

Case Study

Residential Single-Family Home
Edmonton, Alberta

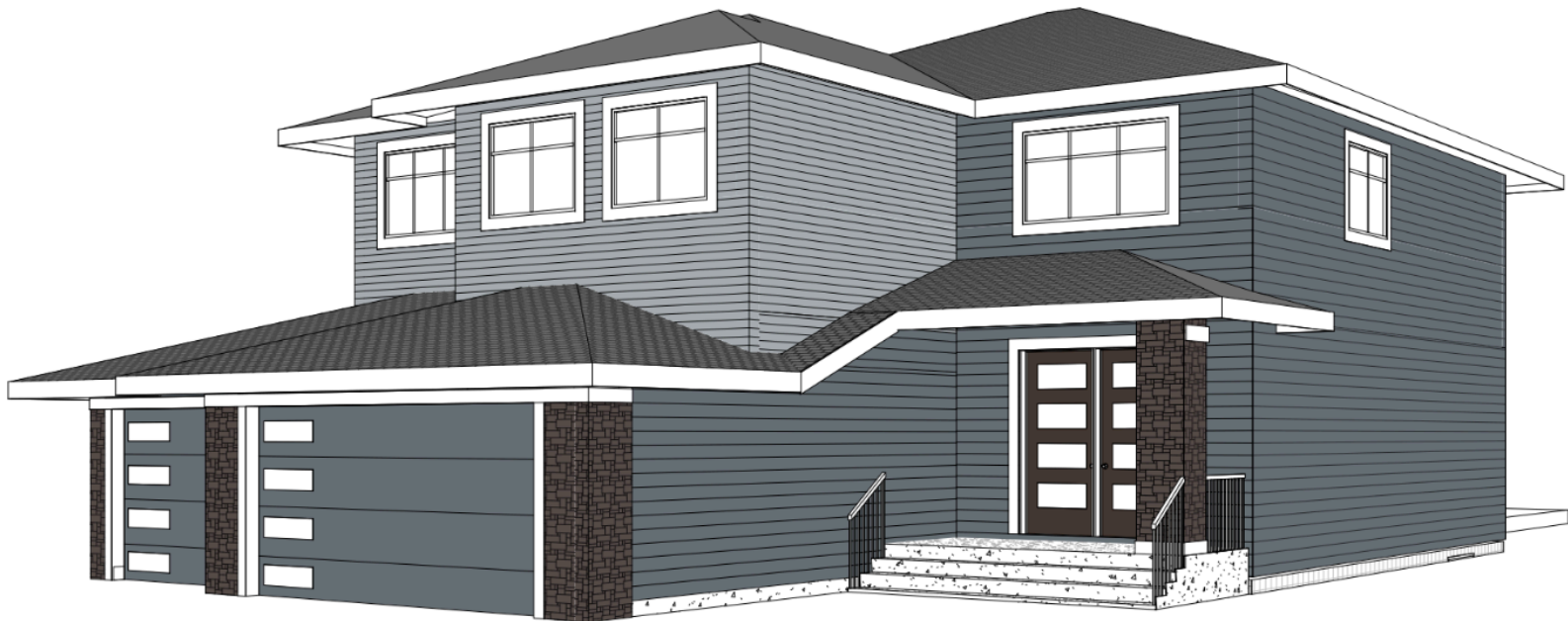
September 2026

Background

The primary goal for the project was to create an extremely comfortable house for a family to live in for the next 20 years. The combination of the tight building envelope, the increased insulation and the upgraded mechanical system has been a resounding success in meeting that goal.

The secondary goal was to reduce the dependence on carbon-intensive energy sources required to power the home. The heat pump hot water tank and an Air Source Heat Pump (ASHP), combined with the solar array added after construction, have allowed this owner to achieve net-neutral electricity consumption, while needing only a small amount of natural gas to heat the house four or five months of the year.

No grants were received for the initial construction, but in May 2025, a solar array was installed using the Canada Greener Homes Grant to cover a portion of the costs.



About the Project

Author/Contributor: ENBIX, Kate Woloshyn, Tyler Wyton

Location: Edmonton, Alberta

Year built: 2023

Size: 2,656 ft² two-storey single-family detached home (1,224 ft² main floor + 1,432 ft² second floor)

Builder: Formed Construction

Energy Advisor: Enviromatics Group Ltd.

Designer: Buildtech Engineering

Pathways to Net Zero

What were the key advancements or changes in building materials and energy systems?

- Structural Insulated Panels (SIPs) wall assembly
 - Learn more about SIPs in our ENBIX webinar: [Continuous Insulated Sheathing & Structural Insulated Panels](#)
- Triple-paned tilt-and-turn windows
- ASHP with a natural gas furnace for backup
- Heat pump hot water tank

What are the best practices implemented for achieving net zero or high-performance standards?

- Supervise the installation of building envelope components closely on site
- Make sure mechanical and electrical trades understand the constraints of working with SIPs
- Carefully seal every penetration (opening for pipes, wires or vents) in the building envelope
- Plan ahead for managing winter humidity in a tight building envelope. In this home, finding the right dehumidification settings on the Heat Recovery Ventilator (HRV) took a lot of trial and error

What were the learnings?

SIP walls installed with careful attention to detail, paired with imported triple-pane windows, can create an extremely tight building envelope. A hybrid mechanical system can adequately heat a house in Edmonton in all but the coldest weeks of the year.

What was the cost of construction?

Approximately \$900,000

What were the costs to build above code?

- Foundation wall insulation: \$3,500
- Under-slab insulation: \$2,900
- SIP walls: approx. \$32,000
- Windows: approx. \$5,000
- Building envelope labour: \$1,500
- Mechanical system upgrades: \$5,000

Carbon Emissions:

Annual Operational Carbon Emissions from Electricity Consumption: 6.98 tonnes (6,981 kg) of carbon dioxide equivalent (CO₂e) per year, calculated using Alberta’s 2023 electricity grid emission factors (*Environment and Climate Change Canada, Emission factors and reference values, Table 5.1 under section 4.2 – applicable to 2023 and 2024*).

Annual Operational Carbon Emissions from Natural Gas Consumption: 1.43 tonnes (1,435 kg) CO₂e per year, calculated using 2023 natural gas emission factors for Alberta (*Environment and Climate Change Canada, Emission factors and reference values, Table 1.1 under section 4.1 and Table 8 under section 4.5 – applicable to 2023 and 2024*).

Embodied Carbon in Materials: Not determined

Energy Performance:

Overall Impressions: The home performs similarly to the modelled predictions. Actual electricity usage appears slightly lower than modelled, while natural gas usage is slightly higher than the model (excluding the initial construction period), confirming the hybrid mechanical system's effectiveness.

Metric	Energy Model Projection (Annual)	Actual Operational Data (Approx. 1 Year)	Performance
Electricity	15,903 kWh	12,927 kWh	Better than Modelled
Natural Gas	24.6 GJ (648 m³)	27.92 GJ*	Slightly worse than modelled

*Note: Actual Natural Gas figure excludes the April 2023 bill (52 GJ), which was used to heat the house during construction, before full occupancy.

2023/24 Actual Energy Use Intensity: 83.8 kWh/m²

Modelled Annual Heating Demand: 21,771 kWh/year

Modelled Annual Cooling Demand: 1,496 kWh/year

Air Leakage Rate: 0.82 ACH50 (Air Changes per Hour at 50 pascals of pressure differential)

Electricity Consumption:

Modelled prediction: 15,903 kWh/year, covering the primary heating source (ASHP), cooling, and the electric heat pump water heater.

Actual Electricity Usage:

- Summer Base Load: In July and August 2023, usage hovered around 800–850 kWh/month.
- Winter Peak: Usage peaked in December and January at approximately 1,400–1,500 kWh/month.
- Total: Summing the available operational months (approx. May 2023 to March 2024) and annualizing the data suggests a total usage of 12,927 kWh.

The home is using about 19% less electricity than predicted. This indicates that the ASHP and the heat pump water heater are operating efficiently, or the occupants are more conservative with lighting and appliances than the standard model assumptions.

Natural Gas Consumption:

Modelled prediction: 24.6 GJ/year. Because the primary heat source is electric, gas was only expected to run during very cold temperatures (backup furnace).

Actual Usage:

- Summer (Zero Usage): From June through October 2023, the home used 0 GJ of natural gas. This confirms that the ASHP handled all cooling and shoulder-season heating needs.
- Winter (Hybrid Operation): November and December Usage was low (~2 to 3 GJ/month), indicating the ASHP handled most of the heating needs.
- January usage jumped to 11.92 GJ. This aligns with Edmonton's deep freeze conditions, where the system correctly switched to the high-efficiency gas furnace backup.

Excluding the April 2023 construction bill (see the note under the table), annual operational usage was about 27.92 GJ, roughly 13% higher than the modelled 24.6 GJ.

Takeaways

The billing data illustrates how the hybrid concept works in practice. For five months of the year (June through October), gas use was zero. The gas furnace is effectively sitting idle until extreme cold snaps (January), proving the ASHP is carrying the majority of the heating load.

The steady electricity usage and zero gas usage in summer confirm the electric heat pump water heater is the home's only hot water source. The gas connection stays active only to serve the backup furnace.

The April 2023 bill shows 52.17 GJ of gas usage, while the January 2024 (coldest month) bill shows only 11.92 GJ. This highlights how significant energy consumption can be during the construction phase (drying drywall, painting) compared to the efficient operation of the finished home.

Technical Details

Airtightness:

0.82 ACH50. The home uses SIPs for above-grade walls, which reduce thermal bridging and air leakage. Detail drawings specify a sealed air barrier with acoustic sealant at all joints, polyethylene barriers sealed to walls/slabs, and careful detailing around rim joists using SIP rimboards.

Building Envelope:

Wall Design:

SIP Panel with graphite foam. 2x6 SIP assembly includes a 1.5" wide 3/8" OSB strip for rainscreen spacing, sealed air barrier, and 1/2" gypsum board interior finish. Total Effective R-Value: **RSI 4.15 (approx. R-23.6).**

Ceiling Insulation:

Blown glass fibre loose fill. Framing was standard trusses @ 24" on centre (o/c), with a 12.75" raised heel to allow full insulation depth to the edge - 18.5" loose fill above the bottom chord + 3.5" loose fill between chords. Total Effective R-Value: **RSI 10.59 (approx. R-60).**

Foundation Wall Design:

Concrete basement walls. Exterior/Interior Rigid: 2" expanded polystyrene (EPS) rigid insulation (RSI 1.3) against concrete. Cavity: 2x4 wood stud frame @ 24" o/c with R20 batt insulation. Slab: 4" concrete slab over 2" EPS rigid insulation and 6 mil poly barrier. Total Effective R-Value: **RSI 3.67 (approx. R-21).**

Windows/doors:

Triple-glazed, low-E (.20), argon filled, vinyl frames. Performance - picture windows: RSI ~0.73 - 0.86 (U-Value ~1.16 - 1.37 W/m²K). Operable windows (Hinged/Slider): **RSI ~0.63 - 0.66.** Glass-to-wall ratio: 12.7% (above-grade fraction of wall area occupied by windows)

Mechanical & Electrical Systems:

Ventilation: Heat Recovery Ventilator (HRV) - model: Aldes Ventzone H190-TRG.

Performance: 74% sensible heat recovery efficiency at 0°C, Energy Star certified, optional MERV6 or MERV13 filters.

Heating: Hybrid system (electric ASHP + natural gas furnace).

- Primary Source: Lennox EL-18XPV-036 ASHP (Heating Seasonal Performance Factor (HSPF): 10.00, Coefficient of Performance (CoP): 4.54 @ 8.3°C).
- Secondary: Lennox SLP99V-090 Condensing Furnace (99% Annual Fuel Utilization Efficiency (AFUE)).
- Thermostats: Trane Zoning Panel and Programmable Thermostats (TZON1050)

Cooling: Integrated with the ASHP. Performance: SEER 20.00.

Hot Water: Rheem Proterra integrated electric heat pump water heater. Performance: COP 4.11, Tank Energy Factor 0.90.

Renewables: Built solar-ready, with wiring roughed in and the roof designed to carry the weight of solar panels. Solar panels were installed in May 2025.

Other: The garage is roughed in for electric vehicle (EV) charging.

Summary

This Edmonton home shows that a house built for Alberta's climate can be very comfortable while using less energy. A house-as-a-system approach, with SIP walls, triple-pane windows and carefully sealed penetrations, produced a very airtight home.

In its first year, the home used about 19% less electricity than its energy model predicted. The ASHP did all the heating and cooling from June through October. The backup gas furnace ran most during January's deep freeze. With solar panels added in 2025, the home now produces about as much electricity as it uses over a year.

The above-code upgrades cost about \$49,900, roughly 5.5% of the total construction cost. The biggest lessons: close site supervision matters, trades need to understand how to work with SIPs, and an airtight home needs a plan for managing winter humidity.

[Alberta Ecotrust Foundation](#) and [ENBIX](#) thank Tyler Wyton for his contributions and participation in this case study. All information and data are courtesy of Tyler Wyton, used with permission.

Appendix: Glossary

This glossary explains building and energy terms used in this case study that may be new to some readers. Terms are listed in alphabetical order.

Above code: A building built to a higher standard than the minimum the building code requires.

ACH50 (air changes per hour at 50 pascals): A measure of how leaky a house is. During an airtightness test, a large fan pulls air out of the house. Testers then measure how many times in one hour all the air inside leaks out and is replaced. A lower number means a tighter, less drafty house.

AFUE (annual fuel utilization efficiency): How much of the fuel a furnace burns becomes useful heat for the home over a year. A higher number means less fuel is wasted.

Air barrier: A layer of material that stops air from leaking in or out through the walls, roof and floors.

Air source heat pump (ASHP): Mechanical equipment that moves heat instead of making it. In winter, it collects heat from the outdoor air, even when it is cold, and brings it inside. In summer, it works in reverse to cool the home, like an air conditioner.

Airtightness test: A test that uses a large fan, called a blower door, to measure how much air leaks out of a building. The result is often given in ACH50.

Annualizing: Estimating a full year's total using data from only part of the year.

Argon-filled: Describes a window with argon, a safe, colourless gas, sealed between the glass layers. Argon slows heat loss better than regular air.

Base load: The energy a home uses on an ordinary day to run everyday things like the fridge, lights and hot water, without any heating or cooling.

Batt insulation: Insulation that comes in soft, pre-cut blankets that fit between the wooden studs in a wall.

Building envelope: The outer shell of a building (its walls, roof, windows, doors and foundation) that separates the inside from the outside.

Carbon dioxide equivalent (CO₂e): A way to count different greenhouse gases using one unit. Each gas is converted into the amount of carbon dioxide that would warm the planet by the same amount.

Carbon-intensive: Describes energy sources, like coal or natural gas, that release a lot of greenhouse gases when they are used.

Coefficient of performance (COP): How many units of heat a heat pump delivers for each unit of electricity it uses. For example, a COP of 4 means the heat pump delivers four units of heat for every one unit of electricity.

Dehumidification: Removing extra moisture (water vapour) from the air.

Embodied carbon: The greenhouse gases released while making, transporting and installing a building's materials, before anyone lives in it.

Emission factor: A number used to estimate how much greenhouse gas is released by using a certain amount of energy, such as one kilowatt-hour of electricity.

Energy model: A computer prediction, made before a building is built, of how much energy it will use.

Energy use intensity (EUI): The amount of energy a building uses in a year divided by its floor area. It makes it easier to compare buildings of different sizes.

Expanded polystyrene (EPS): A lightweight, rigid foam board used as insulation. It is similar to the white foam used in some packaging.

Gigajoule (GJ): A unit for measuring energy that is often used on natural gas bills. One gigajoule is about 278 kilowatt-hours.

Graphite foam: Foam insulation with tiny bits of graphite (the same material as pencil "lead") mixed in, which helps it block heat better.

Greenhouse gases: Gases, such as carbon dioxide and methane, that trap heat in Earth's atmosphere and cause climate change.

Gypsum board: Also called drywall. Flat panels used to build indoor walls and ceilings.

Heat pump water heater: A hot water tank that uses a small heat pump to move heat from the surrounding air into the water. It uses much less electricity than a regular electric water heater.

Heat recovery ventilator (HRV): Mechanical equipment that brings fresh outdoor air into a home and sends stale indoor air outside. As the two air streams pass each other, it moves heat from the outgoing air to the incoming air so less heat is wasted.

HSPF (heating seasonal performance factor): A rating of how efficiently a heat pump heats a home over a whole heating season. A higher number is better.

Hybrid heating system: A system that uses two heat sources. In this home, an electric heat pump does most of the heating, and a gas furnace takes over as a backup in the coldest months.

Kilowatt-hour (kWh): A unit for measuring electricity use. Using 1,000 watts of power for one hour uses one kilowatt-hour.

Loose fill: Insulation made of small, loose pieces that are blown into attics or walls with a machine.

Low-E (low-emissivity) coating: A very thin, invisible coating on window glass that reflects heat. It helps keep heat inside in winter and outside in summer.

MERV (minimum efficiency reporting value): A rating of how well an air filter catches dust and other tiny particles. A higher number catches smaller particles.

Net-neutral electricity: When a home's solar panels make about as much electricity over a year as the home uses.

Net zero: When a building produces as much clean energy as it uses over a year, or balances out its greenhouse gas emissions.

On centre (o/c): The distance measured from the centre of one wall stud or roof truss to the centre of the next one.

Operational carbon: The greenhouse gases released by the energy used to run a building every day, such as for heating, cooling, lights and appliances.

Oriented strand board (OSB): A strong building board made from layered, glued, and pressed strands of wood.

Pascal (Pa): A unit for measuring pressure. A pressure difference of 50 pascals is about the same as a 30 km/h wind blowing against a house.

Penetration: Any opening through the building envelope for pipes, wires, vents or ducts. Seal each one to stop air leaks.

Polyethylene (poly) barrier: A thin plastic sheet that stops air and moisture from moving through walls or up through a floor slab. "mil" describes its thickness, and one mil is one-thousandth of an inch.

R-value and RSI: Numbers that show how well insulation slows heat flow. A higher number means better insulation. R-value is the imperial measure, and RSI is the metric measure (RSI 1 is about R-5.7).

Rainscreen: A small air gap behind the outside siding of a house that lets rainwater drain away and helps the wall dry out.

Raised heel truss: A roof truss that is taller where it rests on the outside walls. The extra height leaves room for full-depth insulation right to the edges of the attic.

Rim joist: The board that runs around the outside edge of a floor frame, where the floor sits on top of the foundation or wall below.

Roughed in: Wires, pipes or supports installed during construction so that equipment, like solar panels or a car charger, can be added easily later.

SEER (seasonal energy efficiency ratio): A rating of how efficiently an air conditioner or heat pump cools a home over a summer. A higher number is better.

Sensible heat recovery efficiency: How much of the heat in the outgoing stale air an HRV captures and passes to the incoming fresh air.

Solar array: A group of PV solar panels.

Structural insulated panels (SIPs): Wall panels made of a thick layer of foam insulation sandwiched between two boards. They are strong enough to support the house while insulating it.

Thermal bridging: When heat escapes through a material that lets heat pass more easily than the surrounding insulation, such as wood or metal framing. The material acts like a “bridge” that lets heat escape.

Tilt-and-turn window: A window that can either tilt open at the top to let in air or swing open like a door.

Triple-pane window: A window with three layers of glass, which insulates better than windows with one or two layers.

Truss: A pre-made wooden frame, usually shaped like a triangle, that holds up a roof. The bottom piece of the frame is called the bottom chord.

U-value: A number that shows how quickly heat passes through something, like a window. It is the opposite of R-value, so a lower U-value is better.