



# Case Study: Sustainable Laramie

OutBack System with Large-Capacity Energy Storage in a Wyoming Self-Sufficient Living Structure



## Overview

In an environment such as Laramie, Wyoming, a fully sustainable, successful net-zero working and living structure is no small undertaking. Winter average temperature highs barely get above freezing, the average lows are in the single digits—and those are the averages, record lows for Laramie are actually not much different from those recorded at McMurdo Station, Antarctica. On the plus side, relatively strong insolation (solar radiation exposure) in the area provides a natural, practical reason for adopting innovative solar technology engineering in structural design.

This was the motivation behind Marshall Contracting, Inc.'s selection of an "envelope house" scheme to come with a totally passive solar heating solution for their client's unique request for a combination workshop/back-up residential structure for self-sufficient living. An envelope house incorporates a greenhouse section to create a reservoir of warm air and relies on a circulating and reversible air path to collect heat during the day and use it at night. In effect, the house sits in the "envelope" of a thermal barrier and acts like a heat-pump, with solid wood construction providing adequate thermal insulation while the concrete slab foundation stores heat collected during the day for circulation at night.



*This was our first time using OutBack Power equipment in an installation. Talk about a great first impression! We were particularly impressed with OutBack's 2V battery system and how easy it went in. With its reputation and service, OutBack is now our 'go-to' source for off-grid power and storage solutions. For an installation which must perform, there is simply no better choice."*

**Jim McGrath**

System Designer and Principal, Sustainable Laramie LLC

## System Specifications

**Location:** Laramie, Wyoming

**System Power:** 6kW PV System

**Components:** FLEXpower TWO (FX inverter/chargers, FLEXmax charge controllers and MATE3 system display/communications) OutBack EnergyCell RE High Capacity (2700RE-24V battery bank configuration with (12) RE 2700 2V batteries)



General contractor Kent Marshall takes a break next to the large-capacity energy storage system inside the structure.



## Objective

- Powering a self-sufficient combination workshop/living structure designed to provide preparedness for natural and other disruptions

## Benefit

- Comfort and security of a self-sufficient structure ready for harsh duty and extended off-grid autonomy

While the theory of envelope design is proven in simple, smaller home construction, this project was more than a house: it also included a 2-bay garage and a working shop area as well as living quarters. To achieve the project's ambitious design and self-sufficiency goals, Marshall Contracting's Kent Marshall knew two things.

First, he'd need to modify the envelope design principle to fit a unique structure to achieve passive solar heating, which he did by designing the home around an integral greenhouse structure on the "warmer" south side with warmed air circulating through a ceiling return to the north side and downward into a concrete "thermal collector" for heat storage. And second, he'd need to come up with equally innovative methods to provide for water and electricity for the home—and, in fact, solar energy with large-capacity electricity storage provided the means for both of those as well.

## Solution

Kent turned to Sustainable Laramie's Jim McGrath, maverick engineer and solar designer who enlisted the help of OutBack Power's tech support group for an all-in-one solution. Jim worked with the project's electrical contracting firm Voltech Electric to configure and install an off-grid electrical system that could power a 240V deep well water pump designed to supply 500 gallons of water per week, plus large-capacity freezers and other refrigeration, a working shop, two large automatic garage doors, and finally a complete, self-contained back-up living quarters with lighting, microwave, 16-head automatic sprinkler system to maintain an aesthetic blanket of green grass around the structure, and other amenities. The entire system had to be contained inside the structure to protect it from temperature extremes.

To harvest, convert and store the output of the PV systems twelve 250W solar panels generating 6kW hours/day, Jim selected an OutBack FLEXpower TWO with twin 3524 inverterchargers as the heart of the renewable energy system, and to achieve the home's autonomy requirement of remaining off-grid without using a generator, upgraded the energy storage system to the OutBack EnergyCell 2700RE-24 battery bank, which consists of twelve large 2V batteries connected in series to form a 24V high-capacity bank. Complete with plexi-shielding and structurally sound UBC steel racking, this battery bank can store 54.9kWh nameplate energy storage safely and securely.

"This upgrade gave us the storage capacity and high cycle-life needed to meet the project's power requirements," explains Jim McGrath. "And the battery bank had the right mix of safety features, construction quality, and 'fit-and-finish' necessary to enable it to 'live inside' the structure without causing the owner any anxiety whatsoever about sharing a close-quarters living-space with big batteries. This system is literally right at home."

With the innovative home undergoing its first trials during the upcoming winter, McGrath and Marshall are confident it will exceed the owner's expectations. "We may add wind power later," noted McGrath, "but even when it's minus 20 degrees outside everything should be able to avoid freezing and the living quarters remain tempered based entirely on what the sun—augmented by OutBack technology—can provide."