



Natural Resources
Canada

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R-2000 NET-ZERO ENERGY Pilot Case Study

VAL-DES-RUISSEAUX CONDOS CONSTRUCTION VOYER



Laval, Quebec



Project DESCRIPTION

Natural Resources Canada (NRCan) spearheaded a national demonstration project to engage the residential industry in designing and building net-zero energy houses. The goal was to showcase industry leadership in realizing such an ambitious goal while delivering homes attractive to the marketplace.

NRCan established the energy performance framework that ensured consistent and transparent rating of the homes. The Pilot requirements were based on NRCan's R-2000 high performance home program, a well-established and premium housing program in Canada.

This project saw the construction of 26 net-zero energy or net-zero energy ready homes. A net-zero energy home is a house that produces as much energy as it consumes on an annual basis. The Val-des-Ruisseaux Condos and Homes project features the first six-unit condominium building in Quebec to have net-zero energy consumption.

The **BUILDER:** **CONSTRUCTION** **VOYER**



Selected as one of the builders in Canada to demonstrate net-zero energy construction in a production environment (NRCan/Owens Corning ecoEl)



Opened the first net-zero energy 6-unit condominium in Canada



Affordability

The Construction Voyer net-zero energy condominium suites cost about \$15,000 more per suite to build (\$90,000 more for the 6-plex) than houses in the same location built to code. For the buyer, each suite costs about 8% more than a comparable standard Construction Voyer condominium suite in Laval, Quebec.

Key **FEATURES**

EnerGuide Rating
for each suite

0
GJ/Yr



Roof:

R-52 to R-60 blown, R-40 batt (flat)



Main walls:

exterior: R-24 batt + R-10 XPS (2")

interior: separation R-30



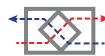
Foundation:

Under slab: R-15 XPS (3")



Windows:

low-E, argon-filled, triple pane



HRV:

74% efficient at 0°C and 64% at -25°C



Airtightness average:

1.5 ACH at 50 Pa



Space heating and cooling:

air source heat pump, 8.87–9.74 HSPF/
19–25 SEER + electric baseboards



Water heating:

2.73 EF hybrid heat pump water heater,
57.3% efficient drain water heat recovery



Rated annual energy consumption:

146.5 GJ



Electricity generation:

whole-building solar PV system, 150 panels 255 W
each, rated annual energy production: 148.57 GJ



Estimated net annual energy use:

2.88 GJ

The HOME



first-floor/ground plan



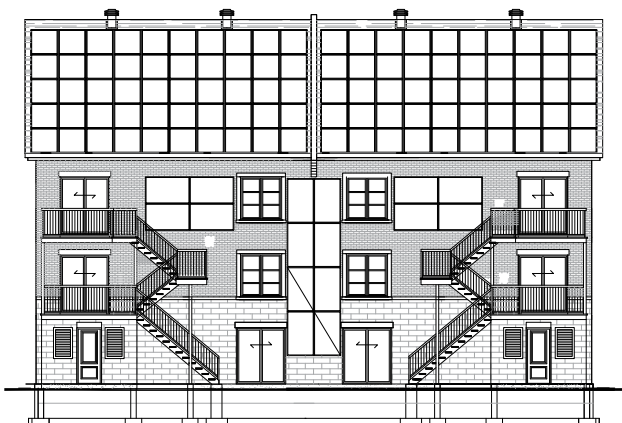
second-floor plan



third-floor plan



front and back elevations



Note: Elevations may differ from the actual construction.

Technical SUMMARY

Construction Voyer, Laval, Quebec				
Site characteristics				
Location	Laval, Quebec			
Site type	Suburban, new development			
Design conditions				
Number of occupants	2 adults ¹			
Heating degree days ²	4,500			
Building description				
Type: Three-storey, stacked townhouse - 6 suites total				
Floor area	549.88 m²			
Heated volume	1,510.00 m³			
Ceiling area	251.10 m²			
Main wall area	496.74 m²			
Total window area	82.44 m²			
Thermal characteristics	Effective		Nominal	
Roof (attic)	9.3 to 10.66 RSI		R-52 to R-60 blown cellulose	
Walls	4.57 to 5.12 RSI		R-24 batt + R-10 XPS (2")	
Windows (average value)	1.11 RSI		low-E, argon-filled, triple pane	
Basement floor	2.64 RSI		R-15 XPS (3")	
Measured airtightness level	1.5 air changes per hour at 50 Pa			
Building performance (annual energy consumption) ³				
	Entire building	Ground floor	Second floor	Third floor
Space heating	14.77 GJ	2.76 GJ	2.02 GJ	2.61 GJ
Domestic water	33.48 GJ	6.02 GJ	5.34 GJ	5.34 GJ
Lighting, appliances and other plug loads	84.36 GJ	14.06 GJ	14.06 GJ	14.06 GJ
Mechanical ventilation	1.68 GJ	0.28 GJ	0.28 GJ	0.28 GJ
Space cooling	12.2 GJ	1.78 GJ	2.28 GJ	2.04 GJ
Rated annual energy consumption	146.49 GJ	24.95 GJ	23.98 GJ	24.33 GJ
Rated annual energy production ⁴	148.57 GJ	25.31 GJ	24.2 GJ	24.78 GJ
Net annual energy use (consumption minus production)	-2.88 GJ	-0.39 GJ	-0.63 GJ	-0.45 GJ
EnerGuide rating (ERS) for each suite		0* GJ		

1. Occupant assumptions based on EnerGuide Rating System Version 15. Reduced baseloads were considered for this multi-unit residential building as allowed by Natural Resources Canada.

2. Heating degree days data from the National Building Code.

3. Building performance is modelled using HOT2000 version 11.3.

4. The rated annual energy production accounts for the contribution of eligible energy-producing systems. These houses use only solar photovoltaics as their energy-producing system for electricity generation.

*This building has been designed to produce more energy than it consumes on an annual basis.

R-2000 standard pick list

Indoor Air Quality

IAQ 001 Reduced volatile organic compounds (VOC)

Coatings, sealants, adhesives, and wall and ceiling finishes. The following shall all have low-VOC content as determined through Green Seal, ECOLOGO or GREENGUARD certification:

- ◆ All coatings, sealants and adhesives used in the interior of the house;
- ◆ All liquid coatings, i.e. paints and varnishes;
- ◆ All finish flooring adhesives;
- ◆ All wall and ceiling finishes (such as wallpaper, wall fabrics, stone and ceramic tile).

IAQ 002 Millwork, cabinetry and countertops

All millwork, including trim, casements, baseboards, wainscoting and built-in cabinets, shall have low-VOC content as determined through ECOLOGO or GREENGUARD certification. Cabinets and vanities shall be made either from solid wood or manufactured wood products. If made from manufactured wood products, products shall meet either of the following criteria:

- ◆ Products must be made from urea formaldehyde-free fibre board or particleboard that meets the E-1 European standard or the HUD Standard, 24 CFR Part 3280.308.
- ◆ Products must have all exposed surfaces sealed with a low-VOC sealer as determined through Green Seal, ECOLOGO or GREENGUARD certification.

IAQ 003 Flooring

Carpeting and carpet cushion

Except as noted, carpeting and carpet cushion used together in the house shall meet either of the following criteria:

- ◆ The carpet shall be labeled under the Canadian Carpet Institute's Green Label Plus Program, and the carpet cushion shall be labeled under the Carpet and Rug Institute's Green Label Plus Program.
- ◆ A non-Green Label carpet and/or non-Green Label Plus carpet cushion shall cover no more than 10 percent of the interior floor area including the basement floor area. Where carpeting is used in the basement, the basement slab shall be insulated with a minimum R-10, be heated, or have no direct contact between the carpet and concrete floor.

Solid surfaces

All solid flooring, such as bamboo, cork, laminate, resilient (sheet) stone, tile and wood, shall have low-VOC content as determined through ECOLOGO or GREENGUARD certification. Wood flooring shall be from a sustainable source, as determined through a third party under the Programme for the Endorsement of Forest Certification (PEFC) International or the Forest Stewardship Council (FSC).

Note: Vinyl flooring shall not be used.

Underlayment

All particleboard-flooring underlayment shall meet either of the following criteria:

- ◆ E-1 European standard or the ANSI A208.1-1993 Table B standard
- ◆ have all surfaces sealed with a sealer with low VOC content as determined through ECOLOGO or GREENGUARD certification or be pre-finished

Flooring adhesives

All flooring adhesives shall all have low-VOC content as determined through Green Seal, ECOLOGO or GREENGUARD certification.

IAQ 005 Air filtration

Install a medium-efficiency air filter with a minimum MERV rating of 13 where air-circulating, heating or cooling systems are used.

Note: The HVAC designer will need to take the pressure drop of the MERV 13 filter into account when sizing the ducts.

Energy Efficiency

EE001 Energy-efficient appliances

An ENERGY STAR® certified clothes washer, dishwasher and refrigerator shall be included with the sale of the house.

EE002 Electricity monitoring and saving devices

Install a whole house home energy display unit that provides ongoing measurement and analysis of the home's energy consumption at the individual circuit level.

EE004 Reduced energy consumption of the house

Predicted energy consumption is at least 15% less than the R-2000 whole house energy target, as provided in Clause 5.1.2 of the R-2000 standard.

Environmental Stewardship

ES001 Reduced storm water discharge

Provide infrastructure to limit the peak discharge rate of storm water to less than 1% of maximum annual rainfall intensity. For example, this can be accomplished by installing walkways and driveways that promote water absorption rather than run-off and/or by installing water retention methods such as rainwater collection, a rainwater garden or a detention pond.

Water Conservation

WC004 Irrigation systems

Landscaping systems shall be designed to not require irrigation, be irrigated with rainwater or domestic reclaimed water (in accordance to CSA B128.1-06 Design and Installation of Non-Potable Water Systems) only, or be irrigated by the following type of system. Should potable water be required for irrigation, irrigation systems shall include a low-volume, non-spray irrigation system (drip irrigation, bubblers, drip emitters, soaker hose) and a zoned irrigation system that separates turf and bedding areas.

Resource Management

RM002 Use of wood-conserving technologies

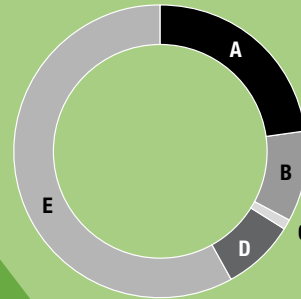
Engineered floors are used substantially (80% or more).

The PERFORMANCE



Whole building (6 units)

Energy consumption by usage

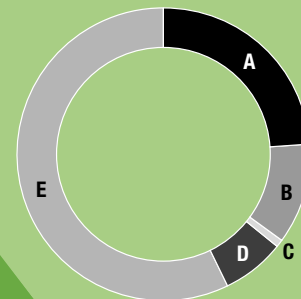


A	Water heating	23%
B	Space heating	10%
C	Ventilation	1%
D	Space cooling	8%
E	Base loads (appliances, lighting, etc.)	58%

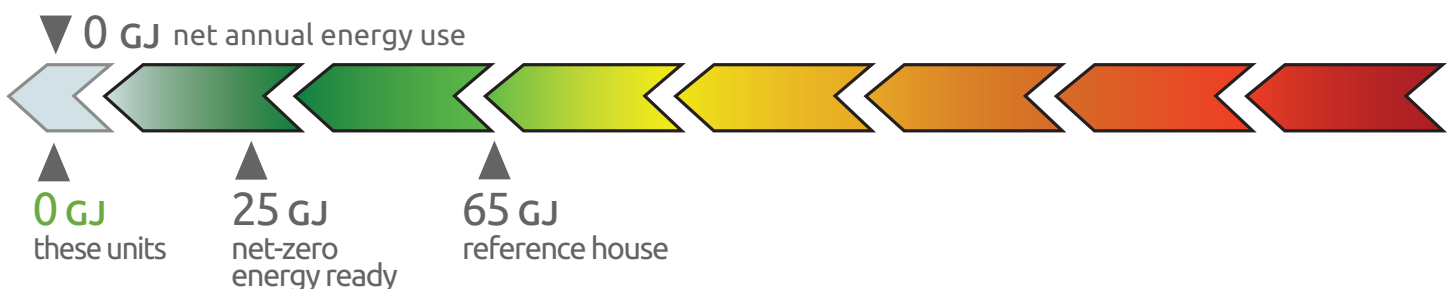


Ground-level units (average)

Energy consumption by usage



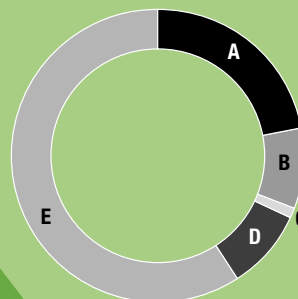
A	Water heating	24%
B	Space heating	11%
C	Ventilation	1%
D	Space cooling	7%
E	Base loads (appliances, lighting, etc.)	57%



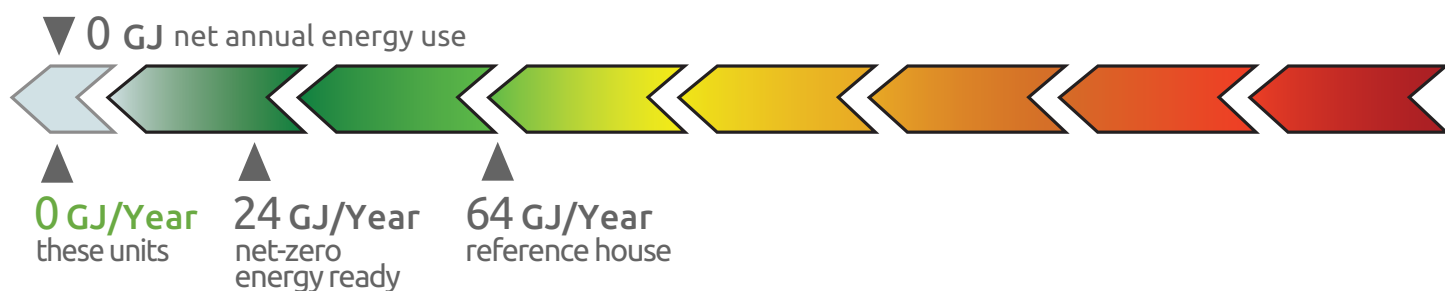


Second-floor units (averages)

Energy consumption by usage

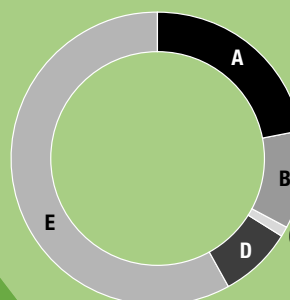


A	Water heating	22%
B	Space heating	9%
C	Ventilation	1%
D	Space cooling	9%
E	Base loads (appliances, lighting, etc.)	59%

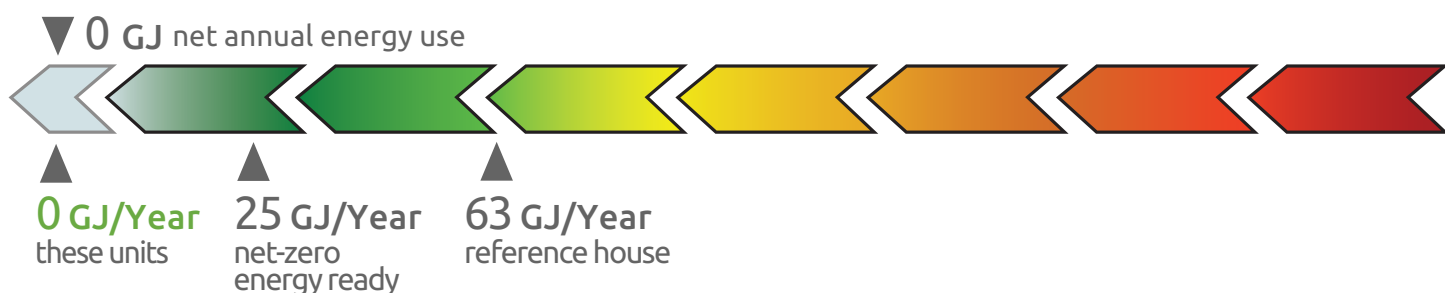


Third-floor units (averages)

Energy consumption by usage



A	Water heating	22%
B	Space heating	11%
C	Ventilation	1%
D	Space cooling	8%
E	Base loads (appliances, lighting, etc.)	58%



This case study was developed by buildABILITY Corporation for Natural Resources Canada's Office of Energy Efficiency, 2016.

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