# Parkland Net-Zero Energy Home

## Project Profile

# Executive Summary

## Project Mission

To build an executive-style net-zero energy home which meets the following criteria:

- Environmental sustainability & energy efficiency
- Produces all of its own energy for heating, hot water, lighting and appliances
- Comfortable and attractive living spaces
- Healthy living environment
- Opportunity for self sufficiency

## Project Description

The Parkland NetZero is a new private residence located in Parkland County just south of Spruce Grove, Alberta. This unique home uses leading technologies to reduce energy usage, have a low environmental impact and, most importantly, produce as much energy as it consumes (*net-zero* energy). The home's annual energy requirement is predicted to be less than its on-site annual production from simple, reliable, renewable energy sources. These include passive heating and a grid-connected solar photovoltaic system.

This custom-built home designed and engineered to be airtight and have high thermal mass. In addition, it employs a vast array of technologies that increase efficiency of the home. The end result is a house that is predicted to use only 23% of the energy required for the same home of conventional construction.

Electricity is the source for all space and water heating energy for the home. It is so efficient that there is no need for a natural gas line. Surplus electricity is fed to the electrical grid and on cloudy days or periods of heavy electrical requirements the grid supplies electricity back to the home. Over the course of the year the house exports as much or more energy than it imports.

The home is of two-storey construction with 4,025 sq. ft. of living space on the main two floors and 2,050 sq. ft. in the basement suite. Energy and water usage has been calculated based on two families occupying the dwelling.

## *LEED® Platinum* Certification

LEED® Canada for Homes is a rating system that promotes the design and construction of high-performance green homes. The rating system measures overall home performance in eight categories, from Innovation & Design to Awareness and Education. LEED® certification application is currently underway with the outlook to become the first LEED® Platinum certified home in the capital region and only the second LEED® certified home in Alberta. Platinum certification is the most difficult performance tier to achieve.

## Project Team

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| Peter Amerongen | Master Builder / Project Manager<br>Habitat Studios & Workshop |
| Stephani Carter | LEED® Accredited Professional<br>EcoAmmo |
| Brandy Burdeniuk | LEED® Accredited Professional<br>EcoAmmo |
| Kim Chiles | Green Interior Design Specialist<br>Midori Spaces |
| Dennis & Christy Cuku | Green Technology Advocates<br>Home Owners |

# Project Features

## Occupant Health and Comfort

Materials selected for the construction and décor of the home minimize indoor air pollutants such as Volatile Organic Compounds (VOC's), noxious chemicals and other potentially hazardous off-gassing materials. Examples include:

- All paint and cabinetry and furniture finishes are water-based and are no-VOC or low-VOC.
- Hard floor surfacing was utilized throughout the home reducing off-gassing and contaminant buildup.
- Eliminate the use of MDF (medium density fiberboard) which off gases formaldehyde.
- Mattresses and linens are made of certified organic cottons and wools.

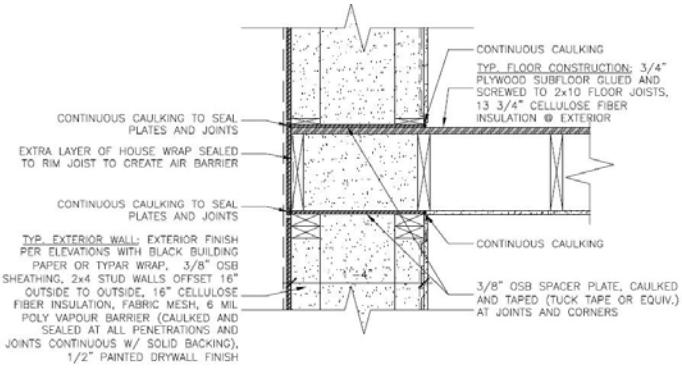
Placement of windows reduces the need for artificial lighting by providing natural light throughout the occupied spaces.

Two heat-recovery ventilators (HRV's) control the homes fresh air intake and humidity. Prior to fresh air being distributed throughout the home, the HRV's pre-heat incoming air with exhaust air.

## Energy Efficiency

Energy efficiency is the most economical form of reducing the amount of energy required by a dwelling. To minimize the space-heating load the building was designed with an airtight, highly insulated thermal envelope. A 16 inch "deep-wall" system is designed to reduce heat loss by about 70% from typical 2 in. x 6 in. wall construction.

Windows were designed specific to the requirements of each face of the house. The north windows are highly insulated and offer little passive solar gain as they do not see direct sunlight. Conversely, the south windows are designed to optimize passive solar heat gain and reduce heat loss. East and west windows have similar characteristics to the north windows. Overhangs and peaks above the south windows are designed to maximize solar heating in winter and prevent summer overheating.




All appliances are high-efficiency Energy Star rated and were selected to reduce electricity requirements without compromising performance. Highly efficient LED and CFL lighting combined with Energy Star light fixtures further reduce the electricity loads.

## Renewable Energy Production

The building's east-west orientation optimizes solar exposure. South facing windows, representing a surface area equivalent to about 15% of the above-grade floor area, provide a predicted 53% of the annual space heat from passive solar gain. Concrete floors and countertop surfaces act as thermal mass to store the passive heat as well as control indoor comfort.

A 60-module, 16.8 kW grid-connected photovoltaic system provides the homes energy for hot water, electricity and space heat. The system is remotely mounted and incorporates a tracking system to substantially increase electricity production. Annually,

the system is predicted to produce 23.5 mWh of electricity – enough to supply the total energy needs for the main dwelling and the basement suite.

Connection to the electrical grid provides electricity "exchange" and "back-up" when the household electricity requirements exceed that produced by the system. Similarly, when the system produces excess electricity it feeds into the grid to be distributed to neighboring electricity users.

## Space and Water Heating

An electric boiler coupled with a hydronic in-floor heating system provides space heat for the home. Heating zones were determined by orientation and allow for extra solar energy to be transferred through the concrete floors to the north areas of the house to reduce the risk of zone overheating.

To maintain occupant comfort during hot days the home is air-conditioned using passive cooling. The highest point in the home is in the A-frame peak. At the top of the peak automatic window openers allow hot air to exit based on control by the main floor temperature sensors.

The domestic hot water system consists of two 50 gallon electric hot water tanks contained in a super-insulated cabinet. Two drain water heat exchangers are connected to the main home drain pipe and act to recover energy from hot shower and laundry drain water by pre-heating cold water entering the hot water tanks.

A high-efficiency wood burning fireplace offers back-up heat in the case of an extended power outage. The fireplace is fuelled by construction scraps and deadfall from the property and will reduce electrical energy consumption. The heat produced by the fireplace has not been included in the energy calculations for the house – it is designed to be net-zero energy without it.

## Raw Material Conservation

Quantities of materials used in the construction process were reduced wherever possible. Such examples include;

- "Optimum Value Engineering" framing details – Exterior walls, although double-walled, only consume 3% more wood than a standard 2 in. x 6 in. wall despite being 10 in. thicker.
- Stairs and decorative doors are made from reclaimed glue-lam beams.
- Over 95% of the homes insulation is comprised of recycled newspapers.
- Concrete used in the basement walls and slab floors is made with a 50% fly-ash mix therein reducing the need to produce cement powder.
- Cement fiber siding board has a high-recycled content.
- Metal roofing has a long life span and is recyclable when replaced.
- Kitchen sinks are made from recycled copper wire.

## Water Efficiency

Low flow toilets, faucets and showers were used exclusively throughout the home greatly reducing overall water demands and energy consumption for domestic hot water.

A 5,000 gallon cistern collects rain water from the roof for use in the homes toilets and landscape irrigation. Diverting this water load from the drilled well reduces the energy required to treat ground water.

Landscaping of the site incorporates Xeriscape principles including the use of drought tolerant trees, shrubs and grasses, greatly reducing the need for irrigation.

## Reduced Environmental Impact

The home is built on a mature treed acreage site. Selection of the home site was determined based on minimizing the impact on the existing property and ecology. All trees removed for preparation of the building site were either incorporated as architecture or furniture in the home, used for heating the home in the wood burning fireplace, or mulched for incorporation into the landscaping.

Environmentally preferable products were used throughout all aspects of the homes construction and décor. Selection priority was given to products that were sustainably and locally sourced with the least impact on the environment. For example:

- FSC (Forest Stewardship Council) certified wood was used in the construction of the cabinets, decorative trims and doors.
- Masonry stone was sourced from a local quarry.
- Paints and other coatings used contain low or no VOC's
- Furniture incorporates reclaimed or sustainably sourced wood which does not contain formaldehyde and uses low or no VOC stains or finishes.
- Bamboo was incorporated into the cabinetry and in the butcher block.
- Recycled glass tile in some backsplashes.
- Mattresses and all linens are of sustainable and organic materials such as cotton, wool and bamboo
- Area rugs of natural fibers such as hemp or recycled pop-bottles.
- Window coverings made of bamboo and sea grass

Great efforts were taken to divert construction waste. Cardboard, metal scraps, polyethylene, plastics and other site worker waste was collected and sorted for recycling. All waste lumber generated during construction was saved for use in the fireplace for home space heating.

Septic discharge is treated by an advanced waste treatment system that produces effluent that is clear, odorless and can be used for subsurface irrigation.

## Education and Training

Research and design for this project has been a huge undertaking for my wife and I and it would be a shame to let the information we gathered (and mistakes we made) go unshared. As such, we have committed to actively promote the principles of the project a number of ways; (1) Public Tour Oct 15, 2011 (2) private tours to industry and homeowners (3) Website www.net-zero.ca and (4) magazine and newsletter entries (Home Power, Green Builder, Natural Home). In addition, we are exploring the possibility of (5) newspaper articles (county papers, capital region); (6) YouTube clips.

## Contact

For more info on the upcoming public open-house tour, please visit our website www.net-zero.ca .

Media contacts please contact the homeowners at dcuku@net-zero.ca or ccuku@net-zero.ca