Sustainable and Energy-Efficient Housing Design for Rural and Remote Communities

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Background
The Blood Tribe First Nations face an ongoing housing crisis due to substandard housing construction and severe overcrowding, stemming from chronic underfunding. Historical housing initiatives for the Blood Tribe have overlooked essential environmental considerations and neglected to prioritize social and cultural preservation. In addition, living in remote areas with poorly maintained roads and unreliable access to power and water increases the challenges of constructing and maintaining habitable homes in these communities.

Methodology
The target of the design was to ensure a reliable, functional, and cost-effective build that encompasses the cultural needs of First Nations communities.

Criteria Selection
The criteria selected for process for all aspects of the design included evaluating the social, environmental, and economic implications as sustainability is the forefront of this building process.

Geotechnical Considerations
Due to these factors and ensuring ease of construction in a remote area, screw piles are recommended for these homes. Regardless of the soil composition, screw piles can successfully be installed and are a low-cost option as well as having a low environmental impact.

Water Considerations
For a home on the Blood Tribe reserve, a rainwater harvesting system was designed to focus on sustainability and compliance with current regulations, targeting a household of six people. Utilizing Lethbridge’s rainfall data from the Alberta Building Code due to its proximity to the Blood Tribe and the availability of data, the system is configured for non-potable use as permitted by the Government of Alberta Regulations (July 2020), specifically for toilet flushing and garden watering. The rainwater harvesting system includes an indoor 200-gallon tank and a larger outdoor 1425-gallon tank, buried below the frost line to prevent freezing, designed to manage overflow from the smaller tank. This setup meets 46% of the home’s non-potable water requirements. The total non-potable water demand for the house is 321 liters per day, which is the peak demand during the irrigation season (June-September).

Sustainability
Photovoltaic System
In recent years solar has been growing in popularity and affordability as an energy alternative or an energy offset for many homes. However, it is still quite expensive to fully power a home with solar alone. By reducing the expected capacity of the solar grid, the cost of installation can be reduced quite significantly. In many cases, the design and installation of solar panels and the associated energy system is a balance between environmental and economical sustainability.

A home that operates fully on electricity and no natural gas can receive approximately 60% of its energy from a photovoltaic system and the remainder from traditional grid energy for a reasonably affordable installation cost. This not only reduces the fossil fuels directly used by the home, but it also reduces the amount of grid energy that the home uses which is primarily from burning coal and fossil fuels. This reduction of carbon output for the homes energy system plays a large role in the environmental sustainability of the home, while economic sustainability is kept in mind by reducing the capital cost of the photovoltaic system as well as reducing the monthly energy bills.

This kind of energy system can also be paired with a home battery bank. A backup battery system acts similarly to how a backup generator might be used. In the event of a power outage, the battery bank provides enough energy to cover the vital functions of the home such as heating, lighting, and refrigeration until power can be restored.

Rainwater Harvesting System
Installing a rainwater harvesting system in remote areas, such as the Blood Tribe reserve, offers a sustainable approach to mitigating water scarcity by decreasing dependency on external water supplies and enhancing self-sufficiency. This initiative contributes to environmental conservation by reducing stormwater runoff, presents opportunities for economic savings, and improves water security for the community, with the potential for expanded use as future regulations allow.

HVC System
Traditional centralized HVAC systems have proven to be bulky and energy inefficient. Along with the need to have a trained individual maintain the system, it takes away from sustainability. Choosing a split HVAC system adds many benefits and improves the sustainability considerations through these components. The split HVAC system allows homeowners to be trained and how to maintain them and are easy to maintain. These systems also have small carbon footprints making indoor temperatures well. In the long run, split systems are more economical with available parts for replacement and do not need a dedicated mechanical room.

Community Considerations
Multi-Generational Family Homes
Currently, overcrowding is an issue faced in many First Nations communities including the Blood Tribe. By providing options for the interior arrangement of the homes, more bedrooms are available for children or extended family members. In addition, this allows elderly members of the community to live an independent life while having familial support.

Aesthetic & Cultural Appeal
To ensure cultural preservation, consideration of cultural activities was considered in this home design. This home comes with the option of a gear room, which aims to provide a dedicated space for gathering, storing traditional gear or a preparation area.

Suburban Comparability
Many First Nations communities are currently limited with small, trailer style homes, while people living in neighboring cities have unlimited options when it comes to their homes. Ensuring both the comfort and build of these homes is on par with Canadian living standards.