

HYDRO-QUÉBEC CASE STUDY

Serenity out-performs pilot program expectations, despite record-breaking cold in Québec



THE CHALLENGE

Hydro-Québec, a state-owned utility that generates, transmits, and distributes electricity to four million customers in the Canadian province of Québec, came to Steffes asking for help to solve a complex problem. To reduce greenhouse gas emissions and encourage the use of electricity as a heating source, the Government of Québec had passed a regulation prohibiting fossil fuel burning furnaces from being installed in newly constructed buildings after 2021 and forbid their use as replacement furnaces in existing residential buildings after 2023.

Hydro-Québec had approximately 200,000 residential customers who still used fuel oil burning furnaces as their primary heating source. Winters in Québec are chilly, with the average low in January being 6°F (-14°C). Hydro-Québec was concerned that having more residences using electricity as a primary heating source could be more than its grid could handle during peak periods in the winter.

Additionally, Hydro-Québec saw an opportunity for Steffes to assist it in reaching its efficient decarbonization goals. Nearly all of Hydro-Québec's electricity is generated from renewable resources. The majority of it is from, as its name implies, hydroelectric sources. Hydro-Québec's goals for the future include balancing its energy and capacity and transitioning to a more interactive energy grid.

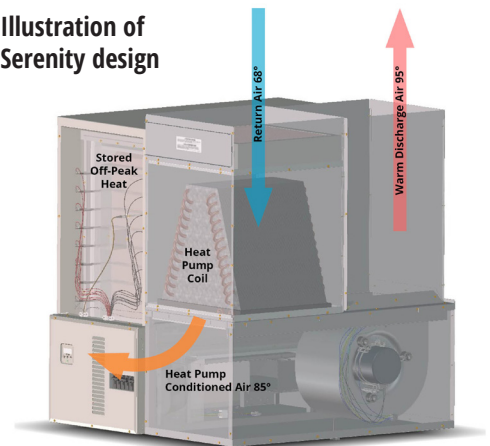
THE SOLUTION

Steffes has been helping electric utilities shift their residential and commercial demands from on-peak to off-peak periods for four decades with its Electric Thermal Storage (ETS) solutions. Its ETS furnaces and room heaters contain a specialized ceramic brick core that stores heat only during off-peak periods. Heat is drawn from the brick core during on-peak periods, keeping spaces at the desired, consistent room temperature all day long.

Steffes developed the Serenity 4200 furnace in conjunction with Hydro-Québec for a trial pilot program. Serenity combines forced air heating with ETS technology. Serenity complements a heat pump to maximize the heating efficiency of the home.

For the pilot project, Hydro-Québec installed and tracked progress in five residential homes. These customers were able to save money by taking advantage of Hydro-Québec's off-peak rate program called Flex D rate. The performance of the furnaces regarding residential temperature output and energy draw during on-peak (6 AM to 9 AM and 4 PM to 8 PM for Hydro-Québec) and off-peak times was monitored during the 2021-2022 winter heating season. Four of the five residences also used a heat pump with Serenity. Serenity's design eliminates the need for a resistance strip heat or secondary heat source, thereby allowing the heat pump to be utilized at maximum efficiency even during cold outdoor temperatures. When combined with off-peak electric rates, this makes the heating system the lowest operating cost option for homeowners.

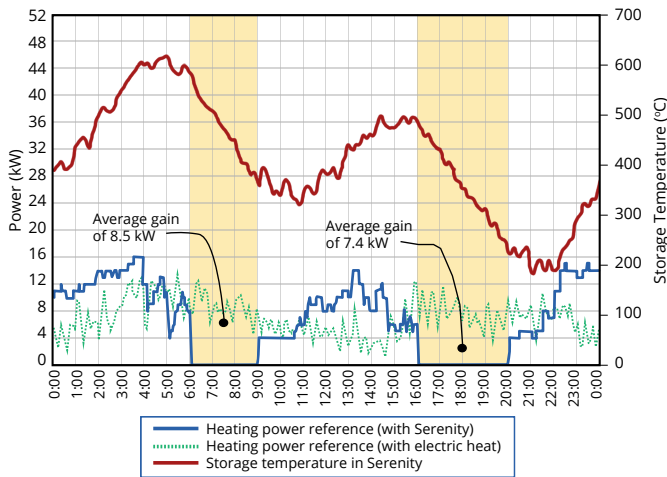
Illustration of Serenity design



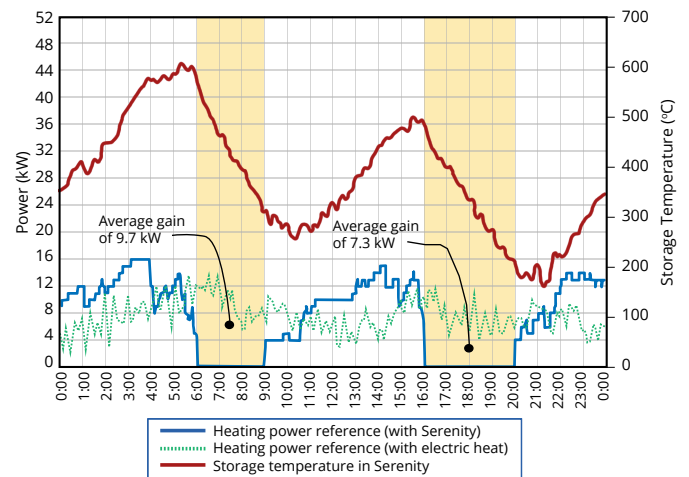
THE RESULTS

The winter of 2021-22 was the coldest Québec had in almost 20 years. Despite these extreme testing parameters, the Serenity furnaces performed well and did not require any electrical draw during peak periods. The average reduction in power demand on the grid for each of the five participants was 8.9 kW during morning peak periods and 7.0 kW during the evening peak periods. These averages were calculated using 25 critical power peak management events that included 81 on-peak hours during the coldest days of the 2021-2022 winter, with 19 events during on-peak morning hours and 6 during on-peak evening hours. The average temperature during these events was 2°F (-16.6°C). The use of ETS has enabled an average of 673 kWh of energy to be curtailed during these power peak management events.

Aggregate profile of heating power and storage temperature during the peak day of January 11, 2022



Aggregate profile of heating power and storage temperature during the peak day of January 21, 2022



The charts above show the energy draw and capability of the pilot Serenity furnaces on the two coldest days of the 2021-2022 winter in Québec: January 11 and January 21. The blue line indicates the energy draw, the red line shows the temperature of the brick core of units, and the green line represents the average draw of traditional electric furnaces during the same time period.

As shown in the chart, Serenity required zero energy draw from the grid during on-peak periods (shown in yellow) and was still able to keep the residences at the desired room temperatures. Serenity is designed to stagger its brick core recharging so there is not a large draw from the grid immediately after the on-peak periods end.



ABOUT STEFFES

As an industry leader in electric thermal storage (ETS), Steffes has been manufacturing, distributing, and supporting ETS systems including room units, forced air furnaces, and hydronic furnaces since 1987. Steffes ETS heating systems allow customers to enjoy lower heating bills by utilizing off-peak rates offered by their power companies. During off-peak times, Steffes ETS devices work to efficiently store heat in specialized ceramic bricks that act as a “thermal battery.” The units automatically stop charging when the optimal internal temperature is reached and provide the stored heat as needed to keep the room or home at a desired set temperature without drawing energy from the utility’s power grid during on-peak times.

Based on Alain Moreau - Hydro-Québec Research Institute. Technical report: Results of the 2021-2022 pilot project on the Serenity central thermal accumulator for the residential sector. (May 2022).