INNOVATIVE BUILDINGS

Benny Farm Redevelopment, Montréal

Figure 1 – General view of the project

Background

Benny Farm is an 18-acre (7.3 ha) residential property in the Notre-Dame-de-Grâce (NDG) borough of Montréal (Figure 1). The property was developed in 1947 for Second World War veterans and their families. Canada Lands Company (CLC) Limited assumed ownership in 1999.

In July 2002, CLC started a participatory process to redevelop the property so it would be economically viable, integrate well with its surroundings and respond to the needs and expectations of the local community. A task force of local community representatives guided this process.

The result, the Benny Farm redevelopment plan, combines several objectives and reconciles a number of different values. The plan responds to NDG's needs for housing and community services.

Summary

The Benny Farm redevelopment in Montréal demonstrates the possibility of overcoming complex and difficult technical, social and financial hurdles to provide housing that delivers very high environmental performance.

Options analysis and simulation selected cost-effective renovations to existing units and build new apartments. Construction waste was minimized; salvaged materials were reused; energy efficiency and building performance were improved; and infrastructure changes were made to reduce water usage and runoff, and accommodate future geothermal energy.

This project was recently awarded the Bronze Global Holcim Foundation Award in the first worldwide sustainable development competition. The project was previously awarded the Gold Prize in the North American regional competition in 2005.

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The project takes into consideration concerns for social diversity and pays particular attention to groups with the greatest needs.

It offers an harmonious interface with adjacent streets and respects the original character of the site.

Until February 2004, there were 52 buildings, each with six apartments, on the portion of the Benny Farm site to be redeveloped.

The Zone of Opportunity (Z.O.O.) Housing Cooperative managed the repair and upgrading of existing buildings, and the demolition and replacement of other buildings. Z.O.O. is a non-profit organization created in the fall of 2000 to provide comfortable, affordable housing for families.

This case study deals with Z.O.O.'s portion of the redevelopment. The novel infrastructure developed for the Z.O.O. project will eventually be applied to the entire site.

The redevelopment plan included three phases (Figure 2):

Phase 1: Renovation of 30 units (three storey, wood-frame, brick cladding)

Phase 2: Construction of 16 new units (four storey wood-frame, brick cladding)

Phase 3: Implementation of the green energy plan for Benny Farm Phases 1 and 2 were completed in late 2005. From the outset, the project was designed to be converted to renewable energy and on-site treatment of storm and greywater. Phases 1 and 2 were designed to be compatible with Phase 3.

In advance of Phase 3, the Quebec Energy Efficiency Fund and Hydro Québec's Novoclimat program permitted construction of a demonstration project compatible with the future infrastructure project. The environmental objectives for the renovation and new construction were:

- to utilize low-embodied energy building materials;
- to reduce construction waste;
- to reuse demolition materials where technically and economically feasible;
- to improve the use of interior space, increase natural lighting and improve air quality;
- to maximize thermal efficiency.

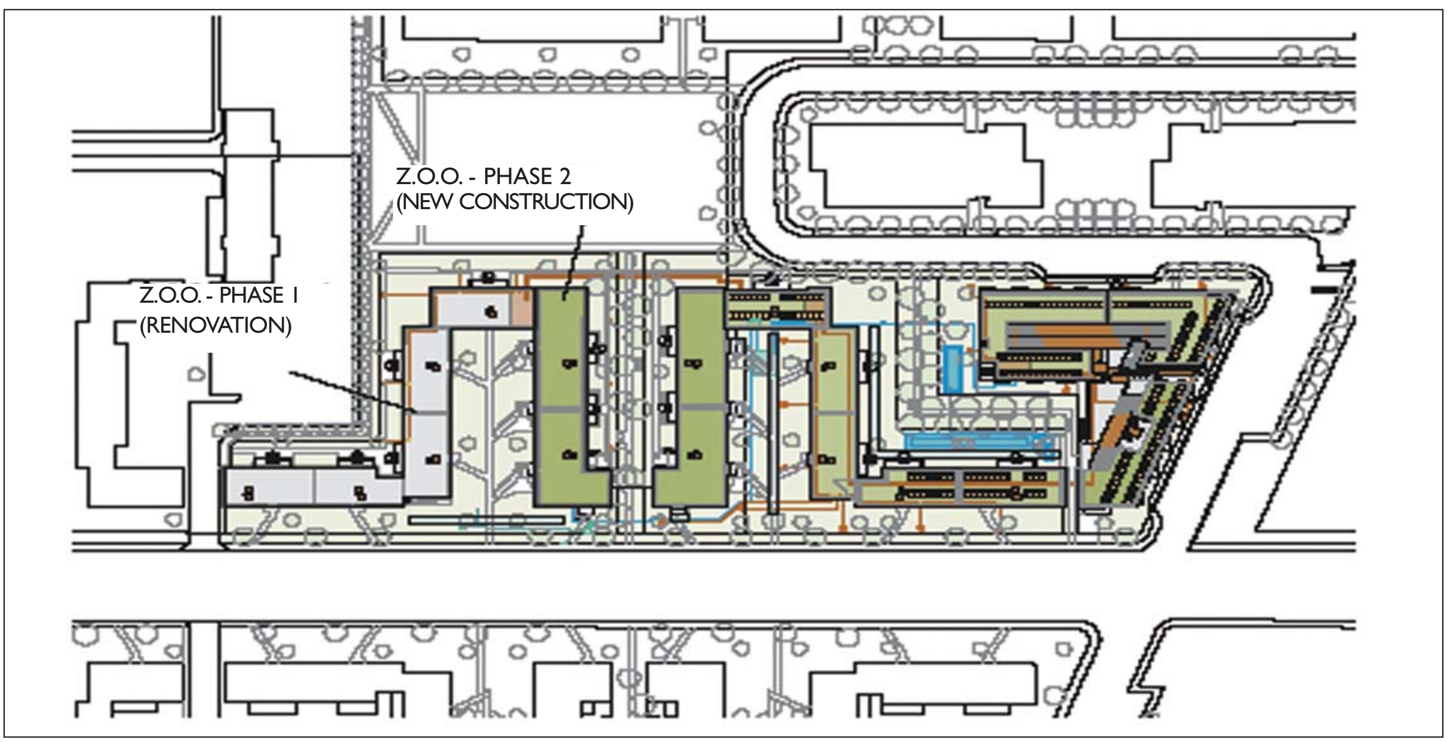

Figure 2 – Z.O.O. Phase 1 (renovation) and Phase 2 (new construction)

Figure 3 – Glass block reused in new entrances

Reuse of demolished materials

There were several opportunities to reuse demolished materials economically for both renovations and new construction. These materials came from both the demolished buildings and from areas of the renovated buildings where in-situ repair was not possible.

- **Hardwood flooring** salvaged from demolished buildings was used to repair floors in the renovated units and it was also used in another Benny Farm co-operative project.
- **Glass blocks** (Figure 3) were salvaged and used for the new entry foyers.
- **Cast-iron radiators** were salvaged and used to repair damaged units in the renovated buildings. Energy simulations showed that the radiators provided energy-efficient heat distribution and a good level of occupant comfort.
- **Brick** from demolished buildings and areas of the renovated buildings that could not be repaired was removed and reused for renovations and new construction.

Phase 1 – Renovation of existing buildings

At the start of the project, a study determined which buildings could and could not be renovated. Site inspections showed that the plaster wall finishes and basement pipe insulation contained asbestos. Prior to renovation/demolition, the asbestos was removed and safely disposed. In general, the condition assessment determined that much of the building's envelopes, although deficient in some ways, were in good condition. It was estimated that buildings that were economical to save could be renovated and upgraded for about $67,000 a unit—less than the costs of new construction—which, in turn, contributed to lower rental rates.

Exterior walls

The thermal resistance of the original envelopes did not meet current minimum energy standards. Two options for upgrading the walls were considered.

- **Option A** (Figure 4) involved the repair of the exterior walls, doing nothing to reduce air leakage through the envelope especially at floor and wall junctions. It was seen as a medium-term solution because the original mortar was estimated to be in the latter stages of service life. It would have been more difficult to achieve air-seal continuity to new windows. Adding insulation to the interior required relocating the heat distribution system (radiators and piping) and a small loss in usable space.

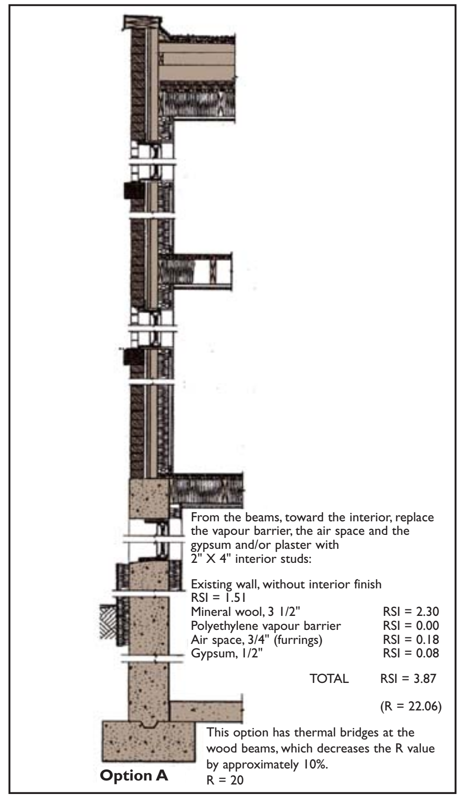

Figure 4 – Wall section – Option A

- **Option B** (Figure 5) involved removing the brick cladding, making the necessary envelope upgrades and reinstalling the brick. It permitted exterior application of sprayed polyurethane foam insulation and continuous air barrier to meet modern standards and offered a life expectancy of 50 years.

  Energy use simulation showed that energy performance before renovations was about 50 per cent below modern code requirements. Option A was forecast to reduce heating costs by about $300 per unit annually.

  Option B was forecast to reduce heating costs by another 26 per cent or $378 per unit annually. Option A required repairs to about 35 per cent of the area of the brick—leading to higher costs to the point where Options A and B were comparable.

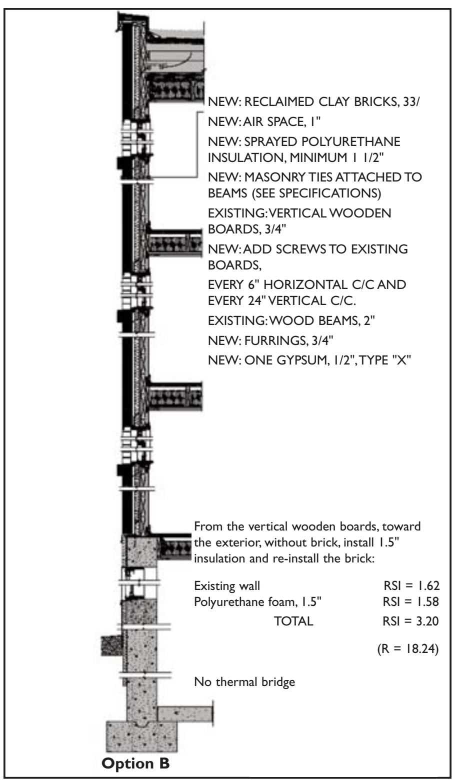

Figure 5 – Wall section – Option B

Option B was selected because it provided significant advantages in service life and envelope performance for the same cost.

Roof repair

The existing roofing was removed down to the wood rafters. This permitted installation of rigid insulation to improve thermal performance. A continuous air barrier was installed and was structurally supported between fibreboard and gypsum wallboard.

A multi-layered membrane roof (fibreglass felt) was installed. The parapet crown flashings (including the fire-wall parapets) were replaced with new, pre-painted metal flashings.

As part of the renovation, it would have been possible to increase the structural capacity of the roof to enable converting three-quarters of the existing roofs to green roofs but renovations were too far advanced when funding became available. Renovation of another Benny Farm site will include substantial green roofs.

Electrical and mechanical

The renovated buildings were rewired and additional outlets installed. Reflectors were installed behind radiators to increase heating efficiency by five to ten per cent. Thermostatically controlled valves and electrical controls were installed to increase temperature control and protect against over-heating.

A heat recovery ventilation (HRV) system was installed to provide fresh air to each room and exhaust stale and moist air, especially from the kitchen and bathrooms. Natural ventilation works simultaneously with the mechanical ventilation (Figure 6). In the summer, theoretically, one can turn off the HRV, but so far, the mechanical engineer thinks it is best to operate it year-round. Projected monitoring (on and off conditions) will, hopefully, provide the answer. To reduce air emissions, only building materials with low volatile organic compounds (VOCs) emissions were used in the renovations.

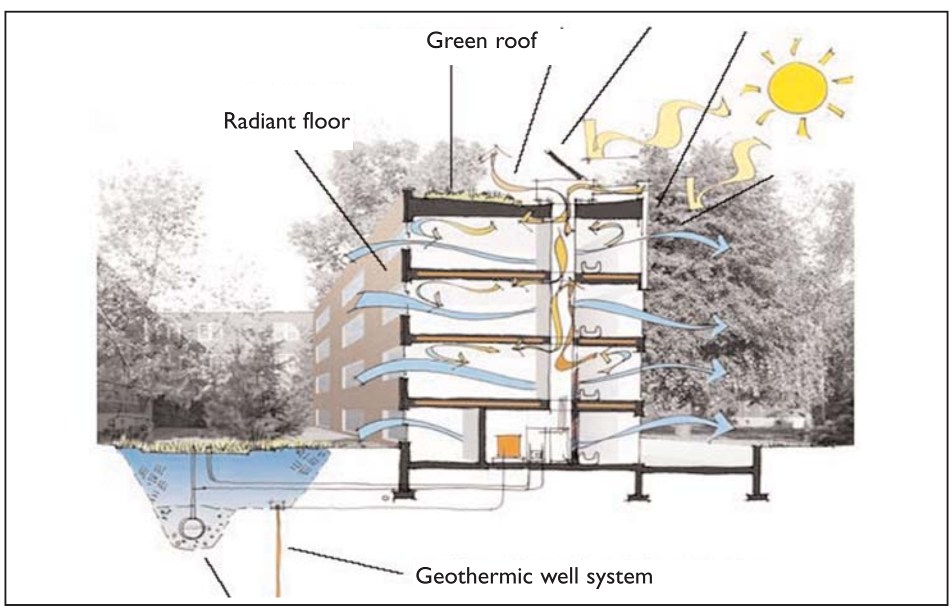

Figure 6 – Natural ventilation diagram

All the water fixtures were replaced with low-flow heads and taps. Toilets were replaced with low-flow units (6 L per flush). Additional plumbing (water supply) was installed for filling toilets with on site treated grey-water or filtered rainwater (see "Designing for Green Infrastructure"). Heat is recovered from the shower drain water by a greywater heat recovery system.

Upgrades to the heating system included:

- retaining existing cast-iron radiators and distribution piping;
- replacing boilers with high-performance boilers;
- replacing hot water heaters with high-efficiency units —95 per cent efficiency;
- replacing bathroom feeder and return lines;
- making the heating system compatible with eventual conversion to geothermal heating.

Windows and doors

Existing windows were replaced with fibreglass frame, double-glazed, low-e, argon-filled, insulating glass units (Figure 7). Double-hung windows were used in the living areas. The glass blocks in the stairwells were replaced with new windows. The entry doors were replaced with insulated steel doors.

Figure 7 – New fiberglass windows

Living areas

Several functional changes were made to the living areas.

- The space between the kitchen and dining-living area was opened to improve lighting and ventilation.
- Interior service stairs were removed and replaced with exterior stairs.
- Laundry areas were modified to accommodate washers and dryers.
- Basement storage spaces were created for the residents.
- Bedrooms closets were improved.
- Hardwood floors were repaired.

Other features

The balconies were enlarged and provided with exterior stairs (Figure 8). Cracks in the foundation walls were repaired. Vapour barriers and rigid insulation were applied on the foundation interiors to boost the R-value to RSI-1.25 (R-7.1).

Phase 2 – New construction

Some of the salvaged materials were reused in the new construction. In addition, several design innovations minimized the environmental effects of new construction for both embodied and operational energy.

Exterior walls were constructed to provide a high level of thermal insulation and resistance to air and vapour movement. In addition to the batt insulation in the wall spaces, the same spray-on insulation used for the renovation was applied to the exterior wall sheathing.

The roof structure is designed to carry the additional load of a green roof and the waterproof membrane is compatible with future installation of drainage layers, a capillary watering mat and topsoil.

Motion detectors in the common areas and compact fluorescent lamps reduce electricity use. Radiant in-floor heating was used in the new construction and was designed to be compatible with future connection to a geothermal heat source.

Figure 8 – New patio doors and balconies

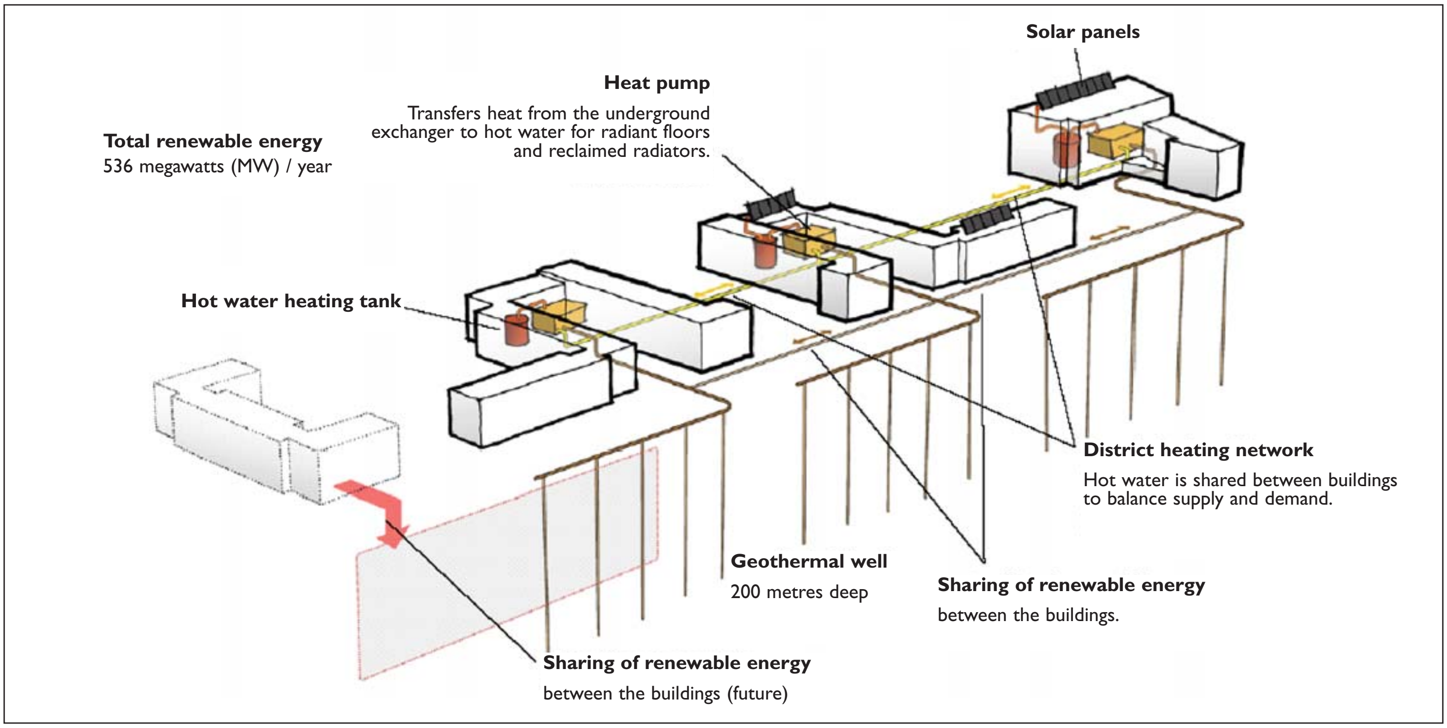

Figure 9 – Energy infrastructure

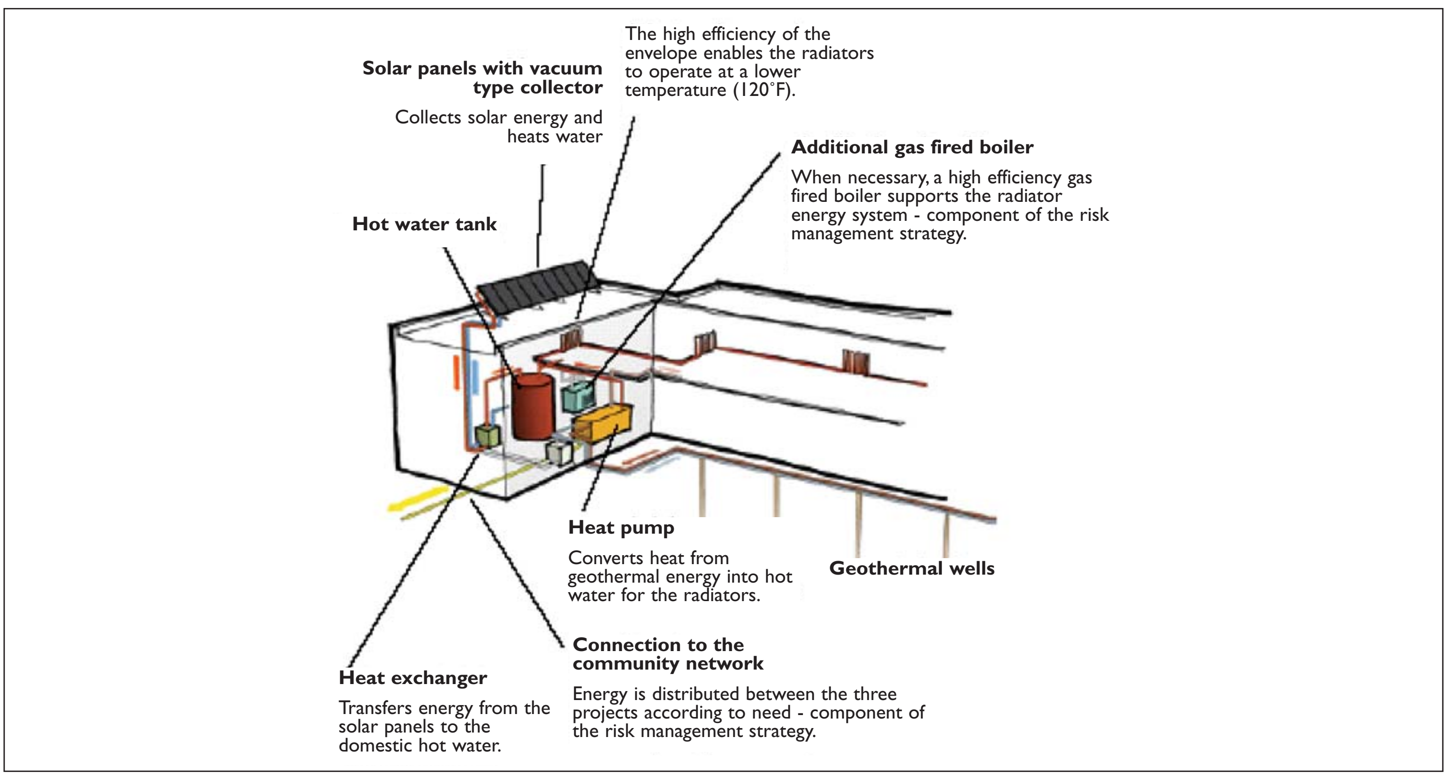

Figure 10 – Renewable energy

Phase 3 – Designing for green infrastructure

The Z.O.O. project and others at the Benny Farm site are being constructed in anticipation of connection to renewable energy, greywater and runoff management systems. A grant has been received for Phase 3 and once completed, the innovative infrastructure will be operated by a non-profit community organization that makes investment decisions that affect energy and water efficiency.

Water conservation

The infrastructure will be capable of treating greywater from all Benny Hill co-operative housing showers and washing fixtures and recycle it for toilets or to recharge the water table. Because of reduced hard surfacing on the redeveloped site, there will be more absorbtion of runoff into the water table. Excess water will be directed into a percolation bed. Runoff will be further reduced by eventual addition of green roofs to the new buildings.

Conversion to renewable energy

Preliminary studies indicate geothermal is a viable energy source for Benny Farm and the building heating systems can be converted to geothermal or solar-electric energy systems.

The geothermal heating system (Figures 9 and 10) would circulate hot water through the existing heating network (piping, radiators and in-floor piping).

The estimated cost of a geothermal system (including wells, closed-circuit pumps and modifications to the heat distribution system) is about $7,000 per unit, compared to $4,000 for natural gas and $2,500 for electricity. In spite of a higher initial capital investment, a savings of $30 to $40 monthly per living unit would be achievable. The simple payback period is seven to ten years, without taking into account likely cost increases for conventional energy or increased maintenance of the renewable system in comparison with conventional systems—especially electric baseboards. There are added economies from having 100 to 150 living units on the system.

Future considerations

The Benny Farm pilot project has many features that can be implemented in other projects.

Housing co-operatives are especially sensitive to energy cost increases. Reducing water consumption by half, improving thermal performance and heating efficiency, and the future transition to renewable energy will buffer tenants from increases in the cost of conventional energy. The savings mean more disposable income for the residents. The outcome of this project will be long-term comfort, security, enjoyment and economy for Benny Farm residents.

Figure 11 – View of renovated building

For more information

L'OEUF Architecture
642, rue de Courcelle no. 402
Montréal, Que. H4C 3C5
Tel: (514) 484-7745
Fax: (514) 484-8897
http://www.loeuf.com/en/index.php
Attention: Daniel Pearl, Architect

Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa, Ont. K1A 0P7
Tel: (613) 748-2000
Fax: (613) 748-2098
http://www.cmhc.ca/
Attention: Sandra Marshall, CMHC Project Manager
smarshal@cmhc.ca

A full report *Benny Farm: Zone of Opportunity* about the project is available from the Canadian Housing Information Centre (CHIC) at 613-748-2367 or toll-free in Canada at 1-800-668-2642.

If you have any comments, or would like to submit your project for publication, please contact: smarshal@cmhc.ca

For more information about innovative building solutions and green buildings, visit the Canada Mortgage and Housing Corporation (CMHC) website at **www.cmhc.ca**

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