



Varennnes Net-Zero Library

City of Varennes

2016 Canadian Consulting Engineering Awards





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Introduction

The City of Varennes wanted to offer its residents a new, modern, comfortable, and welcoming living environment that promoted access to information, education, and culture. To achieve this, the City opted for an integrated design approach that encouraged input from numerous experts, professionals, researchers, and members of the community for construction of the new municipal library.

In that context, Stantec was mandated in 2011 to carry out the systems' electromechanical design as well as structural and civil engineering for the building, which would become a flagship project in sustainable development. It was an ambitious objective: design a net-zero building that produces the same amount of energy as it consumes.

While a number of avenues were considered, the retained solutions were limited to those offering top energy performance within construction cost parameters, along with system reliability and ease of maintenance.

The new library is spread across two floors and covers a total area of 2,230 square metres, offering an environment conducive to learning and discovery, with an abundance of natural light-bathed spaces. Open to the public since December 2014, the library includes an activity room, work spaces, reading room, parenting and breastfeeding area, computer lab with state-of-the-art technology, and listening and viewing stations.



First Net-Zero Institutional Building in Canada





Innovation

Built on the site of the former library, this new building offers unique and innovative features, indicating a new era in the design of more efficient facilities. To obtain the high performance sought for the building, our team carried out multiple simulations before selecting the definitive electromechanical design.

Firstly, with the library being spread out on two floors, and given its elongated shape and reduced depth, this ensures optimal light penetration and cross ventilation. The shape is oriented to maximize a southern exposure for wall and roof surfaces. Pitched at 37°, the roof exposes 425 solar photovoltaic panels on its southern side.

These solar photovoltaic panels have an efficiency of approximately 15%, meaning that 85% of the sun's energy is transformed into thermal energy, which is recovered by the ventilation air. Subsequently, that air reaches a ventilation unit equipped with a heat wheel. The latter ensures that a portion of the heat and humidity contained in the solar panel ventilation air is transferred to the fresh air. The use of a heat wheel makes it possible to reduce outside air heating and humidification needs by more than half.

Furthermore, our team recommended a system with water-source geothermal heat pumps, combined with eight 152-metre-deep geothermal wells. Hot/cold radiant flooring and high-efficiency variable-speed fan-coil units help maintain a comfort level in rooms while obtaining

an optimal power coefficient for the heat pumps.

With lighting being a major source of energy consumption, the building's fenestration was designed to take full advantage of natural light. The library was equipped with windows offering superior energy performance (minimum air infiltration certification) and high-efficiency insulation. Each office or zone has an occupancy sensor which keeps lights on only when the premises are occupied.

In addition, a weather station was located on the roof to provide exterior lighting level data to a centralized DALI (digital addressable lighting interface) control system, so that lighting fixture light levels could be adjusted according to the information received.

A control system records and displays energy consumption information on a screen located near the library entrance, thereby enabling easy monitoring of changes in energy consumption and production.

Thanks to these superior high-efficiency systems, the building uses only 20% of the energy consumed by a building of comparable usage and scale and built to meet the applicable energy codes.



Complexity

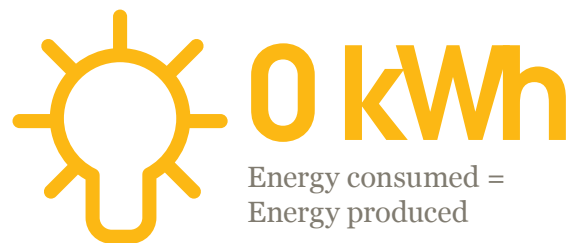
The major challenge for Stantec's team was to design the energy-efficient systems to achieve the net-zero objective, or "energy production—consumption = 0 kWh."

The first step in carrying out a building project of this type is to reduce the energy demand by as much as possible; but given Quebec's extreme weather conditions, designing electromechanical systems that offer the desired comfort level, while meeting the established budgetary envelope, proved to be a complex job, indeed. For that reason, the Stantec team chose to use energy simulation as a tool to support the design.

Running simulations for a building in order to obtain its energy behaviour details, for every hour in a year, facilitates an analysis of the building's global operation while helping to reveal interactions between building components. For example, the cross effects of lighting, which releases heat, contribute to heating during the winter, but add

to the air conditioning load in summer. Aside from accounting for energy, the analysis makes it possible to forecast the building's energy costs and savings, as well as calculate the return on investment (ROI) period for the proposed measures.

The energy simulation analyses were indispensable when it came to choosing a system that uses solar panels, so that energy consumption would be equal to energy production for those panels.



 **\$30,000**
Annual energy savings

Social and Economic Benefits

Without a doubt, this new library serves as a model for energy efficiency and sustainable development, though first and foremost, it meets the various needs of the community by offering the population a place of culture and knowledge, bringing people together under one roof.

The designs that were put forward for the construction of this building also sensitized the population to sustainable practices and to sound management of public resources. Residents from the City of Varennes can now count on a modern and efficient building, one which has come to symbolize innovation and sustainable development, well beyond municipal boundaries.

In fact, this is one of the first net-zero institutional buildings in Canada, and thereby a source of inspiration and pride for the Varennes community.

Economically, the use of solar photovoltaic panels enables the production of 100% of the energy consumption for this building, evaluated at 120,000 kWh/year, and equivalent to 0.19 GJ/m², which represents exceptional efficiency.

A control system instantaneously records energy consumption and electricity production of the solar photovoltaic panels in kW, and displays the information on a screen installed at the library entrance. This screen makes it possible to easily monitor energy consumption and production changes on a daily, monthly, and annual basis. Annual energy savings for the new library are thus estimated at \$30,000.



75%

Energy consumption level 75%
below MNECB code

Environmental Benefits

In order to minimize a reliance on complex and costly technologies and systems, the project's energy efficiency needed, above all, to be obtained through an efficient design, one ensuring a reduction in water and energy consumption as well as quantity of atmospheric contaminants, and the production of renewable energy.

As such, the new library's optimized design makes it possible to achieve an energy consumption level that is 75% below that set by the Model National Energy Code for Buildings (MNECB).

In addition to the project's net-zero design, the energy efficiency measures established for this building also aim at attaining LEED Gold certification.

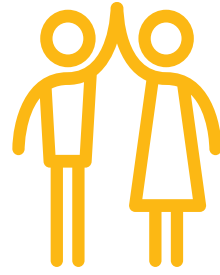
Some of the measures implemented include

- Building on the same site as the former library following its demolition (reduction in carbon footprint by 953 m²)
- Reduction in parking right-of-way
- Permeable parking area with honeycomb grass paving
- Location in the city's centre, thereby encouraging public and active transportation
- Conservation of mature trees at that site
- Irrigation-free landscaping
- Retention ponds from surface runoff water
- View of outside from most spots
- Charging stations for electric vehicles
- Low-flow plumbing fixtures
- Use of wood for coverings of exterior, flooring, interior walls, and ceiling, as well as integrated furniture
- Recycling of at least 75% of construction waste



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The library provides a place of culture and knowledge open to the community

Meeting Client's Needs

One of the client's objectives was to promote a concerted approach with the various stakeholders. In fact, the project sought the contribution of professionals, research teams, simulation experts, elected municipal officials and their representatives, construction contractors, and citizen groups.

Already from the first months in operation, the library saw its attendance double compared with the former structure, thanks to the Varennes population's adoption of this new municipal building.

The Varennes Library is one of only about ten buildings across Canada that produce as much energy as they consume, and the City of Varennes is the first in Quebec with a net-zero institutional building on its territory. This shows that not only can a small city offer a cultural and social place that is open to the community, but it also confirms that ambitious construction choices are now more accessible than previously imagined.

Despite all the substantial challenges that our team needed to overcome, the project was a great success—one which will certainly have a positive impact on the community and the profession by serving as a source of inspiration and creativity. This new net-zero library is a model of energy efficiency and sustainable development which will enable the City and its residents to achieve savings.