solar technology and PV panels, resulting in a HERS score of -2, making it a NetZero emission building with greater energy savings than other alternatives.

• The use of materials is vital to Wapiti's goal of sustainability and affordability. The use of coarse construction materials, such as timber for the structure, concrete for the foundation, and laminate, wood, or tile for flooring, facilitates solar energy absorption. These coarse materials serve as insulators instead of reflectors or barriers to absorb energy and thus are integrated construction techniques to use life-cycle costing in

analyzing project economics.

This, using life-cycle cost to measure a building's overall economics rather than just considering initial cost will offer more accurate statistics in a standardized format, assist in addressing the shortcomings of green affordable construction data, and support the introduction of minimum green criteria into affordable housing.

WAPITI COMMONS CONCEPTUAL DESIGN SHOWING TOWN HOMES AND DUPLEX ORIENTED N TO S, AND 6 TOWNHOME UNITS ON NW CORNER TO BE RELOCATED

Fig 6.2: TOWN HOMES AND DUPLEX UNITS ORIENTED N TO S, AND 6 TOWNHOME UNITS ON NW CORNER TO BE RELOCATED

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