Case Study

Vleeming Custom Homes: Residential Single Family Home - the Hawktail

Near Sylvan Lake, Alberta

January 9, 2025

Background

The Hawktail, a bungalow with an attached garage near Sylvan Lake, Alberta, by Vleeming Custom Homes, showcases high-performance building products and careful craftsmanship. Vleeming prioritizes energy efficiency, durability, and long-term quality, which shape every design decision for the Hawktail. Design features include Insulated Concrete Form (ICF) foundation walls, continuous insulation from slab to basement wall, prefabricated Insulated Composite Envelope (ICE) panel walls with continuous insulation, and rigid insulation beneath the roof truss system.

Beyond the continuous insulation, Vleeming has added many details to improve the comfort of the home, including the ultra-quiet operation of exhaust fans to encourage continuous use.

Other choices include maximizing the benefits of the HRV by feeding all exhaust through the system and using an integrated heat pump hot water tank to eliminate extra building envelope penetrations.

The Vleeming Custom Homes team has extensively documented the Hawktail. There are 30 videos available on their **YouTube channel** specifically for the construction of this house**.** These videos cover many details of the energy-efficient construction in the Hawktail.

Pathways to Net Zero

The Hawktail is not yet net-zero ready, as it was built with a high-efficiency natural gas furnace. However, the hot water system is already electrified with a hybrid heat pump water heater The building could meet net-zero requirements with a cold-climate air-source heat pump (ccASHP) for heating and cooling and a solar array of approximately 12 kW to offset the home's energy consumption.   An analysis of the home shows that there is more than enough room to accommodate a solar system of this size. Future loads such as an electric vehicle (EV) charger could also be accommodated.

Carlo Vleeming, the President of Vleeming Custom Homes speaks energetically about the importance of details in a home. This includes energy efficiency, air tightness, comfort features, durability, careful design and detailing. We asked him a few questions, here is what he had to say below.

About the Project

Author/Contributor: ENBIX, Joseph Henke, Carlo Vleeming, Vleeming Construction
Location: near Sylvan Lake, Alberta
Year built: 2024
Size: 2,505 ft², 4 bedroom, 2.5 bath bungalow
Builder: Vleeming Custom Homes
Project Manager: Carlo Vleeming
Energy Advisor: Sol Invictus Energy Services
Designer: Vleeming Custom Homes
Mechanical Engineer: FM Residential Design

Interview Questions

Q: What was built?

A 2,505 ft², 4 bedroom, 2.5 bath bungalow with an attached garage in a rural development near Sylvan Lake. This home is solar-ready and is built with a combination of Insulated Concrete Forms (ICF) and panelized light gauge steel frame with EPS integral insulation (ICE panel) construction. Air sealing and insulation detailing feature several techniques developed in-house by Vleeming.

Q: What were the programs tied to each project?

The house was assessed under the NRCAN's EnerGuide Rating System (ERS) and is Energy Star Certified.

Q: What were the targets/goals?

The house achieved Energy Star Certification, with a blower door test result of 0.86 ACH50. Vleeming aims for less than 1 ACH50, with increased thermal performance allowing for a smaller furnace (30,000 to 40,000 BTU) as a standard feature.

Q: What were the learnings?

The initial blower door test revealed slightly higher air leakage (0.86 ACH50) due to an uncapped attic conduit. After sealing, the expected airtightness is closer to 0.5 ACH50.

The combination of the ICE panels and custom insulation detailing developed by Vleemming has led to reduced warranty callbacks for many issues. These include eliminating condensation from kitchen exhaust hoods and bath fans by keeping all the mechanical elements on the warm side of the insulation. Elimination of drywall pops because the ICE panels do not shrink or swell due to humidity. The disappearance of ceiling drywall cracks due to the EPS insulation below the ceiling trusses results in minimal truss uplift.

Improved home comfort results from following the “building-as-a-system” approach. Designing the mechanical system to match the improved high-performance envelope and balancing it as part of the building commissioning results in a more comfortable home.

Q: What were the best practices used for achieving high-performance standards?

The detailing of the basement floors is an important step. Using 3M tape to seal poly sheet seams and to seal the poly to the ICF foundation wall. The poly is then covered with EPS sub-slab insulation that is continuous over the footing, achieved by extending the foundation wall by four inches (easier with ICF than traditional concrete forms).

Vleeming has been working with ICE panels for six years. This was a big change as the builder went from a traditional stick/site builder to a building process using panellized components. Carlo Vleeming was sold on the idea of the insulation, vapour barrier, and structure all being incorporated into one panel. The factory-built panels have excellent quality control. The combination of EPS and galvanized steel construction will not rot or degrade. This has eliminated the need for many transitions when moving from below grade to above grade. Greenstone provides good service and support in addition to manufacturing the panel.

Technical:

Building Envelope:

- ICE panel walls (R32 effective)
- R76.5 attic insulation with 4” rigid EPS below roof trusses
- ICF foundation walls with continuous EPS insulation

The building envelope was tested using the EnerGuide Rating System (ERS), and a 0.86 ACH50 was achieved. The estimated annual energy consumption is 69 GJ, 63% of a standard home's. However, with the addition of an approximately 7 KW solar system, supplying 8100 KWh, this home could have only 36% (39 GJ) of the base case's consumption.

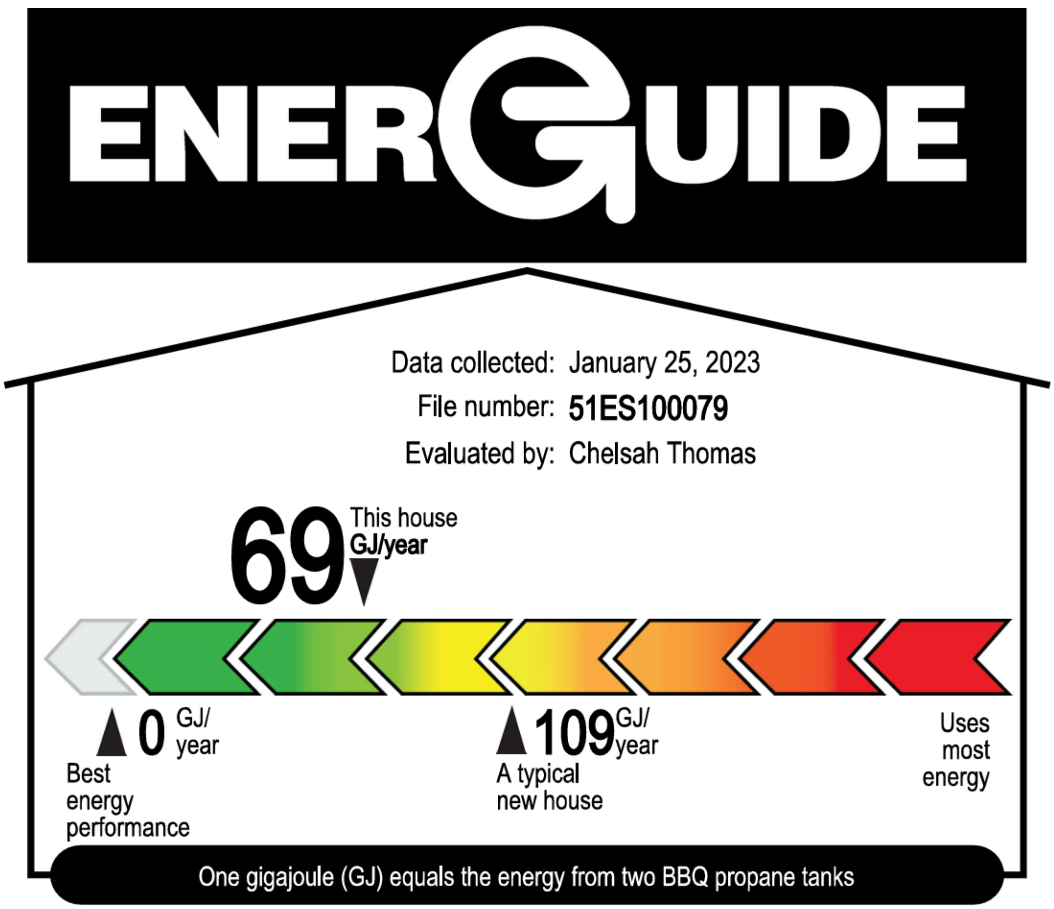


Figure 1 - Energuide Label: the house is estimated to use 69 GJ versus 109 GJ/year in a typical new house.

Energy Sources	Rated Consumption (GJ/year)	Equivalent Units (per year)	Greenhouse Gas Emissions (tonnes/year)
Natural gas	39	1056 m3	2.0
Electricity	29	8160 kWh	6.5
Total	69		8.5

Figure 2 - Breakdown of electricity and natural gas usage.

Constructing with ICE panels

The walls are graphite infused expanded polystyrene (GPS) ICE panels. ICE panels by **Greenstone Building Products** are factory-made custom panels with a galvanized steel stud frame and integrated GPS or EPS insulation. The continuous GPS on the exterior of the ICE panel reduces thermal bridging.

Figure 3 - ICE panels during erection

Figure 4 - ICF foundation wall panels with exterior membrane. Watch the video of the foundation wall pour here.

Airtightness: 0.86 ACH50 measured as part of the ERS blower door test. This is higher than a typical Vleeming home. After the test was completed, it was found that the conduit to the attic had not been capped properly. This was corrected, and while not tested, a value closer to 0.5 ACH50 is expected based on past experience. EPS walls (ICE panels), **rigid 4" EPS ceiling panel,** and careful **detailing of the foundation transition**.

Wall design: The **ICE panels**, made by **Greenstone Building Products**, are graphite-infused expanded polystyrene. ICE panels use galvanized steel studs for structural framing. GSBP provides a few examples of detailing a **building envelope with ICE panels**. The light gauge steel is custom made in house for the **ICE panels.** The walls are 7.5" thick and achieve effective R32 (5.368 RSI) insulation. The exterior rain screen uses 0.5" thick plywood strapping under the hard surface siding elements. Check out the Hawktail **video** on envelope insulation.

Ceiling insulation: A custom Vleeming detail features 4" rigid EPS hung below the roof truss system, with blown-in loose-fill cellulose over top, which achieves an effective R76.5 (13.47 RSI). This approach helps to ensure minimal truss uplift and improves air sealing.

Figure 5 - 4" rigid EPS hung below the roof truss system

Foundation wall design: **Insulated Concrete Form** (ICF) foundation wall - 2.75" of EPS on both the **interior and exterior** of the foundation wall. This is sealed with careful detailing through the main floor rim board to the ICE panel walls to ensure that the air barrier is complete. A 4" rigid EPS panel is set below the concrete footer of the wall to provide a continuous insulation layer. A poly barrier is below the insulation with all joints sealed with 3M tape and sealed to the ICF foundation. The EPS insulation is continuous over the foundation footing. This requires an additional 4 inches of wall height. This can be achieved by using an extra row of ICF blocks.

Figure 6 - ICF foundation wall - 2.75” of EPS on both the interior and exterior of the foundation wall

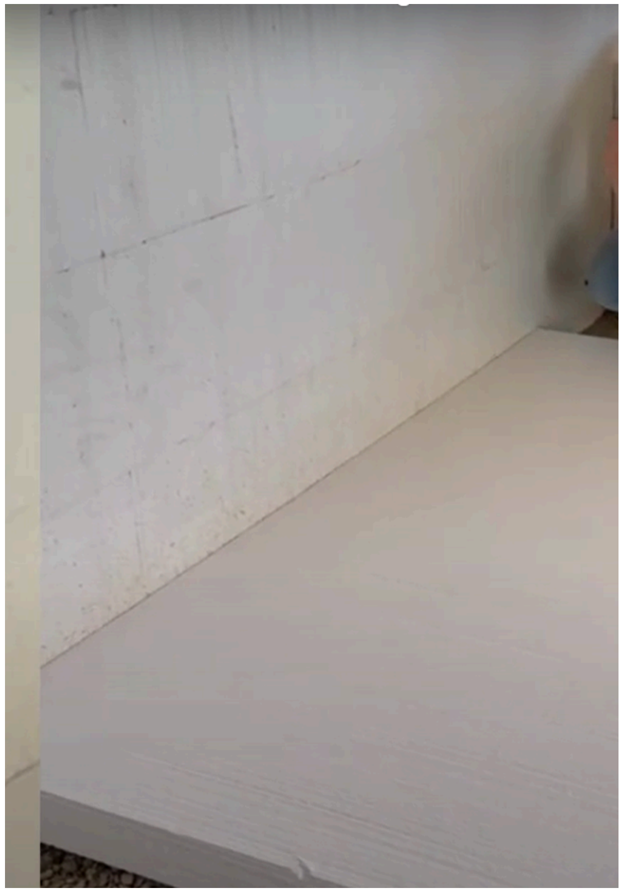


Figure 7 - ICF foundation wall and the continuous subfloor insulation in the basement.

Both the basement floor and the attic ceiling feature a 4" thick continuous layer of EPS insulation. Watch the video on sealing the foundation and floor framing properly from the weather and elements **here**. Here is the **video** on continuous insulation in the basement.

Windows/doors: Triple pane windows, argon filled, with 1 Low-E coating.
Typical U-factors between 0.96 and 1.10 Wm²C. SHGC between 0.12 and 0.19. The windows are installed with closed-cell medium-density spray foam on the sides and top. A caulking backer rod is used on the bottom to create a drainage void, with spray foam insulation behind it. Flanged windows are set to the exterior, creating a deep interior window sill. Custom-built in-house window jam extensions are used, and a final application of spray foam is applied under the window jams.

Mechanical & Electrical Systems:

Ventilation: Clean Comfort VH70220 HRV with 62-watt preheat and 68% sensible heat recovery efficiency at -25 C. Systems with integrated preheaters are used to prevent freezing up on the coldest days.

Heating: Lennox ML296XV AUFE 96% natural gas condensing furnace, ECM motor.

Using a "building as a system" approach the HVAC is carefully designed, including ductwork, a heat loss calculation to size the furnace properly, and sizing for correct airflow. Proper duct sizing ensures the system operates quietly and efficiently. Extra large filter spacing is left to accommodate deep media filters. A steam humidifier is added to improve comfort.

Figure 8 - Lennox ML296XV AUFE 96% natural gas condensing furnace, ECM motor with steam humidifier

Cooling: Air Conditioner model not specified. 16 SEER.

Hot Water: Rheem Proterra Integrated heat pump (hybrid) hot water tank with a Coefficient of Performance (COP) of 4.31 and Uniform Energy Factor (UEF) of 0.9.

Capacity: 189.3 litres. Check out the Hawktail **video** on heat pump hot water tanks.

Figure 9 - Rheem Proterra Integrated heat pump (hybrid) hot water tank

Figure 10 - The overall layout reflects a clean, organized installation of the manifold system

Electrical Service Amperage: 125 amp electrical service is provided.

Figure 11 - Electrical panel with neatly organized wiring and conduit

Renewables: None installed, but the design is solar-ready: including a roof design that supports solar installation and electrical conduit pre-run to the attic.

Energy Performance:

Annual Electricity Consumption: 8160 kWh or 29 GJ (ERS)

Annual Natural Gas Consumption: 39 GJ (ERS)

Energy Use Intensity: 0.34 GJ/m^2

Annual Heating Demand: 1364.0 m3 or 50.8 GJ

Annual Cooling Demand: Not listed - modelled without A/C

Design Heat Loss: 3268 watts

Design Cooling Load: 2016 watts

Air Leakage Rate: 0.86 ACH50

Carbon Emissions:

Annual Operational Carbon Emissions from Electricity Consumption: 6.5 tonnes per annum or 6500 kg per annum. This has been modelled on 2023 grid emissions factors for Alberta.

Annual Operational Carbon Emissions from Natural Gas Consumption: 2.0 tonnes per annum or 2000 kg per annum.

Embodied Carbon in Materials: Not determined

Net-Zero Potential:

While the home was built with a natural gas furnace, it would easily support conversion to an air-source heat pump. Modelling the additional electrical demand in the house shows peak electrical demand to be under 8 kW.

Electricity

13310.98 kWh

Hourly Analysis

About this calculation [?]

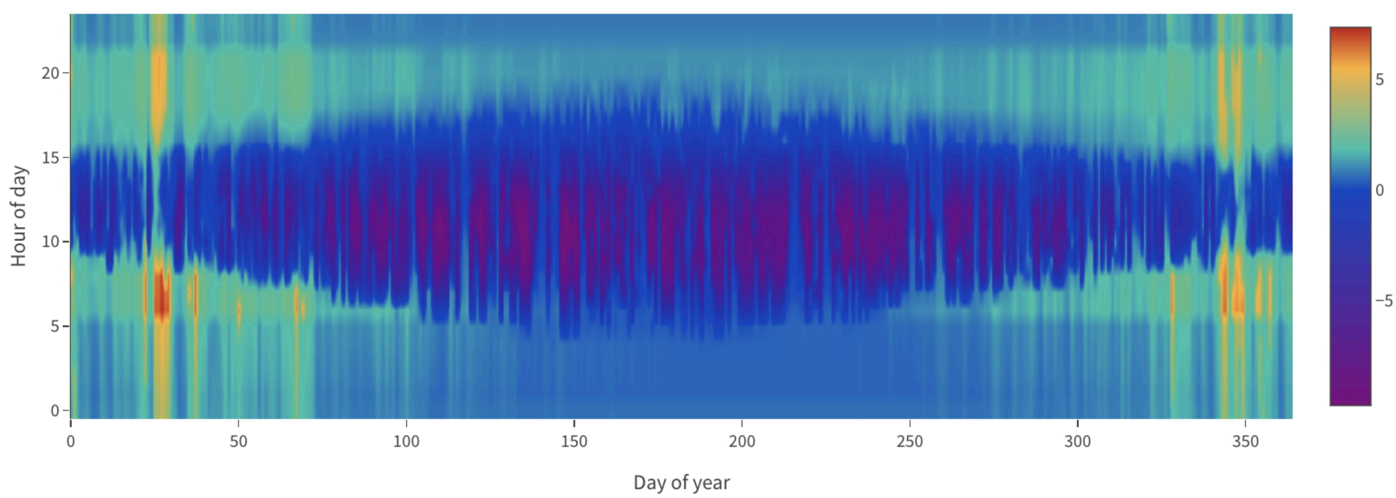
Data Set

Electrical Load

Normalize Scale

Download CSV Data

Hourly Electrical Load (kW)



Winter Peak Load
7.36 kW

Summer Peak Load
2.26 kW

Peak Solar Export
9.72 kW

Load Factor
-3.07 %

Figure 12 - modelled electrical demand from Volta Snap

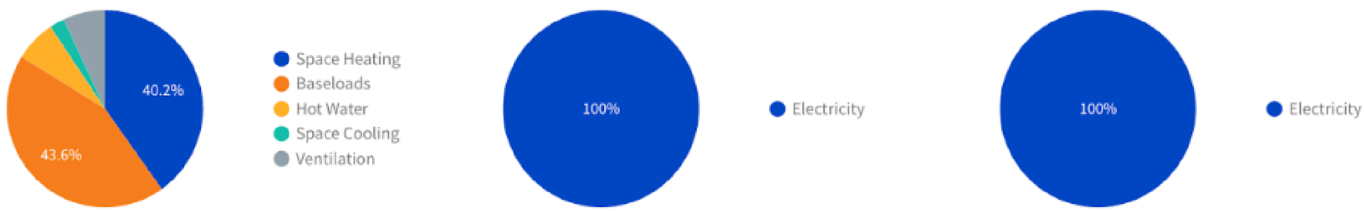
The "Upgrade to Net Zero Pathways Report" shows that a required 14,716 kWh of solar generation is required to offset the electrical usage of the home. This is roughly a 12.75 kW solar array. Modelling the roof area in PV Watts shows the house can easily support up to a 20 kW solar array. This allows for additional electrical loads, such as an EV charger.

The summary of the proposed upgrades is shown below.

Total Annual Energy Consumption	Reference House	% Lower Than Ref. House
0.00 GJ/y	**109.19** GJ/y	**100.00** %

Energy Use Intensity	Greenhouse Gases (NIR 2024)	Nat. ACH (1)	Total ventilation (Qtot, SOC)	Min. Ventilation (Qwarn, SOC)
0.23 GJ/m²/y	**-0.69** tCO_2/y	**0.02**	**34.63** L/s	**24.87** L/s

Energy end use breakdown | **Energy fuel type breakdown (gross)** | **Emissions breakdown (gross)**



Energy end use	
Space Heating	19.26 GJ
Baseloads	20.92 GJ
Hot Water	3.26 GJ
Space Cooling	1.18 GJ
Ventilation	3.31 GJ

Energy fuel type	
Electricity	47.92 GJ
Natural Gas	0 GJ
Oil	0 GJ
Propane	0 GJ
Wood	0 GJ
Solar PV (saved)	52.98 GJ

Emissions	
Electricity	6.52 tCO_2
Natural Gas	0 tCO_2
Oil	0 tCO_2
Propane	0 tCO_2
Wood	0 tCO_2
Solar PV (saved)	7.21 tCO_2

Figure 13 - GHG and energy consumption report.

All photos courtesy of Vleeming Custom Homes, used with permission.

References: Upgrade Pathways Report - Getting to Net Zero In Hawktail

As we aim for an emissions-neutral future, this house demonstrates how a house-as-a-system design approach, paired with careful craftsmanship and attention to detail, can achieve airtight and net-zero-ready homes in Alberta. Equipped with a cold-climate air-source heat pump (ccASHP) for heating and cooling, along with a solar array of approximately 12 kW to offset energy consumption, the Hawktail home has the potential to meet net-zero requirements.

Alberta Ecotrust and ENBIX would like to thank Carlo Vleeming for his contributions and participation in this case study.