



ARCHITECTURE NARRATIVE D8 SUBMISSION

UNIVERSITY OF WYOMING (UWYO)
U.S. DEPARTMENT OF ENERGY
SOLAR DECATHLON BUILD CHALLENGE 2023

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I. Introduction

Overview

Key features of the Wind River house:

- 6.11-acre parcel in Grand Cedars Third subdivision
- 3 Bedroom, 2.5 Bathroom
- Gross Area: 2799 ft²
- Two-slope roof form to address both passive and active solar
- **“Minimal Mountain Modern”** style with rustic exterior materials, including reclaimed snow fence and forest-fire wood
 - Double-height great room with open loft
 - Oversize mud room to address rural lifestyle
 - Polished concrete heated floors throughout
 - South-facing porch with shade structure and operable shading
 - Radiant in-floor heating and cooling
 - Landscaping using hardscapes, native plants and drought-resistant plants

Located in the Wind River mountains near Lander, Wyoming, the Wind River project aims to show Wyoming homeowners and builders that Zero-energy homes can be both market ready and attractive. The Wind River team believes that homes should be both sustainable and attainable. Individuals unfamiliar with passive and sustainable building strategies may view Net zero homes as science experiments. The Wind River project tackles this misconception by incorporating off-the-shelf equipment, standard construction methods, and a rustic style that fits the landscape and meets the expectations of Wyoming homebuyers.

Minimal Mountain Modern design incorporates rustic materials such as wood and metal siding. Neutral color palettes and locally sourced materials are also important characteristics of this style. The home is made to be sympathetic with its surroundings and regional architectural traditions. It connects interior and exterior with large windows and outdoor spaces.

Beyond creating a sustainable and attainable home, the Wind River project also aims to create a livable and functional dwelling that Lander residents can grow old in. 84.4% of the Lander community lived in a home for more than one year in 2020. With the Wind River Home’s ADA compliance, resilient finishes, and privacy of the site, we hope to contribute to the 84.4%. Although the home is away from the city of Lander itself, the views and energy savings compensate for the drive.

The Wind River home is adjacent to the Wind River Reservation, home to 3,900 Eastern Shoshone and 8,600 Northern Arapahoe and about 2,268,000 acres of land within its exterior boundary. The home's site overlooks part of this land, a canyon with bright red rocks formed from the high levels of oxidized iron between and on the grains of the rock. The landscape's color pallet morphs throughout the seasons as snow conceals the cliffs and only a few green specks peek through. We considered the land and its history throughout our community outreach efforts and within the home's interior design elements.

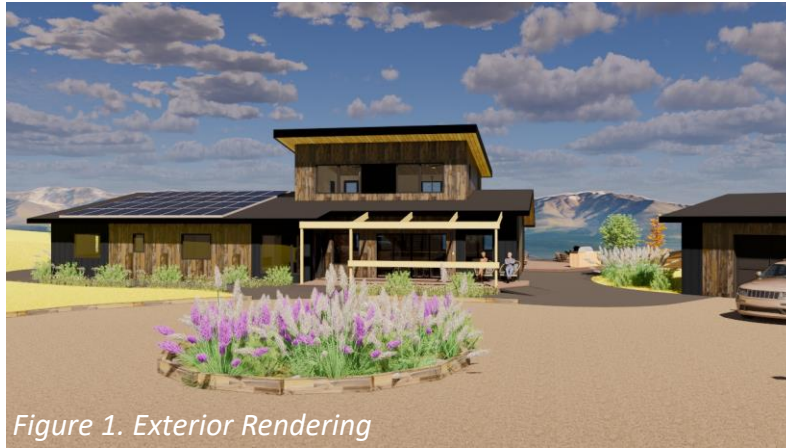


Figure 1. Exterior Rendering

The home sits on 6.11 acres of land in Grand Cedars Third subdivision. At 2799 ft², the 3 bed 2.5 bath home features an oversized mud room, double height great room, and polished concrete flooring. The house also has a detached 2 car garage and turn around driveway, to meet the expectations of homebuyers.



Figure 2. View from site

II. Design Process and Concept

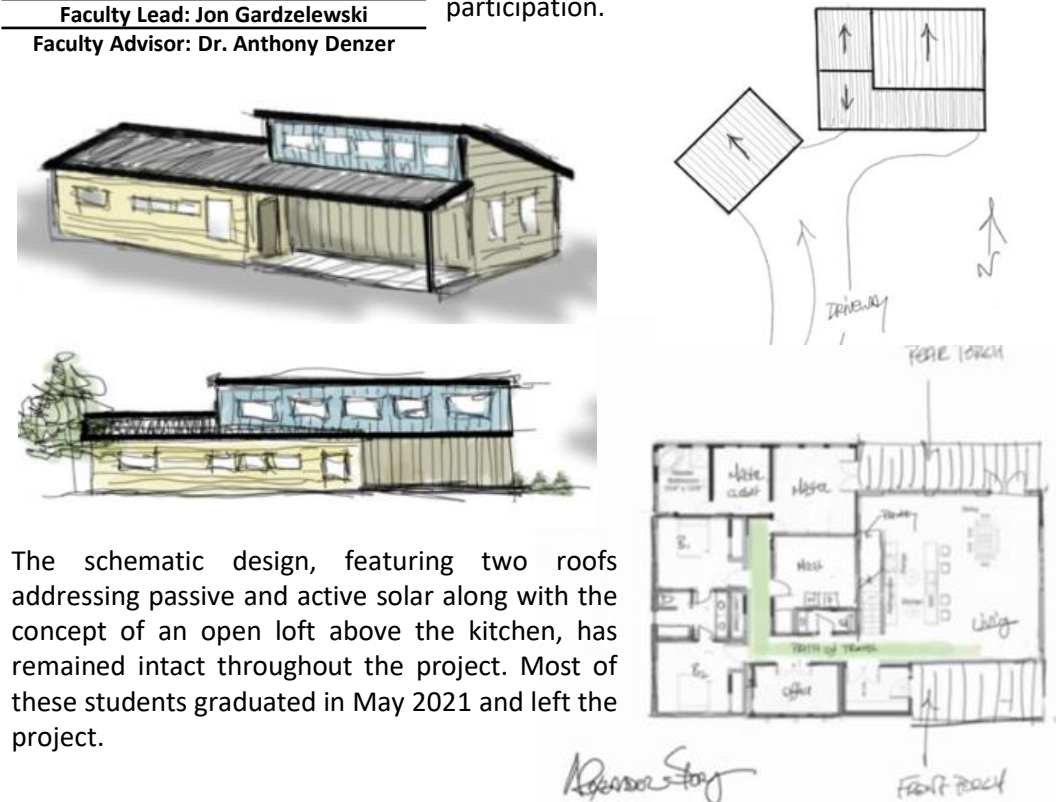
Phase I

The process began in Spring 2021 when University of Wyoming faculty advisor Jon Gardzelewski assembled a team of ten students to complete schematic design for the Wind River house.

Team Members Phase I	
Tessa Anderson	ChooiKim Lau
Sarah Bridges	Caroline Long
Casey Bonagofsky	Caleb Pachel
Ione Chandler	Peyton Smith
Hope Farris	Alexzander Story
Faculty Lead: Jon Gardzelewski	

Faculty Advisor: Dr. Anthony Denzer

We worked with Timshel Construction to establish the program and vision for the project; they had purchased the land at this time. The students each produced a design, and we held an internal 'competition' to select a scheme, with Timshel's participation.



The schematic design, featuring two roofs addressing passive and active solar along with the concept of an open loft above the kitchen, has remained intact throughout the project. Most of these students graduated in May 2021 and left the project.

Figure 3. Sample project-Phase I schematic design 'competition'.

Phase II

In Fall 2021 and Spring 2022 we recruited a new student team to complete the engineering design, construction documents, and submittals D1 through D4. Several of these students graduated in May 2022 and left the project.

Phase III

In Fall 2022 and Spring 2023 we recruited a new student team to manage the project, complete D5 through this final submittal.

The initial design goals focused on creating a home centered around occupant experience, sustainability, and palatability to Wyoming consumers. The product was an attractive minimal mountain modern design with clean, sharp lines and materials that mirror the western landscape. Multiple elements throughout the home reflect the focus on occupant experience and sustainability. Take, for instance, the upper and lower sets of south-facing windows. A widespread problem among passive solar heating is the uneven distribution of heat and light in the home. Creating two levels through which the south-facing sun enters ensures light and heat are evenly distributed.

Team Members | Phase II

Alison Carlo (lead)	Nick Meier
Manuel Cabrera	Elias Rhoads
Benjamin Cole	Shianne Shaver
Keelie Wortmann	Travis Wicks
Erika Wilson (Ferrell)	

Faculty Lead: Jon Gardzelewski

Faculty Advisor: Dr. Anthony Denzer

Team Members | Phase III

Alison Carlo (lead)	Colton McClure
Britt Bardman	Samuel Spiker
Erin Christiansen	Travis Wicks
Emmanuel Iddio	Erika Wilson (Ferrell)
Nick Kulow	Keelie Wortmann

Faculty Lead: Jon Gardzelewski

Faculty Advisor: Dhawal Jain

Faculty Advisor: Aysha Demir

Faculty Advisor: Dr. Anthony Denzer

Careful consideration was taken during every aspect of the home design to ensure the best possible occupant experience. From the garage to the vegetation, occupants are made to feel embraced by their surroundings. Positioned to block the view of the road and neighboring sites, the location of the detached garage adds a sense of seclusion and privacy.

Given the layout of the site, a turn-around driveway was chosen as a safer and more accessible alternative to a traditional driveway. It also provides additional space for parking. The home's orientation at 15 degrees South East (SE) delivers spectacular views of the surrounding site from the north and south-facing windows.

The north view is easily enjoyable from the 2300 ft² deck surrounding the home. The large deck is a central way in which the design connects outdoor and indoor spaces. On the south side of the deck, the porch is covered with operable shading. This system allows the shades to be retracted in the spring and fall months when the desired amount of light entering through the south-facing windows may vary depending on outside temperatures.

The site's planned vegetation consists of a variety of native plant species. The indigenous species' natural resilience to local weather reduces the resources required to maintain the landscaping such as water and fertilizer, making it the ideal choice for both the homeowner and the environment.

III. Architectural Implementation

Spatial Design

The home is split into two distinct sections: public and private. Public spaces include the mudroom, great room, kitchen, and loft. Key features of the public space are the double-height ceiling in the great room and the open loft space with views of the surrounding mountains. The high ceiling in the great room brings in light from the second-story windows and gives the room a spacious feel. The addition of the loft also creates a second, lower ceiling height above the kitchen making the space feel distinct from the living area.

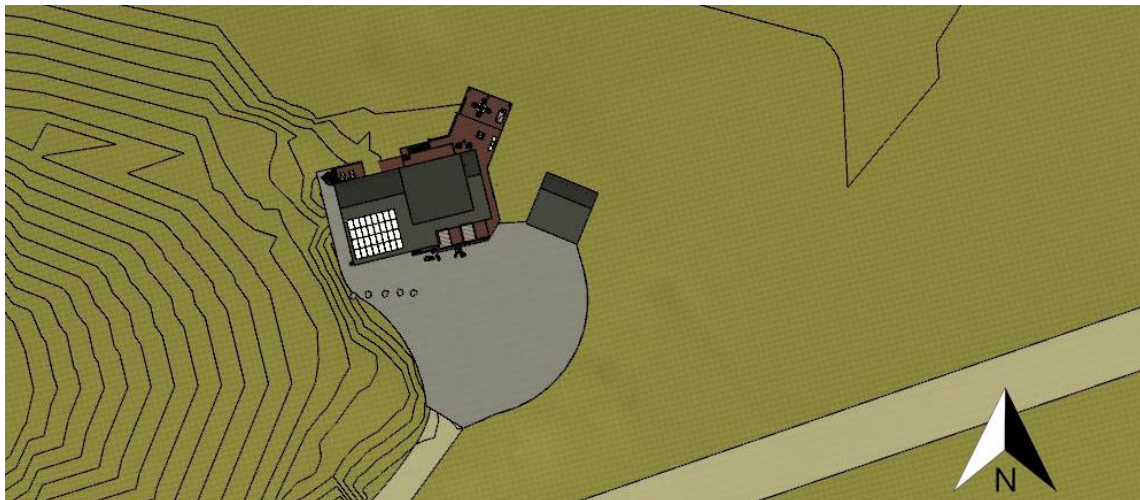


Figure 3. House Orientation on Site

The private spaces are found on the left side of the home. Separating the private living via a hallway off the kitchen gives them a sense of seclusion and separation from the busy communal spaces of the home.



Figure 5 (Right). Image of Double-Height Ceiling and Loft as Seen from Great Room



Figure 4 (Left). Great Room Render Showcasing Double Height Ceiling



Figure 6. Floor Plan

Passive Strategies

Oriented 15 degrees SE, the building uses large south-facing windows to passively heat the residence during winter months. This reduces the homes' reliance on mechanical heating methods. To prevent unwanted heat gain during the warmer seasons, the roofs are angled to block the high summer sun from entering the home and overheating the space. An awning with operable shading is designed to help mitigate unwanted heat gain during spring and fall months when heating and cooling needs may vary. During the summer months, the north and south-facing windows open to function as a natural cross-ventilation system for the home as demonstrated in figures 7 and 8.

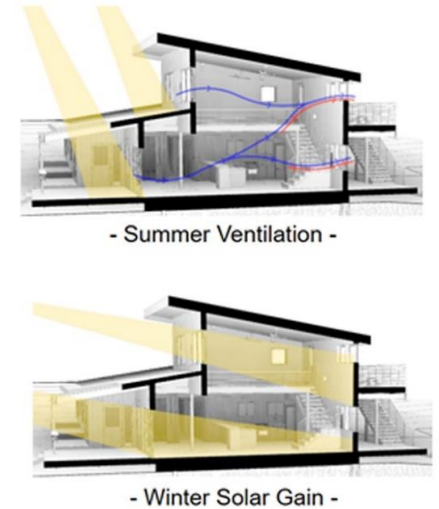


Figure 8. Ventilation and Solar Heat Gain

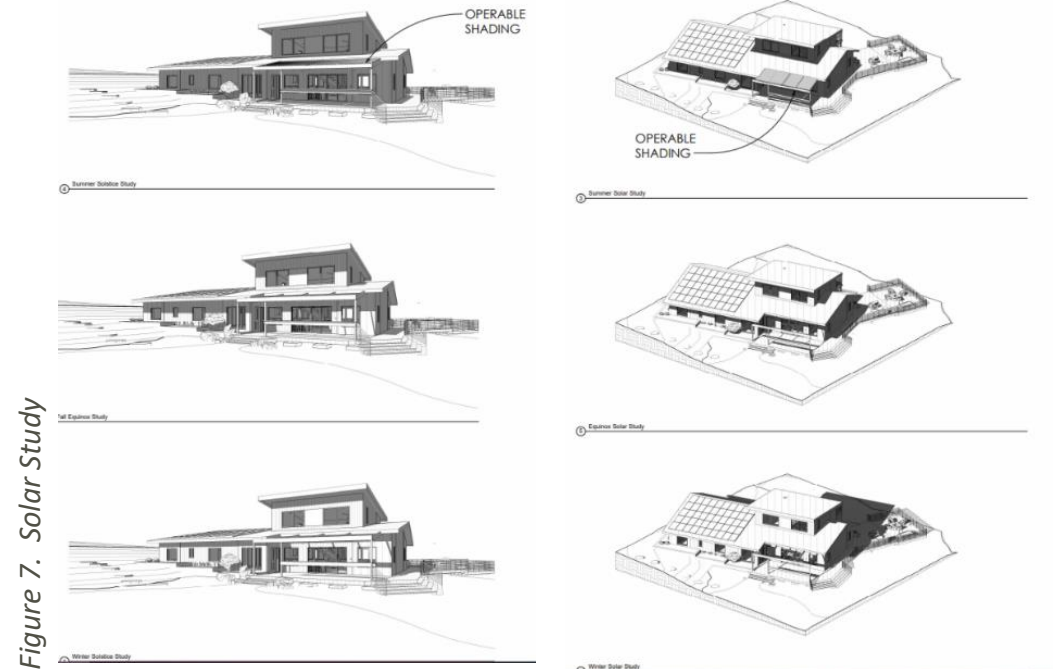


Figure 7. Solar Study

Active Strategies

When selecting a heating and cooling system for the home, comfort and energy efficiency were prioritized. By selecting a hydronic heating and cooling system energy required to heat and cool the home reduces. Occupant comfort is increased as radiant systems heat and cool more consistently and are quieter than their standard air system alternatives.

Additionally, hydronic heating and cooling systems make it easier to maintain good indoor air quality. The increased durability and consequent longevity of the system are added benefits. This system was paired with concrete flooring due to its ability to store heat and radiate it over time.

Regarding measures to ensure a tight seal between the interior and exterior of the home, the house was sealed with AeroBarrier. Given the harsh Wyoming winter, having a tight building envelope is necessary to prevent heat loss. By using AeroBarrier, heating and cooling loads for the home are reduced. This increases energy efficiency and decreases costs for homeowners.

Finally, lighting was another area of active implementation of energy savings. Dimmable LED lighting is found throughout the house to provide homeowners with automatic cost and energy savings. They are also intended to be operable to provide residents with complete control of their home.

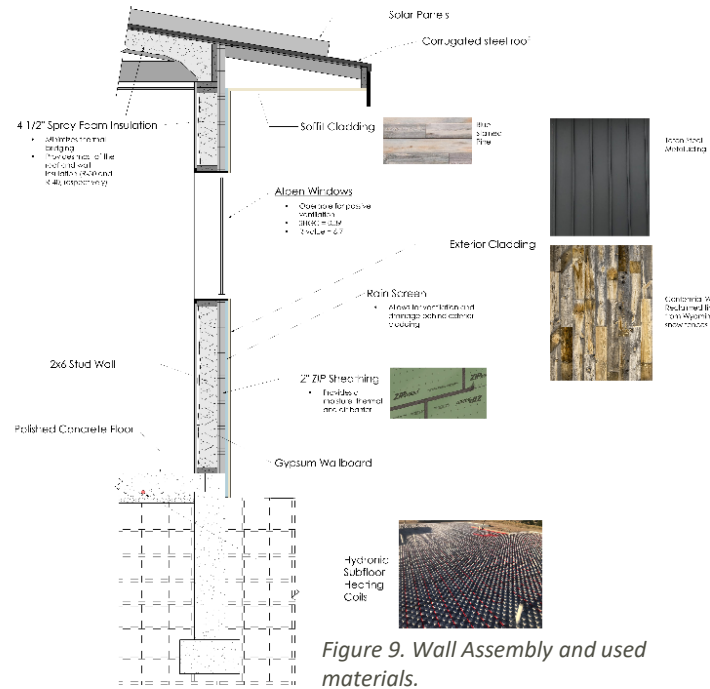


Figure 9. Wall Assembly and used materials.

Materiality

Materials were chosen with environmental impact, insulation, practicality, and aesthetics in mind. Spray foam insulation, used on both the roof and walls, was selected due to its high R-value. The roof is corrugated steel. The team opted for polished concrete floors because of concrete's high thermal mass allowing them to retain and disperse heat from the radiant heating system throughout the day.



Figure 10. Material Collage



Figure 11. Reclaimed Forest-Fire Wood for Entry and Bench

Using reclaimed wood sourced from local forest fires and snow fences played a significant role in the design strategy for the home.

Compared to virgin alternatives, reclaimed wood has a significantly lower environmental impact. Reclaimed wood both prevents deforestation and reduces the waste of valuable materials. As such, reclaimed wood sourced from Cheyenne, Wyoming and the Snowy Mountain Range is featured as the siding throughout the home, the front entry interior beams, and the living room live edge bench (Figure 11).

Other materials and finishes used throughout the home were carefully selected for longevity of the design. A timeless modern aesthetic includes chrome plumbing fixtures to combat the site's perceptibility to hard water providing homeowners.

Other materials and finishes used throughout the home were carefully selected for longevity of the design. A timeless modern aesthetic includes chrome plumbing fixtures to combat the site's perceptibility to hard water providing homeowners with fixtures that are both durable and aesthetically pleasing.



Figure 11. Render of Primary Bedroom and 1/2 Bathroom

Functionality

A design homeowners can grow old in; the house is compatible with all stages of life. It is ADA accessible meaning residents can continue living in the home into old age, but the build is also well suited to those with a more active lifestyle. Unique to the home's design, the front entrance doubles as a mudroom. Because Lander is known for its outdoor recreation and beauty, a mudroom was an important addition to the home for a seamless transition from the exterior to the interior.

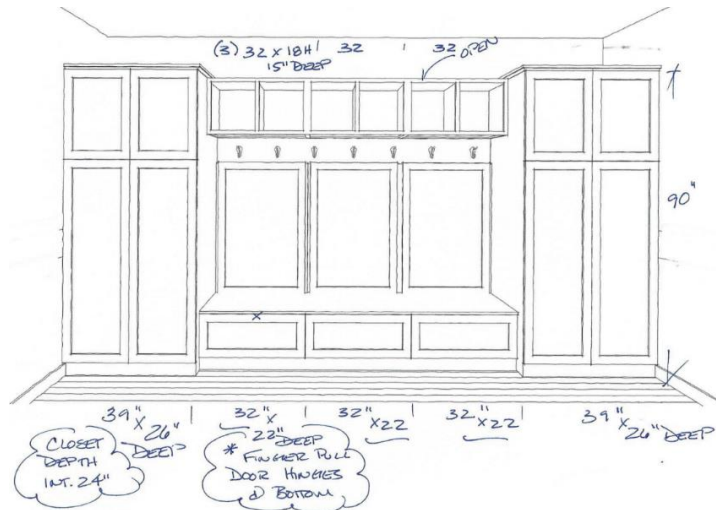


Figure 15. Mudroom Storage Design

This feature showcases the functionality of the design of the home for its intended occupants as it provides additional storage for any gear or equipment that would be used for outdoor activities and the active lifestyle of Lander residents.

Additionally, the kitchen and living room layouts are designed for both entertaining guests, as well as seamlessly transitioning from indoors to outdoors. The kitchen itself features a large six-seater island with bar height seating, as well as an efficient work triangle, making it functional for both entertaining and daily life. The kitchen also has a door that accesses the back porch.

The main living space includes a large entertainment center equipped with an LED fireplace, built-in shelving, and wall-length live-edge wood bench. It also is large enough for a number of furniture arrangements, so homeowners can make this space function as they need it to. The space is also paired with a set of sliding doors, accessed through the dining area, so residents can also experience indoor-outdoor living.

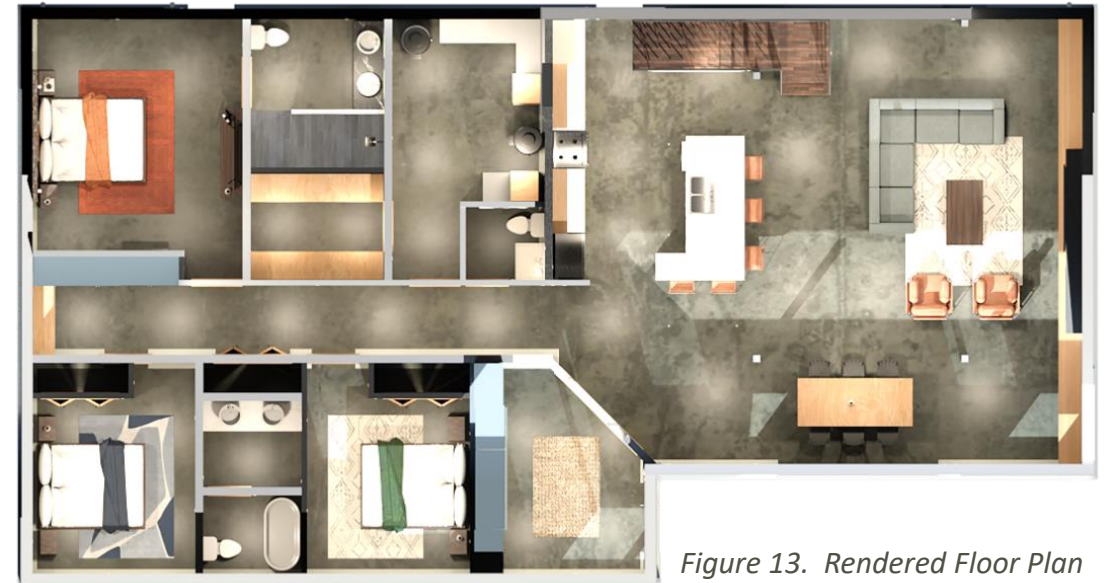


Figure 13. Rendered Floor Plan

IV. Architectural Innovation

Composition

An important characteristic of the design of the home that distinguishes it from others is its readiness to be sold to homeowners as a spec home. Standard construction methods were used as well as off-the-shelf materials to allow a typical Wyoming buyer to feel confident in their purchase of a zero-energy home.

A second innovation in the development of the home was the use of reclaimed wood. As an uncommon building material, reclaimed woods lower environmental impact makes it a great alternative to other materials. Wyoming is also one of the world's top producers in reclaimed wood from snow fences. As such, implementing a local material that also helps lower environmental impact is unique to the Wind River home.

