EQuilibrium™
HEALTHY HOUSING
FOR A HEALTHY ENVIRONMENT

Project Profile:
Abondance Montréal: le Soleil—Montréal, Quebec

This Project Profile highlights Abondance Montréal: le Soleil, 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—Abondance Montréal: le Soleil

Key Features

- Urban infill project in an established metropolitan area close to amenities;
- Net-zero energy consumption target;
- Energy is conserved through advanced building envelope construction and air tightness, a geothermal heating system and energy-efficient appliances and lighting;
- Energy is produced using a solar photovoltaic array and solar hot water panels;
- Energy is recovered in a greywater heat recovery system and heat recovery ventilators;
- Rainwater is harvested from the roof for use in toilets.

Project Description

Abondance Montréal: le Soleil is a three story triplex condominium situated in Montréal's southwest borough of Verdun. It is a multi-family community revitalization project on the site of a former parking lot and car wash.

In keeping with the EQuilibrium™ Housing initiative, the developer, EcoCité Developments, in partnership with the builder Les Constructions Sodero Inc., designed and built this condominium project with the intent that it is healthy

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

Canada

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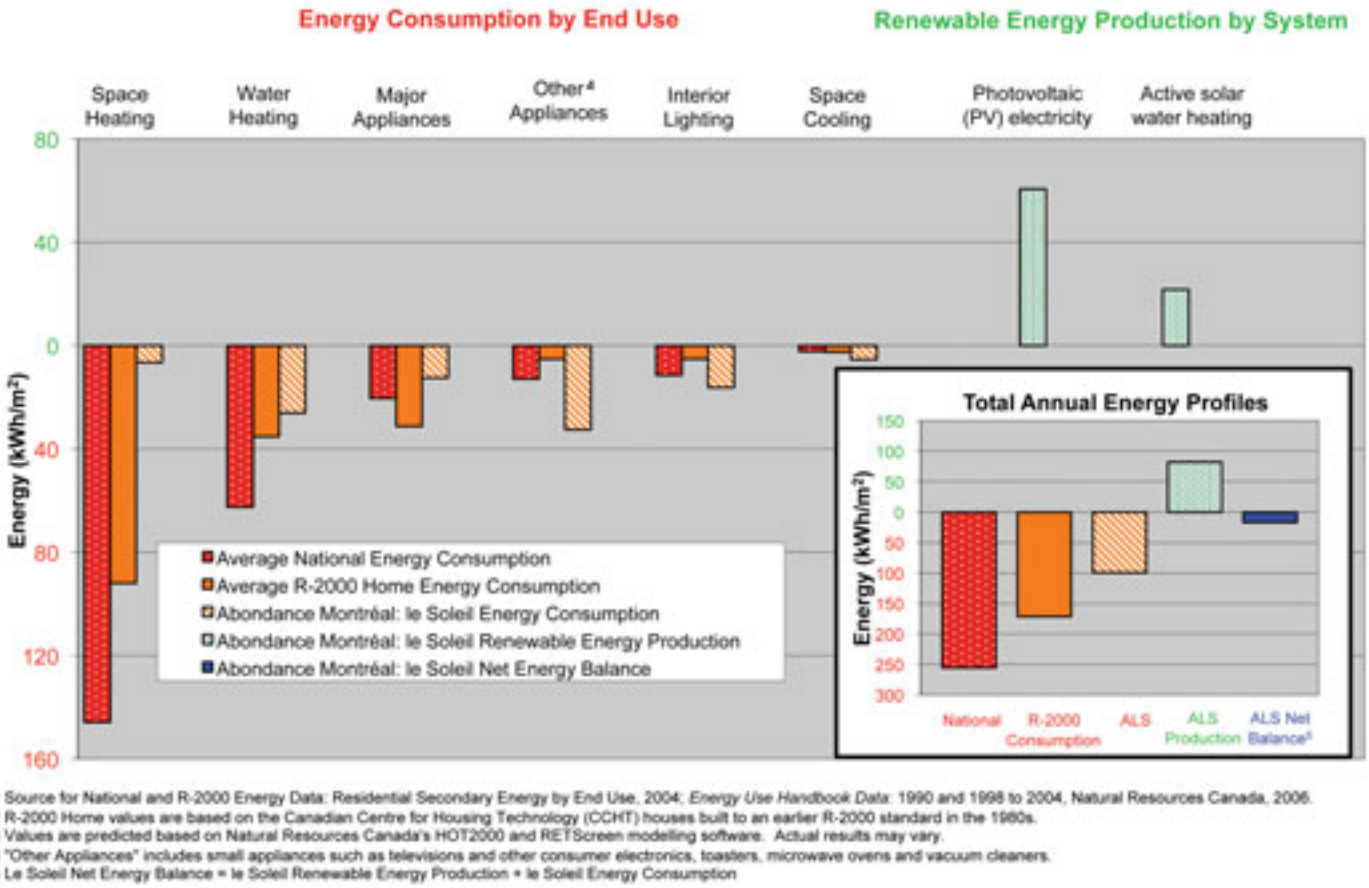

1 Source for National and R-2000 Energy Data: Residential Secondary Energy by End Use, 2004; *Energy Use Handbook Data*: 1990 and 1998 to 2004, Natural Resources Canada, 2006.
2 R-2000 Home values are based on the Canadian Centre for Housing Technology (CCHT) houses built to an earlier R-2000 standard 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 Le Soleil Net Energy Balance = le Soleil Renewable Energy Production + le Soleil Energy Consumption

Figure 2—Comparison of Canadian National Average[1], R-2000 Home[2], and Predicted Abondance Montréal: le Soleil[3] (ALS) Annual Residential Energy Consumption and Production

and comfortable to live in, produces as much energy as it requires in a year, reduces energy use to a minimum, conserves resources, has low environmental impact, and is marketable to people interested in investing in sustainable homes.

Each of the three 79.3 m² (854 sq. ft.) apartments[2] is located on a separate level of the building. They share a rooftop terrace and rear courtyard and parking area. The basement contains the mechanical and storage rooms. Each apartment is based on an open-plan design and contains a living room, dining room and kitchen, a four piece bathroom, and a flexible space that can be used as two bedrooms, a bedroom and den or office, or one large bedroom. Le Soleil's annual energy requirements are predicted to be slightly more than the on-site production from renewable energy sources, which include passive and active solar heating systems and a solar photovoltaic (PV) electricity generating system. The apartments' energy requirements, on a per m² (sq. ft.) heated floor area basis, are predicted to be only 39% of the requirements for the average Canadian home.

2 These figures represent the heated space area of the apartment. The total area of each suite, including exterior walls, is 94.4 m² (1016 sq. ft.). These figures do not include other areas such as the stairwell adjacent to, or the basement storage assigned to, the apartment.

Le Soleil has a net-metering agreement with Hydro Quebec, whereby surplus electrical production fed into the utility grid will be credited against electricity supplied by the grid to the building.

During the first year of occupancy, the energy generation, energy and water consumption, and indoor air quality for the building will be monitored to assess performance.

Occupant Health and Comfort

Establishing and maintaining indoor air quality is an important goal for EQuilibrium™ homes. Materials selected for the le Soleil apartments help minimize indoor air pollutants, such as volatile organic compounds (VOCs) and other noxious chemicals. Urea-formaldehyde free plywood, oriented strand board (OSB) and cabinet materials were used throughout. Low and no VOC paints and flooring sealers were applied.

The airtight building envelope effectively minimizes uncontrolled air leakage, which enhances the durability and energy efficiency of the project. As the building is very airtight, heat recovery ventilators (HRVs) are installed in each apartment to ensure energy efficient indoor-outdoor air exchange. The HRVs also help control moisture and odours by exhausting air from the kitchens and bathrooms while delivering fresh air to the other rooms in the apartments. In the winter, the HRVs transfer heat from the outgoing exhaust air to warm the incoming fresh air. In the summer, the HRVs can cool the incoming warmer outdoor. This helps to ensure that the fresh air is delivered at a temperature that is comfortable. The HRVs also contain filters that can reduce the amount of airborne particulates that enter the apartments. A humidifier is provided in each unit to help maintain desired humidity levels in the winter.

The design, size and placement of the triple glazed aluminum windows ensures that the homes are well daylit, with maximal penetration of natural light into the main living areas, thereby reducing the need for artificial lighting. Blinds or curtains on the lower portion of the windows ensure that the levels of early morning and late afternoon sunlight in the homes can be easily controlled, which slightly reduces the space cooling requirements.

The highly insulated and well sealed windows and doors help to eliminate cold zones, drafts, and the penetration of street noise. The bedrooms are placed at the back of the building, away from the street and overlooking the rear courtyard. This further helps reduce street noise in the sleeping area. Noise transfer between the units is reduced using a floor assembly of materials resistant to sound transfer, including recycled wood fibre subfloor panels. Independent on-site testing of noise transfer reduction through the floors yielded an FIIC (field impact insulation class) of 59, which is very good.

Energy Efficiency

As an urban infill project, le Soleil's physical orientation and exterior façade were predetermined by the site and local architectural heritage. Given the site constraints that limited passive solar gain, an extremely well-insulated and air-tight building envelope, maximization of energy recovery, and reduced electrical consumption was required to meet the net zero energy target.

The building envelope is insulated with a spray applied polyurethane foam insulation which is composed of a soybean oil and 40% recycled plastic. This material also acts as the air and vapour barrier. The foam was applied to both the inside and outside of the building, providing insulation values in excess of R-40 in the walls and R-70 in the roof. By paying particular attention to the window installation and the sealing of other envelope penetrations, an excellent airtightness of 0.4 air-changes per hour at 50 Pa was achieved during the blower door test.

Heating and cooling is provided to each apartment by its own dedicated forced air ground source heat pump (GSHP) system. In the cooler months

the GSHPs collect heat from deep in the ground to heat the apartments; in the warm summer months the GSHPs return excess heat to the ground to cool the apartments.

The GSHPs employ two-speed compressors that can operate at 40% capacity for increased efficiency under typical (partial load) heating and cooling conditions. The three GSHPs are connected to a shared ground loop consisting of two 76m (250 foot) deep closed-loop wells located under le Soleil's front yard. A 5kW back-up electric heating coil in the forced air ducting in each apartment helps ensure occupant comfort under extreme heating demands or in the case of a GSHP malfunction.

The combination of Le Soleil's highly insulated building envelope and the heat from passive solar gains, occupants, appliances and lighting may result in overheating of the apartments from time to time. To help limit the amount of air-conditioning required to maintain comfortable conditions, the forced air systems in each apartment can operate in a "free-cooling" mode that draws in outdoor air (by-passing the HRVs) to cool the apartments when outdoor temperatures are sufficiently cool (7°C - 21°C, 45°F - 70°F) and air-conditioning is required.

A variety of strategies were employed to further reduce le Soleil's day-to-day energy consumption. Highly energy-efficient appliances are provided with the apartments, along with a complete compact florescent lighting package. To further conserve electricity, a master switch by the front door of the apartment turns off all interior lighting and a selection of electric outlets. Devices, such as electronic equipment that continues to consume electricity when not in use, can be plugged into these outlets to reduce their small, but otherwise continuous electricity consumption. In addition, motion sensors and timers control lights in the common areas and stairwells, and the outdoor lighting.

Renewable Energy Production

The site orientation of le Soleil and the future construction of a four storey building immediately to the south of the triplex decrease the passive solar potential for the building. Le Soleil's windows face southeast, southwest or northeast, thereby decreasing the potential passive solar gain in comparison to that which could be realized if windows were south facing. However, even with these sub-optimal conditions, passive solar gain is predicted to contribute at least 35% of the building's space heating needs.

The 13.8 kW solar PV array is made up of sixty panels. These are mounted on an elevated roof-top steel structure that also provides shade to a portion of the accessible roof-top terrace. The PV array is predicted to generate 15,100 kWh annually. PV production is concentrated mostly in summer, while demand is distributed over the entire year. To respond to this, a net-metering arrangement is employed that allows le Soleil to send surplus energy to the Hydro Quebec grid when available (e.g. during the summer daylight hours), and to consume energy from the grid when needed. At the end of the year, the balance between total consumption and production is tallied to determine if the net-zero energy goal is met.

Up to 80% of le Soleil's domestic hot water needs are expected to be met by a rooftop array of six 1.2 m x 2.4 m (4' x 8') flat plate solar panels. In the summer months solar hot water production is expected to exceed demand and any surplus may eventually be sold to the adjacent building, potentially allowing le Soleil to become a net producer of energy.

Energy efficiency is further enhanced by recovering energy that would otherwise be lost. The HRVs in each apartment recover heat energy from the outgoing exhaust air and use it to heat the incoming fresh air to save on heating

costs. Drain water heat recovery devices capture heat from the shower drains that would otherwise be lost to the sewer system and transfer this heat to the incoming cold water destined for the hot water tank, thereby reducing the domestic hot water energy consumption. When required, further heating of water is provided by the GSHP desuperheaters.

Resource Conservation

Le Soleil was designed to minimize natural resources consumed during construction, and over the building's lifetime. An important factor is the use of sustainably manufactured and recycled materials. For example, the building is framed with Forest Stewardship Council[3] (FSC) certified wood. The hardwood flooring, which is from a local mill, is also FSC certified. Locally-manufactured gypsum board contains 95% recycled materials.

Efficient use of materials includes engineered, open-web wood joists for the floor structure as well as as strategic design practices such as adjusting building dimensions (such a window opening) to help reduce the amount of natural resources required for the project and on-site lumber cuts and resulting material waste.

During construction, site erosion was controlled by creating sedimentation basins to reduce rain water runoff velocities and to retain ground water emanating from the GSHP wells during drilling. The builder, who is experienced in waste reduction, also had solid waste collected, sorted and recycled in order to meet or exceed Recyc-Québec's[4] minimum solid waste diversion target of 60%.

Le Soleil's apartments are designed with minimal load-bearing partitions, a strategy that maximizes the space's flexibility while meeting people's evolving needs over their building's lifetime. The floorplans can be left as an open space or easily modified to create one or two bedrooms, making the apartments well suited for couples and small families, as well as home-based professionals. This flexibility helps to limit the amount of renovation work and materials required to adapt the units as needed over time.

Reduced Environmental Impact

The project's urban setting offers its residents convenient access to a range of services and benefits that allow them to significantly reduce their transportation-related environmental footprint. Its close proximity to the metro, major bus routes, bike paths and a full service shopping concourse means that it is easy and practical to live without a car. For occasional longer trips, membership in a car-share program (with several nearby vehicles available for use) is included in the condominium fees.

To reduce municipal water consumption and waste water production, the apartments are fitted with low-flow plumbing fixtures and appliances. In addition, rainwater from the roof runoff is collected in a basement cistern, filtered and distributed through an independent plumbing network to non-potable end uses such as toilets. If the cistern is emptied, the network automatically transfers to the municipal water system as backup. This feature alone is estimated to reduce the annual consumption of potable toilet water by 75%.

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[3] For further information on the Canadian Forest Stewardship Council see http://www.fsccanada.org/default.htm

[4] For further information on Recyc-Québec see http://www.recyc-quebec.gouv.qc.ca/client/fr/accueil.asp

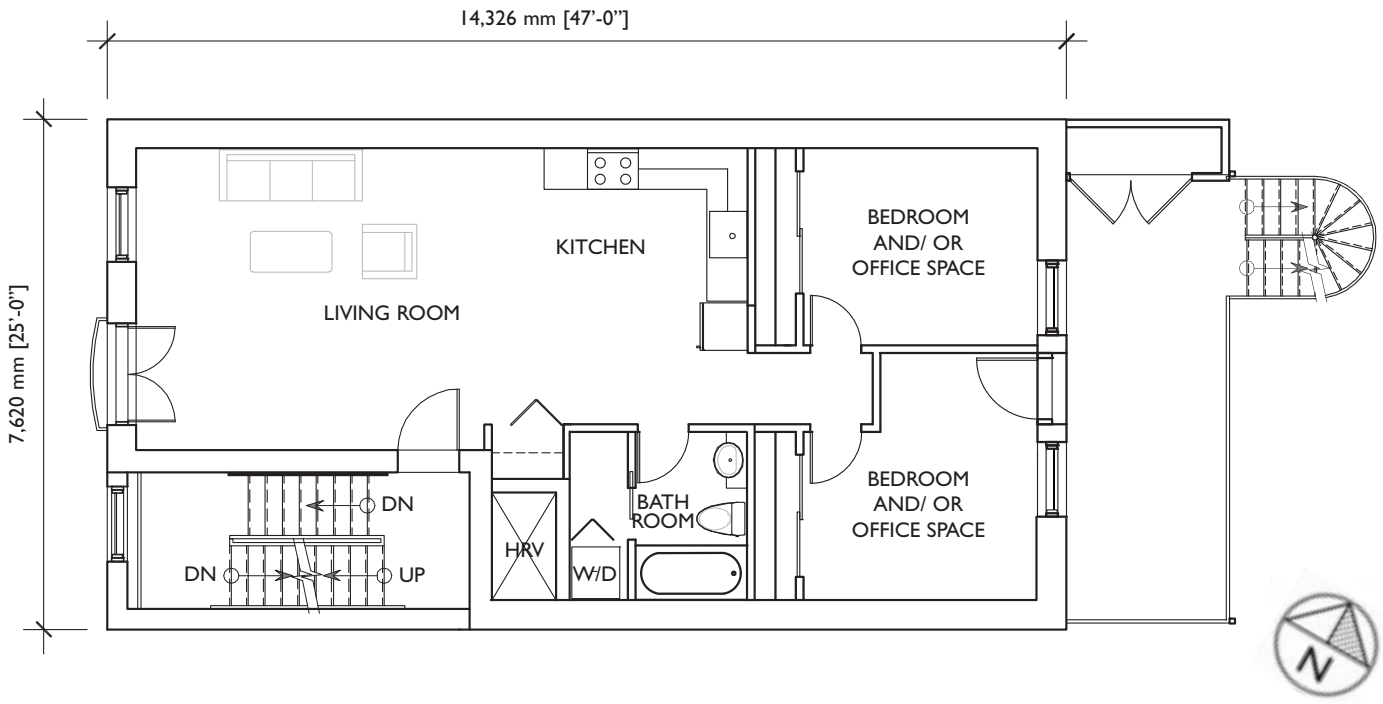

Figure 3—Floor plan of an Abondance Montréal: le Soleil home

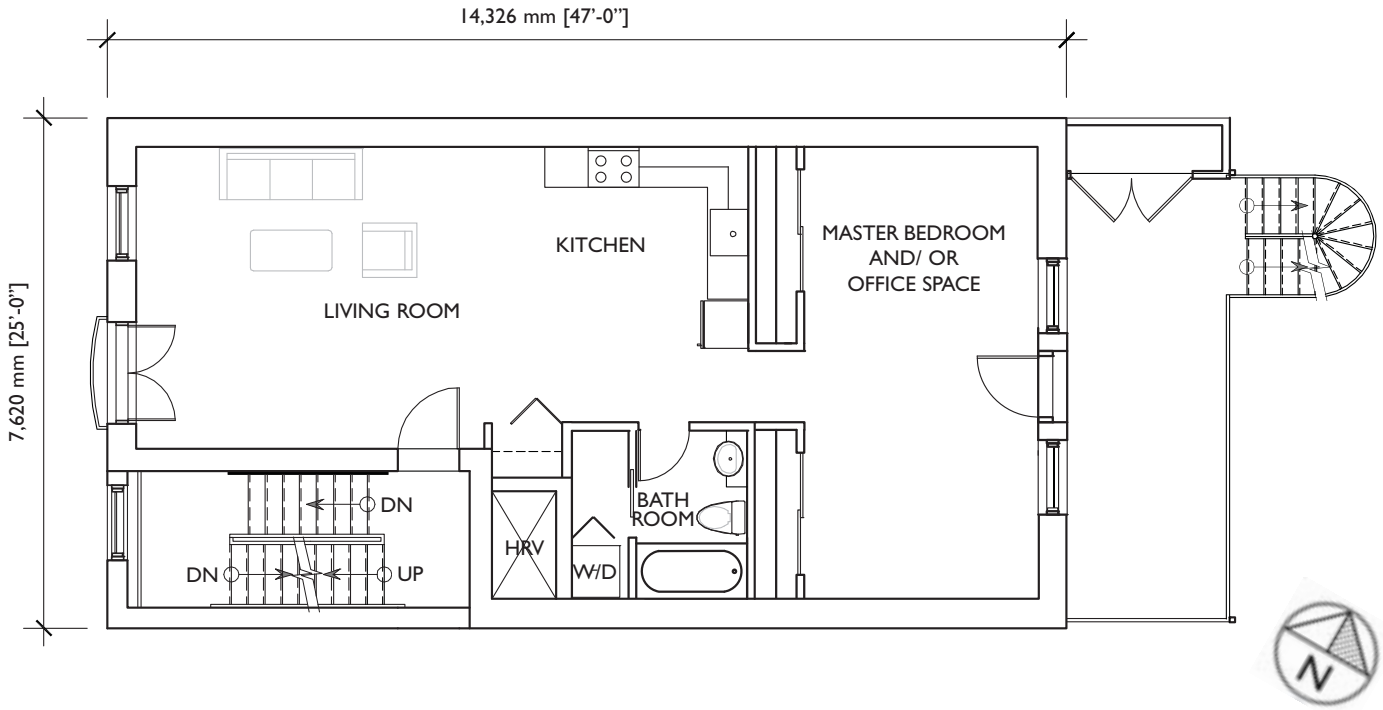

Figure 4—Alternate floor plan of an Abondance Montréal: le Soleil home

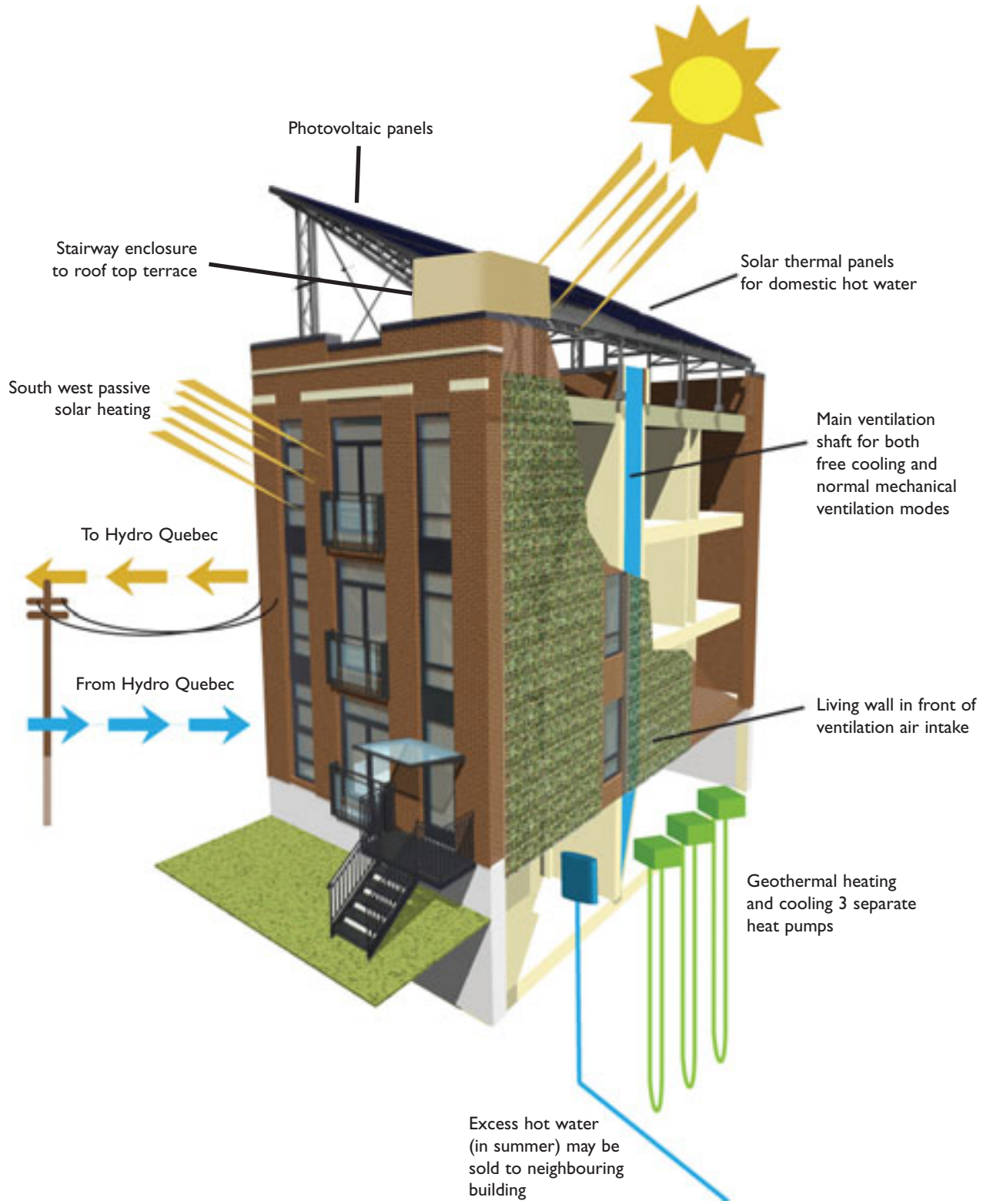

Figure 5—Rendering of Abondance Montréal: le Soleil, showing space and water heating technologies

Technical Summary: Abondance Montréal: le Soleil, Montreal, Quebec[1]

Building Description

Type: New condominium - 3 units, open concept		
Floor space of each apartment	94.4 m²	1016 ft²
Solar Orientation	northeast / southwest	
Building footprint	109.2 m²	1,175 ft²
Heated volume of each apartment	211 m³	7,452 ft³
Heated floor area of each apartment	79.3 m²	854 ft²
Ceiling area of each apartment	79.3 m²	854 ft²
External wall area of each apartment	346.2 m²	3,726 ft²
Window area total in each apartment	19.44 m²	209.3ft²
Southeast	3.19 m²	34.3 ft²
Northwest	0 m²	0 ft²
Southwest	9.38 m²	101 ft²
Northeast	6.87 m²	74 ft²
Ratio of south glazing area to floor area:		n/a

Thermal Characteristics

Roof		RSI 12.3	R-70
Walls	First, 2nd and 3rd floor	RSI 7.92	R-45
	Basement below grade	RSI 6.34	R-36
Windows		RSI 1.23	R-7.0
Basement floor		RSI 2.64	R-15
Measured Airtightness Level		0.4 ACH @ 50 Pa	

Site Characteristics

Location	Montreal (Verdun) Quebec	
Site type	Urban, new development	
Site area	255.5 m²	2,750 ft²
Elevation	29.2 m	96 ft.
Latitude		45°28'N
Longitude		73°45' W

Climate

Average daily horizontal solar irradiation		3.5 kWh/m²
Average daily vertical solar irradiation		2.8 kWh/m²
Average annual precipitation	967 mm	38 in.
Average annual wind speed	14.3 km/h	9 mph
Average outdoor temperatures		
January	-10.4 °C	13.3 °F
April	5.7 °C	42.3 °F
July	20.9 °C	69.6 °F
October	7.9 °C	46.2 °F
Building design temperatures[5]		
January	-24°C	-11.2 °F
July	26.7°C	80.1 °F
Heating Degree Days (base 18°C [64°F])	4,575	[8,234]
Cooling Degree Days (base 18°C [64°F])	235	[423]

Predicted Annual Energy Consumption

Space heating	6.6 kWh/m²
Domestic water heating	26.1 kWh/m²
Appliances/lighting	48.8 kWh/m²
Mechanical ventilation	12.5 kWh/m²
Space cooling	5.4 kWh/m²
Total predicted consumption	**99.5 kWh/m²**

Note: All values are based on heated floor area. The space heating value does not include the contribution from passive solar gains and internal gains (see Space Heating Information, below)

Predicted Annual On-site Renewable Energy Production

Solar (photovoltaic) electricity	60.6 kWh/m²
Active solar domestic water heating	21.7 kWh/m²
Total predicted production	**82.3 kWh/m²**

Note: All values are based on heated floor area.

Predicted Annual Energy Balance -17.2 kWh/m²

EnerGuide for Houses[2] (EGH*) Rating 99.3

Space Heating Information

Space heating requirements for each of the le Soleil apartments will be met as follows (predicted values):

Passive solar gain	35.6%
Internal gains[3]	39.1%
Three-ton ground source heat pump (COP 3.1)[4] for back-up space and water heating	25.3%

Domestic Hot Water Information

Domestic hot water requirements for the le Soleil apartments will be met as follows (predicted values):

Active solar thermal heating system	51%
Three-ton ground source heat pump desuperheater	7.1%
Drainwater heat recovery	31.8%
Electric DHW tank	10.1%

Ventilation

60 cfm heat recovery ventilator (HRV) with 2 ECM motors in each apartment. Maximum efficiency 88% at 0 °C (32 °F). 25 L/s at 125 PA.

Water Consumption (estimated 4 person consumption)

Potable water	Not Estimated	
Rainwater harvesting	36.5 L/day	8 U.K gal/day
	13,333 L/yr	2,935 U.K. gal/yr

[1] All size, area, energy use, and system capacity are the average values of the three units

[2] 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. The rating is based, in part, on the assumed energy consumption of appliances, assumed hot water draws, and other electricity usages in conventional homes. The EGH* Rating allows reductions in electricity and hot water loads in EQuilibrium™ homes, thereby more accurately reflecting the home's potential energy performance.

[3] Internal gains include heat from occupants, lights, appliances, mechanical systems, and consumer electronic items

[4] The coefficient of performance (COP) for a heat pump is the ratio of the heat delivered (output) to the electric energy used in operating the pump (input).

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

Affordability

The compact floor plans reduce the costs to purchase, furnish and maintain le Soleil's apartments. Proximity to essential amenities allows residents to access local goods services, and to live comfortably without the expenses of car ownership.

This EQuilibrium™ Housing Project converts what was a parking lot into three homes. It increases urban density, transforming a corner of the neighbourhood into an attractive building that contributes to the urban fabric while minimizing its impact on the environment.

Project Team

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

EQuilibrium™ Housing

What is EQuilibrium™ Housing?

EQuilibrium™ Housing 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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