



Natural Resources  
Canada

Ressources naturelles  
Canada

# R-2000 NET-ZERO ENERGY Pilot Case Study

## WESTMINSTER WOODS REID'S HERITAGE HOMES



Guelph, Ontario



## 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. Reid's Heritage Homes' first net-zero energy home opened its doors on September 19, 2015.

# The **BUILDER: REID'S** HERITAGE HOMES



Built the first North American LEED Platinum home in Canada



One of five builders in Canada to demonstrate net-zero energy construction in a production environment



Opened the first net-zero energy home in the ecoEII Net-Zero Energy Project



## Affordability

In comparison to houses in the same location built to code, Reid's net-zero energy homes cost about \$60,000 more to build. Reid's is also exploring net-zero energy ready packages that will cost about \$25,000 more to build. For the buyer, the full net-zero energy home is about 12% more than a comparable standard single detached home from Reid's in Guelph.

## Key **FEATURES**

### EnerGuide Rating

**0**  
GJ/Yr



#### Roof:

R-60 blown cellulose



#### Main walls:

R-22 batt + R-15 XPS (3")



#### Basement:

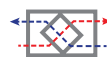
walls: R-22 batt + R-10 XPS (2")

under slab: R-10 XPS (2")



#### Windows:

low-E, argon-filled, triple pane



#### HRV:

67% efficient at 0°C and 60% at -25°C



#### Airtightness:

1.13 ACH at 50 Pa



#### Space heating and cooling:

air source heat pump, 8.09 HSPF/14.3 SEER  
+ electric furnace



#### Water heating:

2.78 EF hybrid heat pump water heater,  
53.3% efficient drain water heat recovery



#### Rated annual energy consumption:

33.95 GJ

*This house consumes ~60% less energy than its reference house.*



#### Electricity generation:

≤10 kW solar PV system, 33 panels 265 W each,  
rated annual energy production: 37.21 GJ



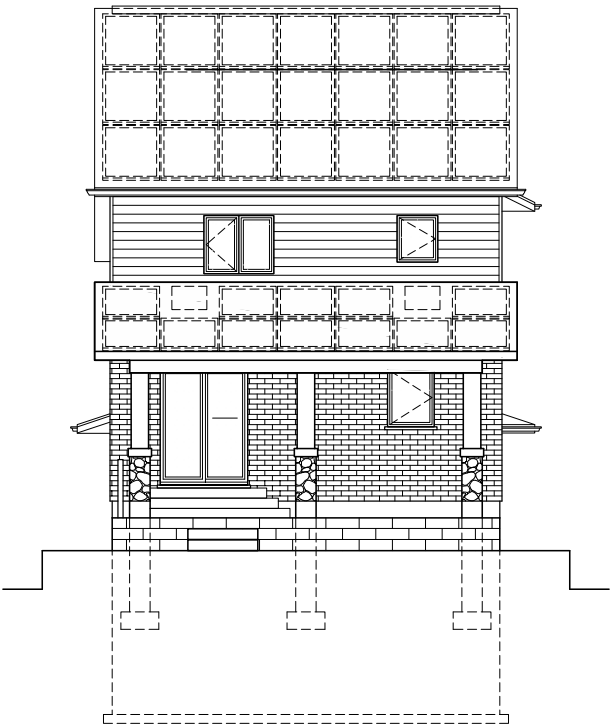
#### Estimated net annual energy use:

- 3.26 GJ

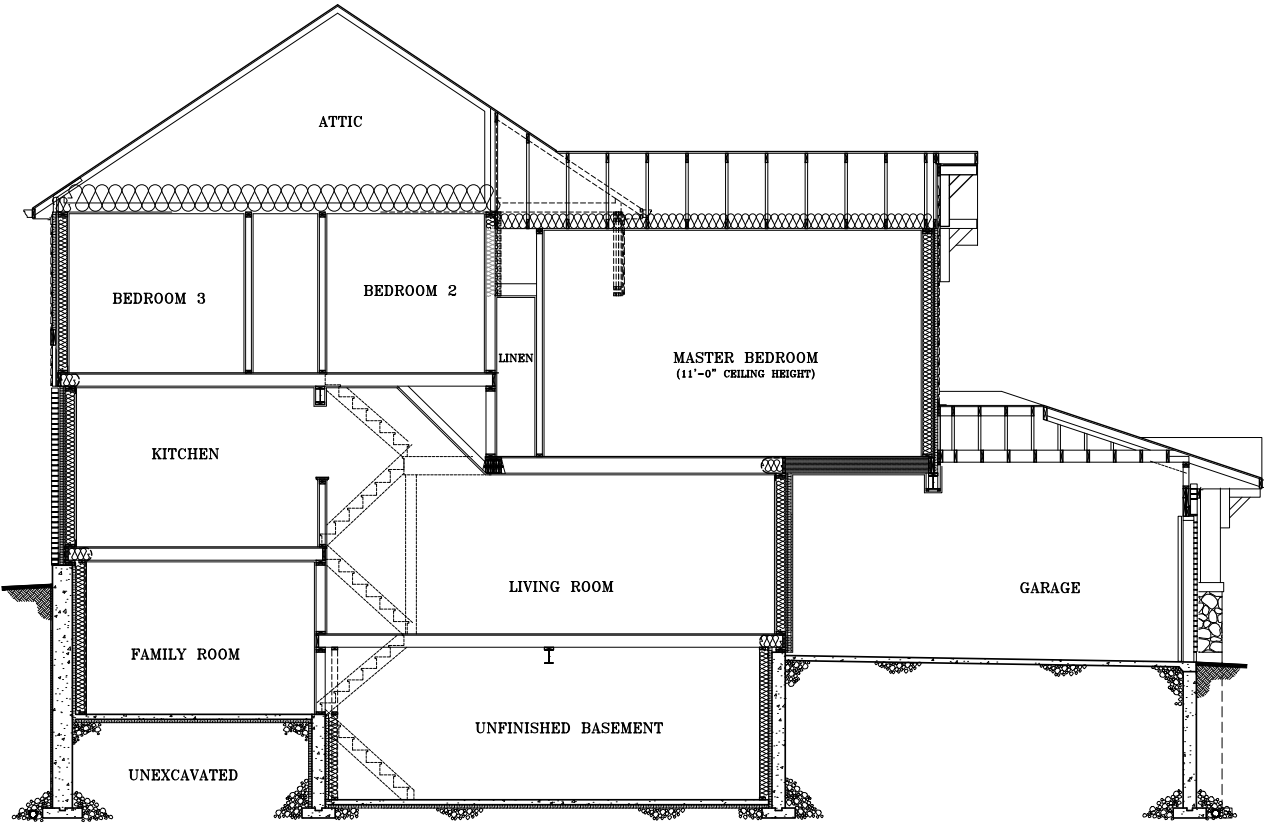
The HOME



front elevation

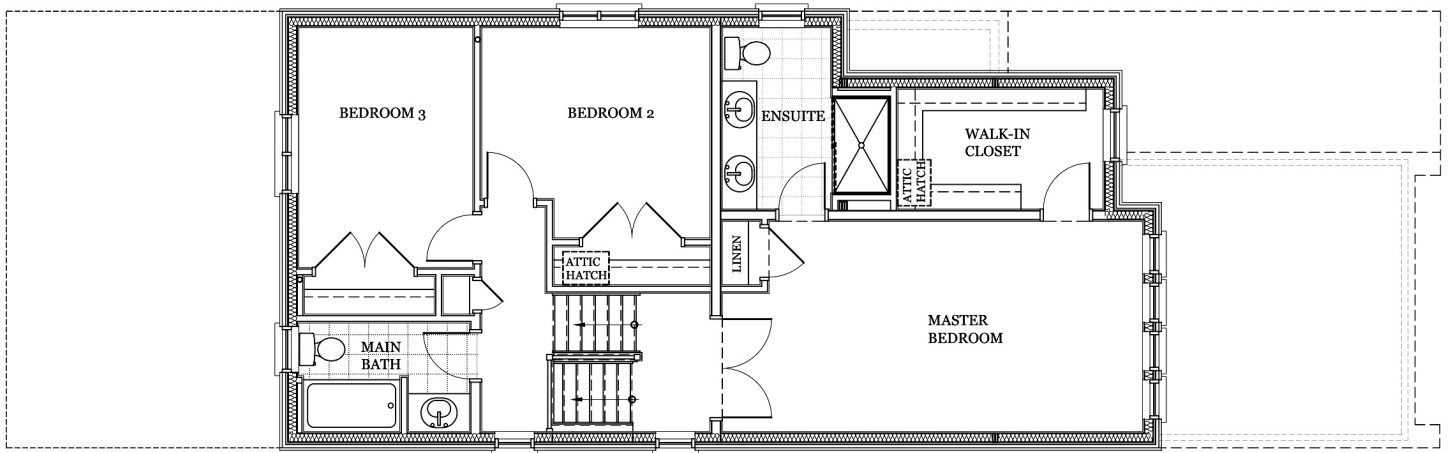


back elevation

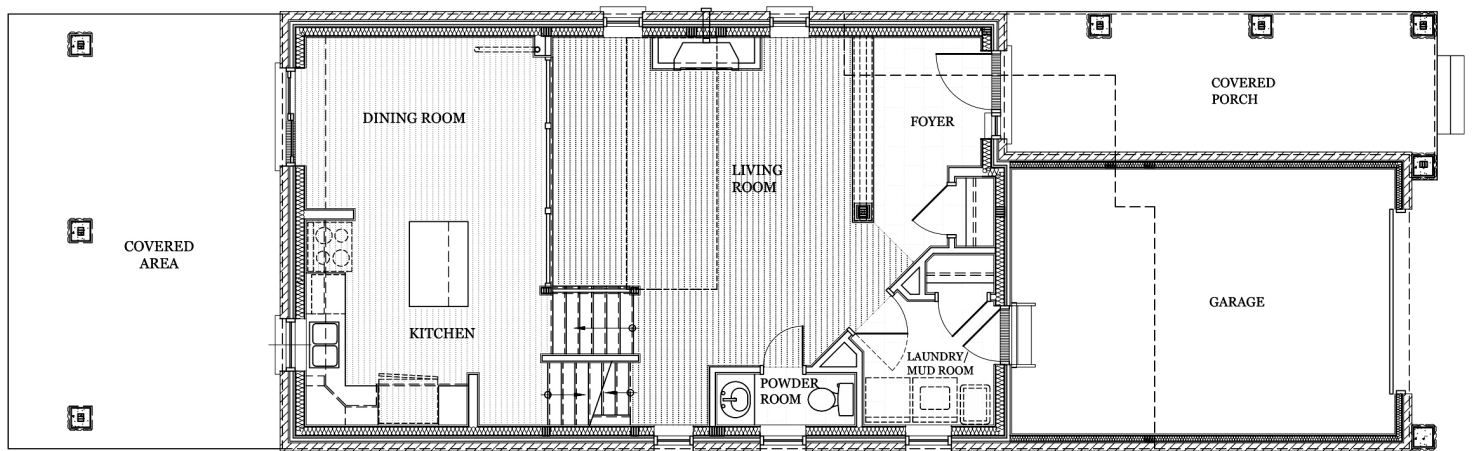


section

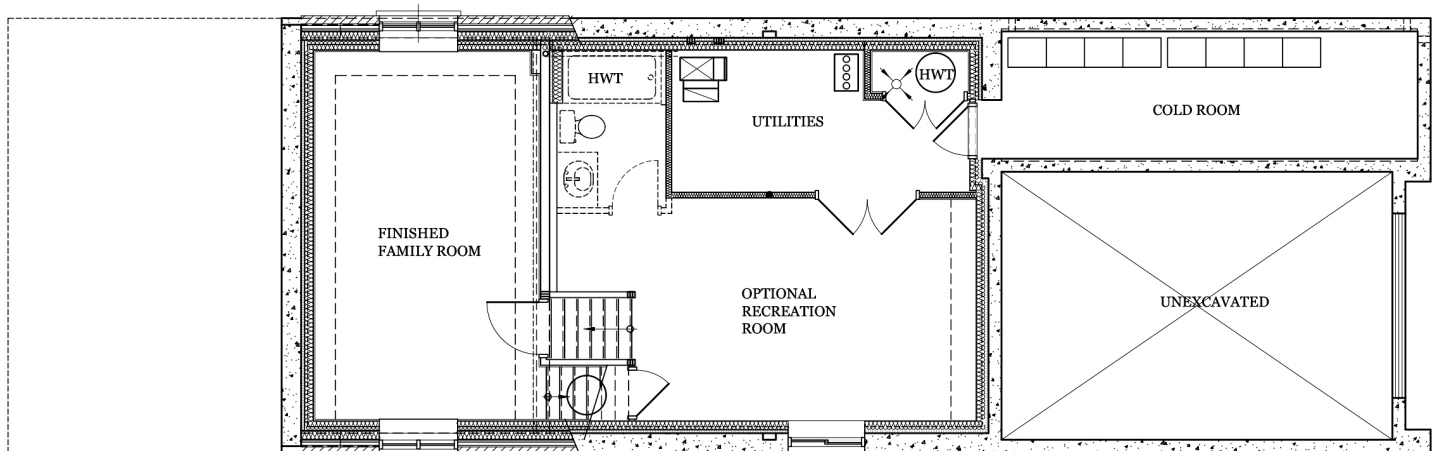
Note: Elevations may differ from the actual construction.



**second-floor plan**



**main floor plan**



**basement floor plan**

# Technical SUMMARY

Reid's Heritage Homes, Guelph, Ontario		
Site characteristics		
Location	Guelph, Ontario	
Site type	Suburban, new development	
Design conditions		
Number of occupants	2 adults, 1 child <sup>1</sup>	
Heating degree days <sup>2</sup>	3,890	
Building description		
Type: Two-storey with walkout lower floor, 3 bedroom single detached residence		
Floor area (including basement)	223.38 m <sup>2</sup>	
Heated volume	565.80 m <sup>3</sup>	
Exposed floor area	11.43 m <sup>2</sup>	
Ceiling area	78.78 m <sup>2</sup>	
Main wall area	204.29 m <sup>2</sup>	
Total window area	22.17 m <sup>2</sup>	
Thermal characteristics	Effective	Nominal
Roof	10.38 RSI	R-60 blown cellulose
Walls: Main floor	6.21 RSI	R-22 batt + R-15 XPS (3")
Basement	5.21 RSI	R-22 batt + R-10 XPS (2")
Windows (average value)	1.04 RSI	low-E, argon-filled, triple pane
Basement floor	1.76 RSI	R-10 XPS (2")
Measured airtightness level	1.13 air changes per hour at 50 Pa	
Building performance (annual energy consumption) <sup>3</sup>		
Space heating	7.09 GJ	
Domestic water heating	2.78 GJ	
Lighting, appliances and other plug loads	22.99 GJ	
Mechanical ventilation	0.25 GJ	
Space cooling	0.83 GJ	
Rated annual energy consumption	33.95 GJ	
Rated annual energy production <sup>4</sup>	37.21 GJ	
Net annual energy use (consumption minus production)	-3.26 GJ	
EnerGuide rating (ERS)	0* GJ	

1. Occupant assumptions based on EnerGuide Rating System Version 15.

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

3. Building performance is modelled using HOT2000 version 11.2.

4. The rated annual energy production accounts for the contribution of eligible energy-producing systems.

This house uses only solar photovoltaics as its energy-producing system for electricity generation.

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

# R-2000 standard pick list

## Indoor Air Quality

### 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 a 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

### ES002 Damp proofing and waterproofing

All damp proofing shall be water-based or all waterproofing shall be mechanically fastened.

## Water Conservation

### WC001 Domestic reclaimed water use

A minimum of 50% of fixtures shall be plumbed to collect domestic reclaimed water, as permitted by local codes, and in accordance with CSA B128.1-06 Design and Installation of Non-Potable Water Systems, CSA B128.2-06 Maintenance and Field Testing of Non-potable Water Systems and CSA 128.3-12 Performance of Non-Potable Water Reuse Systems.

## Resource Management

### RM001 Use of wood-conserving technologies

The measures below shall be used substantially (80% or more) for the given application:

- a) use of at least four advanced framing techniques (Optimum Value Engineering) throughout the framing of the house from existing best practices, such as:
  - ◆ 2x6 framing at 600 mm (24") on centre
  - ◆ spacing roof trusses up to 600 mm (24") on centre
  - ◆ two-stud corners
  - ◆ single top plates
  - ◆ elimination of jack studs and cripples
  - ◆ engineered lintels and single headers, where possible
- b) use of finger-jointed framing lumber or engineered lumber

### RM006 Exterior cladding

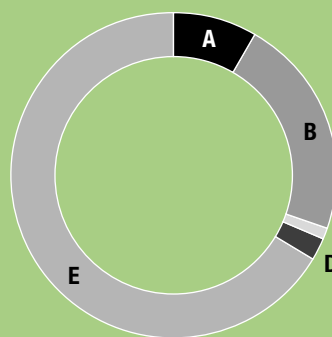
Use a rain screen system (i.e. one that separates the exterior cladding from the wall sheathing and includes a drainage plane).



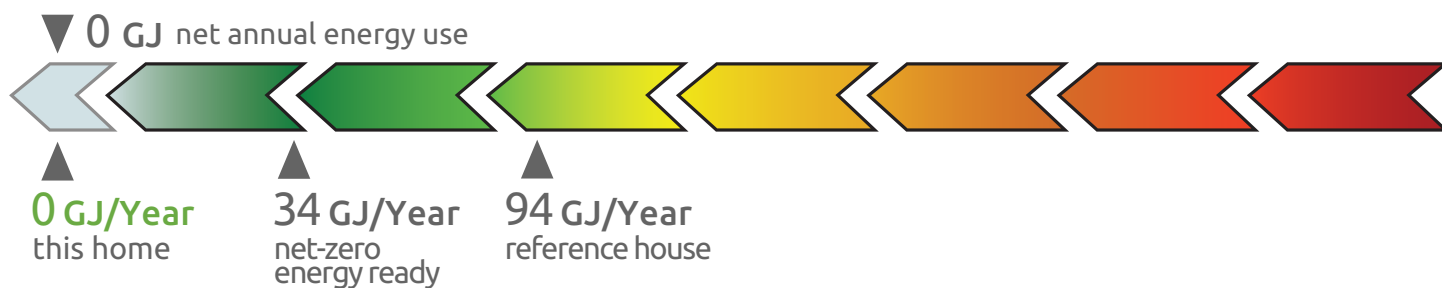
# The PERFORMANCE



## Energy consumption by usage



A	Water heating	8%
B	Space heating	21%
C	Ventilation	1%
D	Space cooling	2%
E	Base loads (appliances, lighting, etc.)	68%



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