CASE STUDY

Carrington View

Net-Zero Energy-Ready Challenge Winners Series

May 2021

The NZER Challenge

The Net-Zero Energy-Ready (NZER) Challenge is a provincial CleanBC incentive program for large buildings (multi-unit residential, office, retail, commercial, institutional, etc.) launched in late 2018. In addition to providing financial support for developments targeting NZER levels of performance, the program aims to celebrate, promote and learn from these innovative and energy-efficient projects.

Out of over 50 applications received, a juried competition resulted in the selection of 11 winning projects that represent the best examples of NZER buildings. These projects received up to $390,000 in incentives to help cover the estimated cost premiums associated with the design and construction of NZER buildings.

825 Pacific Street (Credit: IBI Group Architects Ltd.)

SFU Parcel 21 (Credit: Local Practice Architecture + Design)

UVic Student Housing and Dining (Credit: Perkins & Will)

Project Overview

When Highstreet Ventures (Highstreet) began the Carrington View rental development, there was no municipal requirement to meet any step of the BC Energy Step Code (Step Code). While the Step Code had recently been introduced, only a select group of municipalities had adopted it. Despite this, Highstreet chose to target the highest step of the Step Code for one of the buildings in the Carrington View development. This was prompted by two main reasons. First, the Province had recently launched the CleanBC Plan, which will require buildings to meet the highest level of the Step Code by 2032. Second, the Province was offering a generous incentive for NZER projects through the CleanBC NZER Challenge.

Highstreet believed that it was not only possible to achieve Step 4 of the Step Code twelve years ahead of schedule, but that it could be done cost effectively. Their goal was to provide condo-quality rental units in a near-zero emissions building at no additional cost compared to other rental units on the market. As a developer and builder, Highstreet was uniquely positioned to tackle this dual objective.

Carrington View is a three-building, 186-unit apartment complex located in West Kelowna, British Columbia. Highstreet applied to the CleanBC NZER Challenge with Building A of this complex. This building is Highstreet's first rental building targeting Step 4 of the Step Code - a NZER level of performance. In addition to this energy-related performance target, the development also sought to minimize operational greenhouse gas (GHG) emissions and embodied emissions.

Credit: Skyline Living

Project Specs

Credit: Skyline Living

PROJECT TEAM	
Owner/Developer/ General Contractor	Highstreet Ventures
Architect	W D Fisher Architect
Building Envelope Consultant	RJC Engineers
Energy Modeler & Mechanical Engineer	Reinbold Engineering Group
Structural Engineer	Sorenson Trilogy Engineering Ltd.
Electrical Engineer	Falcon Engineering Ltd.

Address	2200 Majoros Road, West Kelowna, BC
Climate Zone	5
Ownership Type	Rental apartment building
Residential Units	64 one and two bedroom units
Levels	Four storeys above grade and one underground parking level
Electrification	Yes
Minimum Building Code Requirement	BC Building Code 2018 NECB 2015
Canadian Construction Documents Committee (CCDC) Contract	N/A (Developer/Builder)
Gross Floor Area	Residential : 6,130 m^2 (65,983 ft^2) Parking: 1,532 (16,490 ft^2)
Modeled Floor Area	6,156 m^2 (66,263 ft^2)
Window to Wall Area	17.4%
Form factor[1]	0.83
Construction Duration	13 months (November 2019 to December 2020)
Total Energy Use Intensity[2,3,4]	32.8 kWh/m^2 yr
Thermal Energy Demand Intensity[2,3]	14.1 kWh/m^2 yr
Greenhouse Gas Intensity[4]	0.16 kgCO_2eq/m^2 yr
Airtightness at 75 Pa[5]	0.76 L/s.m^2 (0.86 ACH_{50}) (Depressurization only)

1 Form factor calculated using the modeled floor area.
2 Based on the as-built airtightness test results.
3 Includes a corridor pressurization adjustment of 6.9 kWh/m^2.
4 Includes an approximate annual solar energy production of 103 MWh (16.73 kWh/m^2 yr).
5 Extrapolated from blower door test results ranging from -8.6 Pa to -43 Pa.

Technical Details

Structure

The building's underground parking level is constructed using conventionally reinforced concrete footings, walls, slab-on-grade and suspended soffit slab. The above-grade structure consists of conventional 50mm x 100 mm (2" x 4") wood stud framing for the walls, wood beams and pre-engineered wood joists for the floor structures and wood trusses for the low-slope roof. A 38mm (1 ½") thick concrete topping was added to each floor assembly above the ground floor.

Installation of the wood stud framing (Credit: Highstreet Ventures Inc.)

Exterior wall assembly (Credit: Highstreet Ventures Inc.)

Insulation

The above-grade exterior walls were designed to achieve an effective thermal resistance of RSI 6.9 m^2K/W (R-39) using 209mm (8 ¼") thick Insulspan® structural insulating panels (SIP) with an exterior layer of 50 mm (2") thick Roxul Comfortboard 110 stone wool insulation board installed over the SIPs. The SIPs consist of 7/16" thick oriented strand board (OSB) panels and a graphite polystyrene (GPS) core. The exterior insulation was secured to the SIPs using Z-girts. The upper portion of the parkade walls were designed to achieve an effective thermal resistance of RSI 2 m^2K/W (R-11) with 50mm (2") thick rigid extruded polystyrene (XPS) insulation installed on the exterior side. The roof is designed to achieve an effective thermal resistance of RSI 9.2 m^2K/W (R-52) with batt insulation installed in the roof cavity (between the joists). A 152 mm (6") thick layer of glass-fiber insulation was spray-applied to the underside of the parkade soffit slab. This should achieve an effective thermal resistance of RSI 5.3 m^2K/W (R-30) for the ground-level floor assembly.

Fenestration

The casement windows were supplied by All Weather Windows Ltd. and consist of a triple-paned, argon-filled insulating glass unit (IGU) in a PVC frame. The windows have two low-emissivity coatings and a low solar heat gain coefficient ranging from 0.2 to 0.27. The effective U-value of the windows ranges from 0.79 to 0.97 W/m²K. The steel-clad balcony swing doors have a glazed lite with the same IGUs as the windows. The solar heat gain of the doors ranges from 0.09 to 0.11 and the effective U-value of the doors ranges from 1.08 to 1.19 W/m²K. Fixed external aluminum sunshades were installed over all the south and west-facing windows to reduce solar heat gain in the summer.

Installation of the air barrier. (Credit: Highstreet Ventures Inc.)

Windows with fixed external aluminium sunshades (Credit: Skyline Living.)

Airtightness

To ensure a high level of airtightness, a 3M™Air and Vapour Barrier tape was applied over the seams of the SIPs, window and door flanges and a variety of other locations. In addition, a Tyvek® CommercialWrap® air barrier was installed on the outside face of the SIPs.

Ventilation

A Panasonic Intelli-Balance® energy recovery ventilator (ERV) was installed in each apartment. This cold-climate ERV can operate with supply air temperatures as low as -30°C, with the defrost cycle initiated at approximately – 9°C. The ERV has a sensible heat recovery efficiency (SRE) of 81% (at 0°C supply air and 25 L/s airflow). Each ERV is equipped with a timed ventilation boost setting.

Corridor Heating and Cooling

Corridors are heated and cooled using a Daikin Rebel® commercial packaged rooftop unit (RTU) with inverter scroll compressors and a direct-drive, variable-speed fan motor. This rooftop unit uses R-410a refrigerant and has a coefficient of performance (COP) of 3.94 (at 8°C / 47°F), a heating seasonal performance factor (HSPF) of 8.35 and an energy efficiency ratio (EER) of 11.8. A Thermolec electric inline duct heater was added to the outdoor intake of the RTU. When the outdoor air temperature drops below 8°C, the duct heater turns on to heat the incoming air to 8°C. The heat pump then raises the temperature of the supply air from 8°C to the desired indoor air temperature setpoint. The duct heater was sized to allow the heat pump to function in temperatures as low as -25°C.

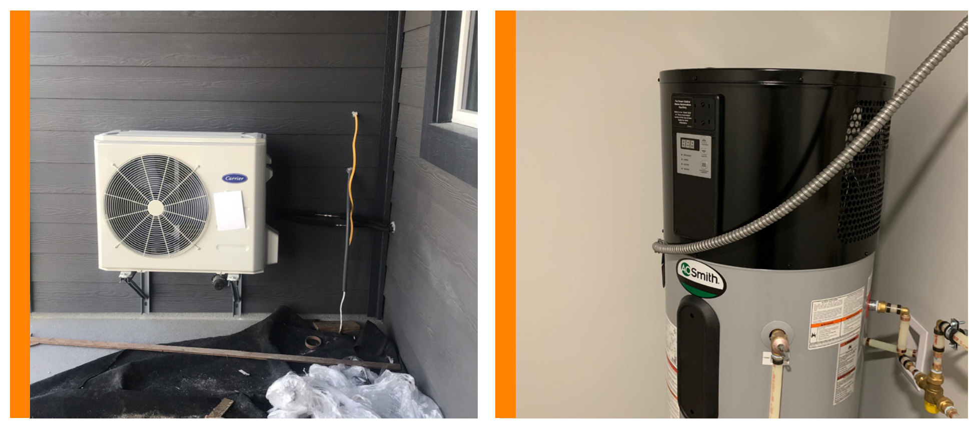
Ductwork above corridor ceiling (Credit: Highstreet Ventures Inc.)

Apartment Heating and Cooling

Space heating and cooling are provided by an energy-efficient, ducted, split heat pump system for each apartment. Both the indoor and outdoor units are manufactured by Carrier®. The heat pump system uses R-410a refrigerant and can provide heating down to an outdoor temperature of approximately -25°C (-13°F). Additional heating is provided by electric kickspace fan heaters in bathrooms with exterior walls. The heat pumps used on this project have a COP ranging from 3.57 (at 8°C/47°F) to 1.65 (at -15°C/5°F), a HSPF ranging from 10.5 to 11.5 and a seasonal energy efficiency ratio (SEER) ranging from 19.6 to 20.5.

Domestic Hot Water

Each apartment is equipped with its own A.O. Smith® Voltex® hybrid electric water heater, each with a heat pump integrated into the top of the tank. When the heater's efficiency mode is selected (using only the heat pump), the energy factor (EF) is 3.61. In hybrid mode, the EF is 3.24 and in electric mode (using only electric resistance heating), the EF is 0.93. For further energy savings, a vacation mode allows the occupant to reduce the setpoint temperature of the water in the tank to 15.6 C (60°F). The heat pump uses R-134a refrigerant.



Left: Heat pump outdoor unit; Right: Integrated heat pump water heater
(Credit: Highstreet Ventures Inc.)

Appliances

All apartments are equipped with Energy Star® appliances to reduce energy consumption (with the exception of the electric range). Apartments are also equipped with ventless Whirlpool® heat pump dryers.

Solar Power

To supplement grid-supplied electricity, a 96kW photovoltaic array was installed on the roof. The array uses over 300 Canadian Solar CS6K-310MS modules and is expected to generate approximately 103 MWh of electricity annually, or approximately a third of the building's estimated annual energy requirement. Surplus energy produced by the solar array is delivered back to the electrical grid through BC Hydro's Net Metering Program.

Rooftop solar panels (Credit: Highstreet Ventures Inc.)

Energy Star® washer and heat pump dryer (Credit: Skyline Living)

Energy and Water Metering

Because the aggregate nameplate capacity for the BC Hydro net metering program is limited to 100 kW, two BC Hydro meters were installed for this building, giving the building owner the flexibility to add more solar power generation in the future. QMC digital revenue meters measure energy consumption for each apartment and vehicle charger in order to pass the cost for energy consumption back to the tenants. The QMC meters provide the landlord and tenants with real-time energy consumption data that allows concerning trends to be identified quickly. QMC meters also measure the energy produced by the solar array.

Project Highlights

> “The payback we expect to see from building improvements are driven by operating cost reductions. Ultimately the product we are developing is a revenue stream, so if we can increase the revenue, then the project is worth more. For this reason, reducing operating costs continues to be one of the biggest drivers of progress.”

— JAY STARNINO, FORMER HIGHSTREET VENTURES SUSTAINABILITY ANALYST

As a developer/builder, Highstreet was in an ideal position to tackle multiple objectives, including minimizing the building’s operational emissions. To do this, Highstreet decided on an **all-electric building** to take advantage of BC Hydro’s near-zero emissions, renewable power supply. Designing and building an all-electric building can be done in a variety of ways with readily available mechanical equipment, but combining this objective with an aim to achieve Step 4 of the Step Code in Kelowna’s climate in a cost-effective way required a new approach.

Despite these multiple objectives, Highstreet was able to achieve these goals by focusing on what comes naturally to developers and builders - aiming for a simple design, minimizing construction costs and optimizing constructability. This approach allowed Highstreet to construct this building for less than the average construction cost of multi-unit residential buildings being built in the region at the time.

Credit: Skyline Living

This project was also the first Highstreet development which used **SIPs**. This new approach represented a risk, but the risk was carefully evaluated against the potential benefits and the decision was made to proceed with SIPs. From a constructability standpoint, SIPs were ideal for a simple building form with little articulation and allowed for a simple air barrier system. Their use also resulted in much greater flexibility in construction scheduling. While the use of SIPs did not result in a shorter construction schedule compared to a building with conventional framing, the construction team's growing familiarity with SIPs over time is expected to result in a shorter construction schedule in future developments.

To achieve the rigorous Step 4 **airtightness** requirement, a few key strategies were adopted. Recognizing that additional training would be useful for future Highstreet developments, the project's Quality Control Coordinator, Site Superintendent and Site Foreman took the Construction Technology for BUILT GREEN® course focused on building science. The Site Superintendent (and some of the key trades) had previously taken some Passive House courses.

In addition to training staff, Highstreet's construction team also instituted a mandatory airtightness orientation program for all trades before beginning work on-site, akin to the mandatory site safety orientation sessions. This provided the trades with a basic understanding of the airtightness strategy and target, as well as the importance of the air barrier system. Second, the use of SIPs allowed for a simple air barrier design and installation, which in turn provided Highstreet and its trades with an ideal opportunity to learn about high-performance air barrier systems. Finally, Highstreet worked closely alongside the building envelope engineer to ensure that they captured all of the necessary air barrier details before and during construction.

Credit: Skyline Living

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