Natural Resources Canada | Ressources naturelles Canada

# R-2000 NET-ZERO ENERGY
## Pilot Case Study

## ARCADIA COMMUNITY I
## MINTO COMMUNITIES

Kanata, 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. Minto Communities opened this net-zero energy model home on October 8, 2015.



Canada

# The BUILDER: MINTO COMMUNITIES

- Built the Innova Home in Emerald Meadows, Kanata – was the largest builder to offer R-2000 homes
- Built the Inspiration - The Minto ecohome as part of the CMHC EQuilibrium Initiative in 2009 to 2010
- Ontario Home Builder of the Year in 2012 and 2014; Ontario Green Builder of the Year in 2011, 2012, 2014 and 2015
- One of the first builders to offer net-zero energy ready as an upgrade for homebuyers

## Affordability

**In comparison to houses in the same location built to code, the Minto net-zero energy homes cost $60,000 to $70,000 more to build. For the buyer, the Killarney model normally starts at $452,900. A net-zero energy ready version starts at $495,600, which includes architectural, mechanical, electrical and solar-ready features. To make it actually net-zero, there is the added cost of rooftop solar panels, which range between $25,000 and $40,000, depending on a family's energy use.**

# Key FEATURES

## EnerGuide Rating

**0** GJ/Yr

**Roof:**
R-60 blown fibreglass

**Main walls:**
R-24 batt + R-10 XPS (2")

**Basement:**
**walls:** R-12 batt + R-15 spray foam (3")
**under slab:** R-10 XPS (2")

**Windows:**
low-E, argon-filled, triple pane

**HRV:**
75% efficient at 0°C and 70% at -25°C

**Airtightness:**
1.24 ACH at 50 Pa

**Space heating and cooling:**
air source heat pump, 9.57 HSPF/15.3 SEER + electric furnace

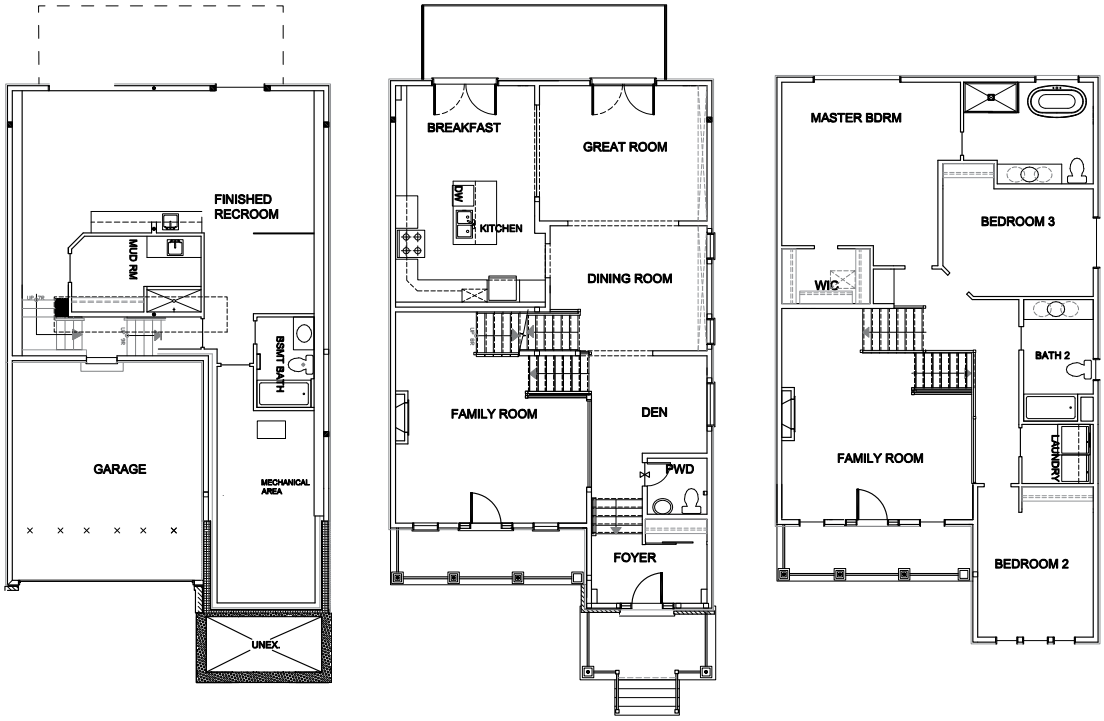
**Water heating:**
2.78 EF hybrid heat pump water heater, 42.8% efficient drain water heat recovery

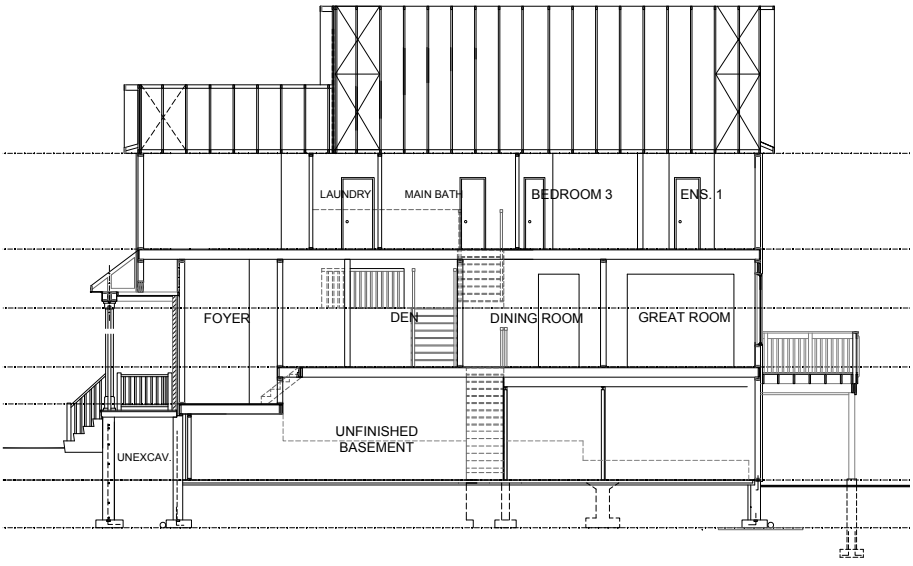
**Rated annual energy consumption:**
43.61 GJ
*This house consumes ~65% less energy than its reference house.*

**Electricity generation:**
≤10 kW solar PV system, 36 panels 265 W each, rated annual energy production: 48.95 GJ

**Estimated net annual energy use:**
-5.34 GJ

# The HOME




**Top (left to right):** *basement floor plan, main floor plan, second-floor plan*

**Middle (left to right):** *front elevation, rear elevation*

**Bottom:** *longitudinal section*

Note: Elevations may differ from the actual construction.

# Technical SUMMARY

| Minto Communities, Kanata, Ontario | | |
|---|---|---|
| **Site characteristics** | | |
| Location | Kanata-Ottawa West, Ontario | |
| Site type | Suburban, new development | |
| **Design conditions** | | |
| Number of occupants | 2 adults, 1 child[1] | |
| Heating degree days[2] | 4,500 | |
| **Building description** | | |
| Type: Two-storey with walkout lower floor, 3 bedroom, single detached residence | | |
| Floor area (including basement) | 277.40 $m^2$ | |
| Heated volume | 866.80 $m^3$ | |
| Exposed floor area | 33.35 $m^2$ | |
| Ceiling area | 120.17 $m^2$ | |
| Main wall area | 240.78 $m^2$ | |
| Total window area | 29.18 $m^2$ | |
| **Thermal characteristics** | **Effective** | **Nominal** |
| Roof | 10.61 RSI | R-60 blown fibreglass |
| Walls: Main floor | 5.45 RSI | R-24 batt + R-10 XPS (2”) |
| Basement | 4.32 RSI | R-12 batt + R-15 XPS spray foam (3”) |
| Windows (average value) | 1.01 RSI | low-E, argon-filled, triple pane |
| Basement floor | 1.76 RSI | R-10 XPS (2") |
| Measured airtightness level | 1.24 air changes per hour at 50 Pa | |
| **Building performance** (annual energy consumption)[3] | | |
| Space heating | 17.67 GJ | |
| Domestic water heating | 3.12 GJ | |
| Lighting, appliances and other plug loads | 20.23 GJ | |
| Mechanical ventilation | 0.58 GJ | |
| Space cooling | 2.02 GJ | |
| **Rated annual energy consumption** | **43.61 GJ** | |
| **Rated annual energy production**[4] | **48.95 GJ** | |
| **Net annual energy use** (consumption minus production) | **-5.34 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 002 Millwork, cabinetry and countertops

All millwork, including trim, casements, baseboards, wainscoting and built-in cabinets, shall have low content of volatile organic compounds (VOC) 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:

- 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; or
- 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 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 004 Insulation

Rigid insulation materials and cellulose loose fill insulations shall have low-VOC content as determined through ECOLOGO or GREENGUARD certification. Rigid insulation materials include extruded polystyrene insulation, polysisocyanurate insulations with or without reflective facers, expanded polystyrene rigid insulations and spray foam insulations. Fibrous insulations (e.g. batt and blanket type, loose fill or semi-rigid boards [fiberglass and mineral wool]) shall be formaldehyde-free, as determined through ECOLOGO or GREENGUARD certification.

## 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.

### EE006 Reduced energy consumption from water tanks

Insulate water holding tanks (i.e. those with a minimum size of 946 litres [250 gallons]) located within the house with a minimum R-10 insulation in order to minimize heat absorption from the house and prevent condensation.

## Environmental Stewardship

### ES003 On-site construction waste management

Provide dedicated on-site bins for salvaging wood, cardboard, metal and scrap as part of a written, corporate, on-site construction waste management plan.

*NOTE: This requirement can also be met by third-party off-site waste diversion.*

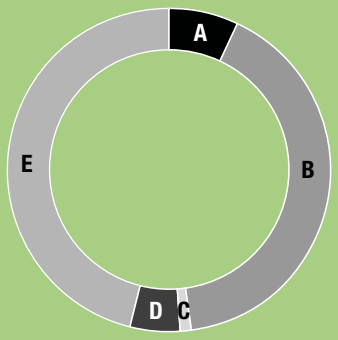
## Resource Management

### 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 | **7%** |
| **B** | Space heating | **41%** |
| **C** | Ventilation | **1%** |
| **D** | Space cooling | **5%** |
| **E** | Base loads (appliances, lighting, etc.) | **46%** |


**0 GJ/Year**
this house

**44 GJ/Year**
net-zero energy ready

**148 GJ/Year**
reference house



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