EQuilibrium™
HEALTHY HOUSING
FOR A HEALTHY ENVIRONMENT

Project Profile:
Now House®—Toronto, Ontario

This Project Profile highlights Now House®, one of the winning entries in the Canada Mortgage and Housing Corporation (CMHC) EQuilibrium™ Sustainable Housing Demonstration Initiative - a national initiative to design, build and demonstrate sustainable homes throughout Canada.[1]

Figure 1—Photo of Now House®

Key Features

- Renovation of an existing home with emphasis on resource conservation and optimal use of the existing property
- Near net-zero annual energy consumption target
- The house produces energy using solar photovoltaic (PV) panels and solar domestic hot water heating and recovers energy in a greywater heat recovery system and heat recovery ventilator
- A predicted 55 per cent reduction in annual greenhouse gas emissions
- Major building envelope improvements and continuous air ventilation and filtration
- Minimal new resources required for retrofit; minimal demolition and waste production

Project Description

Now House® is the retrofit of a 60-year-old post-war house[2] in an established neighbourhood of similar houses in Toronto. This 1½ storey, 139 m² (1,496 sq. ft.) (including basement) detached home has been upgraded to increase energy efficiency, improve indoor air quality, produce energy through renewable sources and recover energy that would otherwise be lost from waste water and exhaust air. The upgrade required only minimal new resources and reduced the impact of the house on the environment.

Now House® shows homeowners and building industry professionals how to dramatically improve the environmental performance of an existing house with

[1] For more information on this initiative and the various EQuilibrium™ projects, visit the CMHC website (www.cmhc.ca) and type the search keyword "EQuilibrium".

[2] For information about renovating post-war houses, see "1½ Storey Post-War Homes" in the *Renovating Distinctive Homes* series, CMHC, 2000, Ottawa
For information about renovating for energy savings, see "Post War 1½ Storey Homes" in the *Renovating for Energy Savings series*, CMHC, 2004, Ottawa

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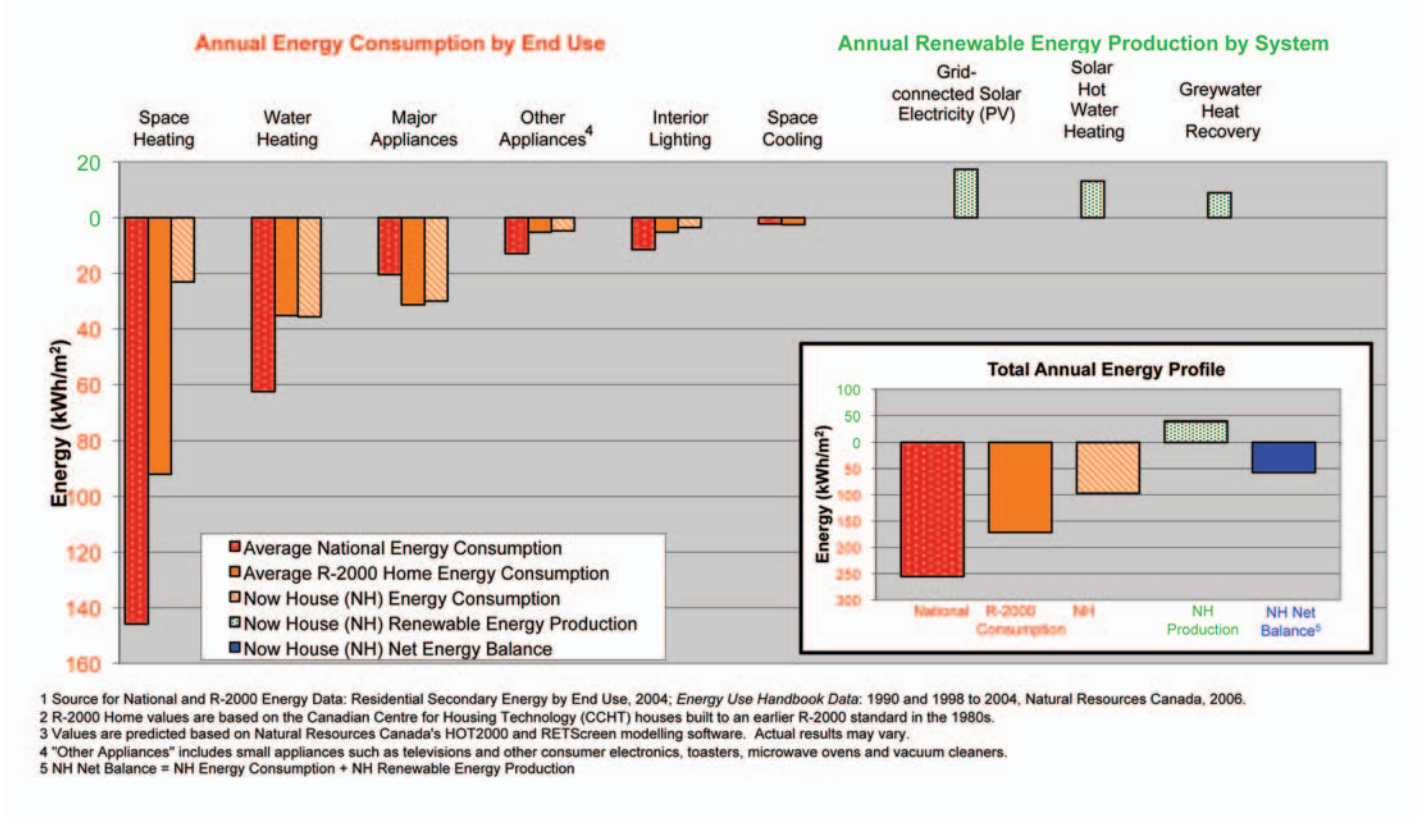

1 Source for National and R-2000 Energy Data: Residential Secondary Energy by End Use, 2004; *Energy Use Handbook Data*: 1990 and 1998 to 2004, Natural Resources Canada, 2006.
2 R-2000 Home values are based on the Canadian Centre for Housing Technology (CCHT) houses built to an earlier R-2000 standard in the 1980s.
3 Values are predicted based on Natural Resources Canada's HOT2000 and RETScreen modelling software. Actual results may vary.
4 "Other Appliances" includes small appliances such as televisions and other consumer electronics, toasters, microwave ovens and vacuum cleaners.
5 NH Net Balance = NH Energy Consumption + NH Renewable Energy Production

Figure 2—Energy profile: Comparison of Canadian National Average,[1] R-2000 Home[2] and predicted Now House® (NH)[3] annual residential energy consumption and production

straightforward modifications, such as improved insulation, new windows, energy-saving appliances and continuous air exchange and filtration. About one million 1½ storey houses were built in Canada between 1945 and 1960. Therefore, the benefits of this project—energy efficiency, healthy living and resource management and conservation—can be repeated.

The total annual energy consumption of Now House® is predicted to be close to the on-site annual production from its renewable energy sources —passive solar space heating, a grid-connected photovoltaic system, and an active solar domestic hot water. Waste water and ventilation air from heat recovery further reduce energy requirements.

Now House® energy consumption is predicted to be only 38 per cent of the requirements for the average Canadian home. In addition, it is predicted that the home will have a 78 per cent reduction in natural gas use and 60 per cent reduction in electricity use compared to pre-renovation consumption.

The electricity produced by the PV system will be sold to the Ontario Power Authority, which will help offset the cost of purchased electricity and the cost of natural gas used to provide supplementary domestic hot water and space heating.

The design of the home is simple. There is a living room, dining area, kitchen and three-piece bathroom on the main floor, and two bedrooms with attic storage on the second floor. The newly renovated basement has a study, recreation room, three-piece bathroom and laundry and utility rooms. Adding insulation, radiant floor heating, and mechanical ventilation improves the basement as a living space.

After a six month public demonstration period, energy generation as well as energy and water consumption will be

monitored for a year to assess the building's performance.

Occupant Health and Comfort

Previous renovation work to the house created some humidity problems. A heat recovery ventilator (HRV) was installed to better manage humidity, remove odours and air-borne pollutants, and provide a continuous source of fresh air.

The renovation work included reducing air leakage and adding insulation to the attic, exterior walls and basement, which reduces drafts and heat loss and increases thermal comfort. A high-efficiency filter on the HRV reduces airborne particles. To further reduce indoor pollutants, low volatile organic compound (VOC) materials and finishes were used. Daylighting was improved by enlarging a south-facing window. Foundation work included adding insulation on exterior walls and under the new basement slab to reduce energy loss and additional drainage to reduce moisture problems.

Energy Efficiency

A variety of strategies reduce energy requirements. In addition to reducing air leakage and adding insulation, new, low-e, argon-filled windows were installed. The south-facing dining room window was enlarged to increase passive solar gain in winter. Retractable awnings provide shade during the summer months to decrease overheating.

The old, energy-intensive appliances have been replaced with energy-efficient ENERGY STAR® appliances and the incandescent lighting with fluorescent and LED[3] lighting. As electronic devices and appliances, such as televisions, microwaves and computers, often draw power even when turned off (known as phantom loads), there are switches on selected electrical circuits to enable devices such as these to be fully turned off when not in use.

- The old gas-fired hot water tank, which operated at about 56 % efficiency, was replaced with a tankless gas boiler (90% efficient) and a new hot water storage tank which takes heat from the solar collectors for distribution to the home's heating and hot water system. In addition to the heating by passive solar gain, energy efficient space heating is delivered by a basement in-floor radiant heating system coupled to the solar thermal system and the new water storage tank via a heat exchanger and a high efficiency air handler with a variable speed motor. A Power-Pipe™ wastewater heat recovery system transfers the heat from the shower drain water to the hot water storage tank.

The air conditioner previously in the home has been removed: cooling needs are met with the upgrading of the insulation, the installation of the awnings and the current placement of shade trees and addition of vines.

Renewable Energy Production

In addition to the carefully designed passive solar heating through the south-facing windows in the winter months, Now House® employs a variety of active solar systems for renewable energy production. The grid-connected solar photovoltaic system is comprised of 16 Day4 48MC 170 panels, with a capacity of 2.7 kW. The system is mounted on the southwest (back) face of the roof, and is predicted to generate 2,800 kWh per year. The electricity generated will be sent directly to the utility grid and sold at $0.42 per kWh under the Ontario Power Authority Standard Offer Program, substantially more than the unit cost of the electricity that will be purchased from the utility.

- The solar hot water system, also mounted on the roof, uses two evacuated tube panels with cylindrical collectors that can take advantage of the sun all day, not just when overhead. The system is predicted to provide 1,823 kWh of heat energy annually.

[3] Light emitting diode

Resource Conservation

In contrast to a home in a new suburban development, Now House® did not require additional land, and uses existing infrastructure, including municipal and utility services such as roads, water pipes, sewers, and gas lines, schools and other public buildings and public transit.

There was minimal use of new materials in the renovation. On the inside of the house, demolition and new construction was restricted to the basement interior walls and concrete floor. To the extent possible, materials (including the solar thermal and PV systems) were sourced from Ontario companies. Construction waste was sorted and where possible recycled.

Low-flow fixtures (showerheads, faucets, toilets) and water-efficient appliances (clothes washer, dishwasher) conserve water, and a roof rainwater harvesting system is used for garden irrigation.

Reduced Environmental Impact

Now House® is within walking distance of public transportation, schools, playgrounds, and shopping, decreasing the need for private transportation. The small footprint of 56.7 m^2 (610 sq. ft.) and minimal use of new building materials significantly reduce the environmental impact in comparison to a more extensive home renovation or new home construction. The improved airtightness, energy-efficiency retrofits and use of renewable energy are predicted to reduce the greenhouse gas emissions by approximately six tonnes/year.

Affordability

Wartime homes were originally designed and built to provide affordable housing for veterans returning from the Second World War. The Now House® model maintains this goal of affordability by designing a retrofit at a cost that can be reasonably managed and financed.

Now House® is focused on the conservation and upgrading of an existing building in an established community and the implementation of renewable energy strategies. Home operating costs, and associated costs such as transportation, have the potential to be much lower than for the majority of Canadian homes. In addition, the sale of electrical power to the grid will help offset costs associated with the purchases of electricity and natural gas. These factors and others will result in housing operational costs that are significantly less than is typically the case.

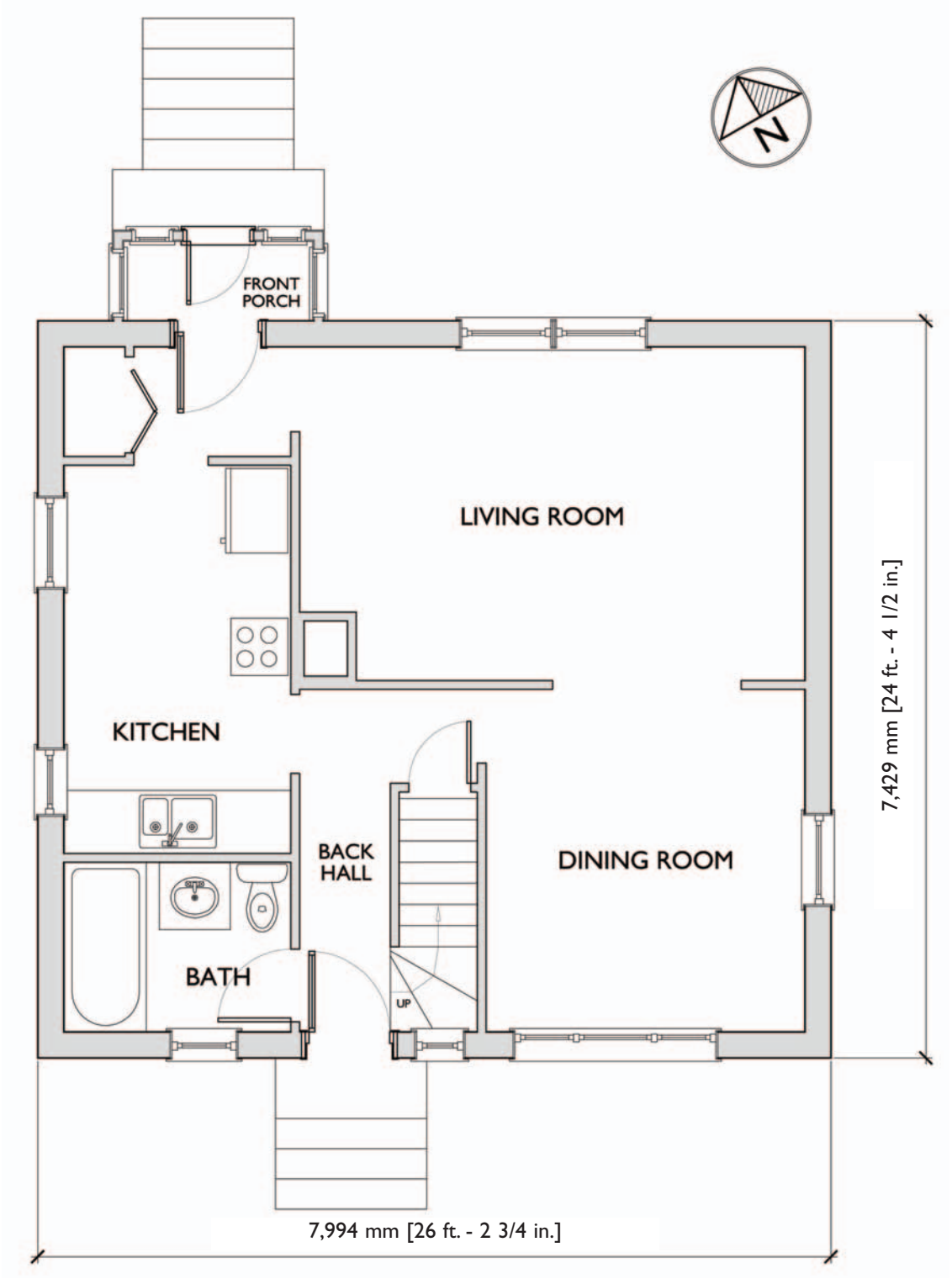

Figure 3—Now House® first floor plan

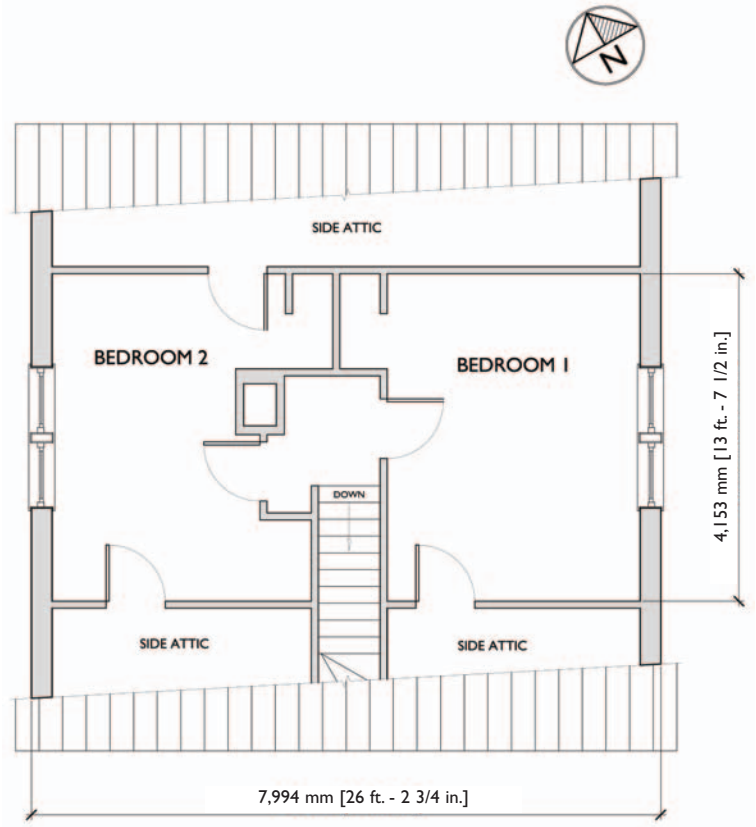

Figure 4—Now House® second floor plan

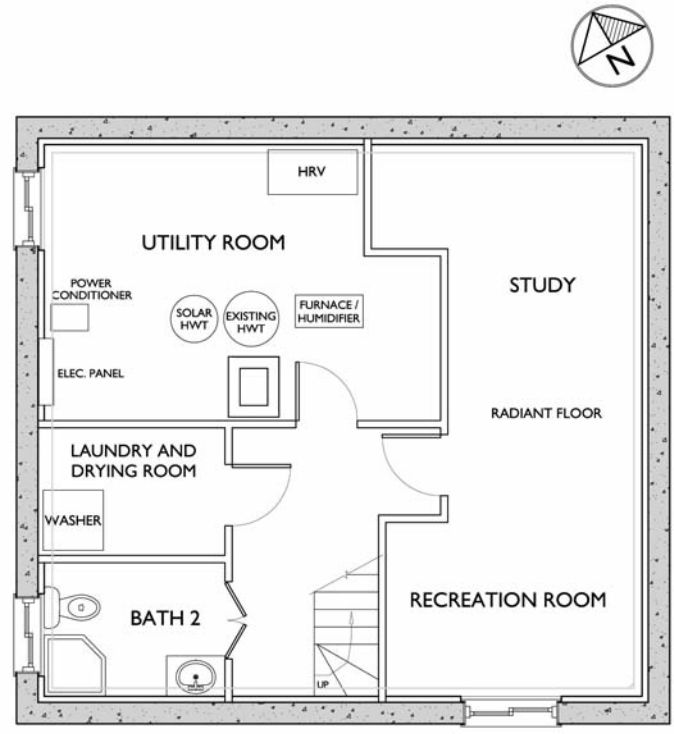

Figure 5—Now House® basement floor plan

Technical Summary: Now House®—Toronto, Ontario

Predicted Annual Energy Consumption (by heated floor area)

Total annual energy use:	96.94 kWh/m²
Space heating:	23.10 kWh/m²
Domestic water heating:	35.62 kWh/m²
Appliances/lighting:	36.76 kWh/m²
Mechanical ventilation:	1.46 kWh/m²

Predicted Annual Energy Production (by heated floor area)

Total annual energy production:	39.36 kWh/m²
Solar electricity:	17.34 kWh/m²
Solar space and water heating:	13.12 kWh/m²
Shower drain water heat recovery	8.90 kWh/m²

Predicted Annual Energy Balance: -57.58 kWh/m²

EnerGuide for Houses* (EGH*) Rating[1] 94

Natural Resources Canada's EnerGuide For Houses (EGH) Rating is a standard measure of a home's energy performance, and can range from 0 to 100.[1] A modified rating, termed the EGH* Rating, was developed specifically for the EQuilibrium™ initiative and is presented here. The EGH* Rating allows reductions in electricity and hot water loads and accounts for the contribution of renewable energy systems in EQuilibrium™ houses, thereby more accurately reflecting the home's potential energy performance.

Site Characteristics

Location:		Toronto, Ontario
Site type:		Urban, existing structure
Site area:	400 m²	4,306 ft.²
Elevation:	128 m	420 ft.
Latitude:		43°42' N
Longitude:		79°18' W

Average Outdoor Temperatures

January:	-4 °C	24.8 °F
April:	6 °C	42.8 °F
July:	21 °C	69.8 °F
October:	10 °C	50.0 °F

Building Design Temperatures[2]

January:	-22 °C	-7.6 °F
July:	31 °C	87.8 °F
Heating Degree Days (base 18°C [64°F]):	4,000	[7,200]
Cooling Degree Days (base 18°C [64°F]):	359	[646]

Climate

Average daily horizontal solar irradiation:		3.44 kWh/m²
Average daily vertical solar irradiation:		0.99 kWh/m²
Clearness index:		0.47 Kt
Average annual precipitation:	830 mm	33 in.
Average annual wind speed:	10.8 km/h	6.7 mph

Building Description

Type: Retrofit, single detached 1 1/2 story with basement

Floor space:	111.5 m²	1,200 ft.²
Building axis:		Northwest-Southeast
Building footprint:	58.1 m²	625 ft.²
Heated volume:	382 m³	13,490 ft.³
Heated floor area:	139 m²	1,496 ft.²
Ceiling area:	63 m²	678 ft.²
External wall area:	127.3 m²	1,370 ft.²
Window area total:	14.8 m²	160 ft.²
Southwest:	4.6 m²	50 ft.²
Northeast:	2.7 m²	29 ft.²
Northwest:	4.2 m²	45 ft.²
Southeast:	3.3 m²	36 ft.²
Southwest glazing area to floor area		8.0%

Electricity

2.7 kW grid-interconnected solar photovoltaic (PV) system predicted to generate 2,800 kWh of electricity per year.

Thermal Characteristics

Roof: Flat ceiling	RSI 6.34	(R-36)
Sloped ceiling	RSI 6.34	(R-36)
Walls: Wood frame	RSI 7.22	(R-41)
Foundation above grade	RSI 4.93	(R-28)
Foundation below grade	RSI 4.40	(R-25)
Windows:	RSI 1.00	(R-5.7)
Basement slab:	RSI 4.40	(R-25)
Airtightness Target:	1.5 ACH @ 50 Pa	

Space Heating

Solar hot water, wastewater heat recovery system, stand-by tankless gas boiler and air handler with variable speed motor.

Ventilation

55 L/s HRV

Water Heating

Solar hot water, waste water heat recovery system and back-up on-demand high-efficiency natural gas heater.

Water Consumption (estimated 4-person consumption)

Potable water use

1,340 L/day	294 U.K. gal./day
489,100 L/year	107,650 U.K. gal./year

Potable water reuse (greywater use) n/a

[1] For further information on EGH Ratings, see www.nrcan.ca and search under "EGH Rating"

[2] Building design temperatures are based on historic temperature data and are used when designing a building and its heating and cooling systems for a particular geographic area.

Project Team

Developer: The Now House® Project Inc.

Primary contact: Lorraine Gauthier, President
lorraine@workworthdoing.com

For more information about this project and other EQuilibrium™ housing projects, visit the CMHC website at www.cmhc.ca

EQuilibrium™ Sustainable Housing Demonstration Initiative

What is EQuilibrium™ Housing?

EQuilibrium™ is a national sustainable housing demonstration initiative, created and led by Canada Mortgage and Housing Corporation (CMHC) that brings the private and public sectors together to develop homes, and eventually communities that address occupant health and comfort, energy efficiency, renewable energy production, resource conservation, reduced environmental impact and affordability.

CMHC's EQuilibrium™ housing initiative offers builders and developers across the country a powerful new approach to establish a reputation for building premium quality sustainable homes that will meet the needs of Canadians now and well into the future.

EQuilibrium™ housing combines a wide range of technologies, strategies, products and techniques designed to reduce a home's environmental impact to an absolute minimum. At the same time, EQuilibrium™ housing also features commercially available, on-site renewable energy systems to provide clean energy to help reduce annual consumption and costs.

The ultimate goal is a highly energy-efficient, low-environmental-impact house that provides healthy indoor living for its occupants and produces as much energy as it consumes on a yearly basis. As part of the initiative, all EQuilibrium™ projects will be open to the public for a minimum time period of six months and then monitored for performance with occupants for at least one year.

For more information on this project and on the CMHC EQuilibrium™ Sustainable Housing Demonstration Initiative, visit www.cmhc.ca

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