GRID INNOVATION FUND 2024
Electrification and Demand Management

Project Brief

Organization: Confederation College

Project Title: Local Distribution Company (LDC) grid peak demand management by using customer sited large scale heat pump system integrated with thermal storage tanks

Project Length: 36 months

IESO Funding Request: $3,201,834 (50% of $6,403,668 total project value)

Location: Thunder Bay, ON

LDC Partner: Synergy North Corporation (SNC)

Project Summary

This project, located in Northern Ontario, will design, install and test a large-scale heat pump system integrated with thermal storage capacity and control integration to provide heating, ventilation and cooling (HVAC) load flexibility in the form of winter peak shaving for the distribution system.

Synergy North Corporation (SNC) is anticipating that the Birch transformer station (Birch TS) will not be able to serve forecasted electrical load in Thunder Bay within the next 10 years. Confederation College, a customer of SNC, is proposing a new HVAC system which will be able to provide ~390kW of net flexibility to SNC during winter peaking hours to address future system needs.

The HVAC system will consist of 5 water-to-water heat pumps and one large thermal storage tank; a distributed energy resource management system (DERMS) integrated into the existing building automation system (BAS); and a third party software platform linking SNC activation instructions to the facility. The project will test the ability of the facility to provide demand flexibility and will also conduct the IESO-prescribed tests to demonstrate the provision of wholesale services (outside the IESO-administered market environment).

Project Partners

Confederation College: project lead and facility owner/operator.

Synergy North Incorporation (SNC): local distribution utility partner for the project, and will contribute to project planning, integration, and operation.

Powerconsumer Inc: software platform provider communicating between SNC and the blackPAC DERMS.

Blackstone Energy Services: project developer, and will contribute to engineering design, project planning, implementation, integration, operation.

Barriers and Opportunities

Opportunity to improve reliability and affordability	Barrier keeping opportunity from being realized in Ontario	Solution to be tested / evaluated
1. Installation and testing of heat pumps integrated with thermal storage	Lack of industry experience	Installation and integration of heat pumps and thermal storage, controlled by DERMS and existing BAS system.
2. Demand flexibility: Using thermal storage to shift building space heating/HVAC load during distribution network winter peaks	Lack of industry experience with automation and machine-to-machine integration for activation of flexibility between a distribution utility and a flexible load facility	The project will implement the blackPAC™ DERMS platform that provides supervisory data acquisition and analytics for the built environment. This project will install new sub-meters for the heat pump, thermal storage tanks, new pumps, live stream energy usage data at hourly interval to provide real time visibility of system performance, implement a control/supervisory layer to respond to activation instructions from Powerconsumer platform.
3. Ontario-specific cold-climate heat pump performance data	Lack of industry experience	There is a lack of data overall in heat pump performance in colder climates such as Northwestern Ontario and this project will provide Ontario-specific cold climate data.

Additional Project Details/Context

The proposed system will consist of hardware, software and the integration of the following systems:

1. Five (5) units of water-to-water heat pumps (WWHP, up to 130 tons capacity) along with the installation of one vertical thermal storage tanks, for the total thermal storage capacity of 15,000 gallons.

2. blackPAC™ distributed energy resource management system (DERMS) integration (from Blackstone Energy Services) to the existing building automation system (BAS) to monitor and control the new system and provide a supervisory layer above the BAS to deploy the discharge event (from Powerconsumer platform).

3. Powerconsumer platform to activate and measure flexibility: a) Forecasting of system needs of SNC (Thunder Bay), automated bids. b) Providing activation instructions for Confederation College/Blackstone (blackPAC™ DERMS) and performing automated machine-to-machine (M2M) measurement and verification (M&V) on activation API calls. c) Providing as-needed analytics to understand the rebounding effect of thermal storage.

This system will eliminate the Shuniah Building's economizer air handling unit (AHU) control system strategy during winter periods, providing the base source of heating through the heat pump plus thermal storage tanks (at least 1 hour duration) when outdoor air (OA) temperature is above -5 degree Celsius; and top up heating demand through the existing biomass boiler plant (carbon neutral) when the outside air temperature is below -5 degree Celsius. The use of heat pumps with thermal storage and the temporary elimination of perimeter electrical heating and electric reheat coils results in a net reduction in electricity demand, and a shift in consumption to regional off-peak times. Additionally, the system is designed to be modular and will be capable of expanding its capacity in the future if required.

The flexibility will be quantified (M&V) as follows:

- Feeder demand profile forecasting (hourly) for baselining
- Feeder demand actual data for comparison
- Customer demand profile forecasting (hourly) based on distributor-installed meter for baselining
- Customer sub-meter data (if available), for comparison; if no sub-meter data is available, distributor-installed meter used for comparison.

The flexibility (in kW) will be displayed on Powerconsumer's software platform in near-real-time (4s delay), in addition to the customer asset and Birch TS data. The M&V method proposes a non-hardware, low-cost and repeatable method to measure and validate a customer's demand response, contrary to the traditionally expensive revenue grade metering method. By using historical meter data and known customer peak curtailment behaviour, accurate demand response details such as duration and magnitude can be inferred and accurate.

Outcomes

If successful, this project will demonstrate:

1. Program Design:

This project is focusing on system technical viability and scalability, not on cost-effectiveness. However, results from this project can be applied by SNC and the IESO to inform new program/participation model – utilizing HVAC load flexibility to offset winter peaks in Northwestern Ontario.

2. Emerging Technology Demonstration:

Individual equipment such as the heat pump and thermal storage are technologies already available in the market. Combining them into a system to offset a building's HVAC load responding to SNC's winter peak activate calls in Northwestern Ontario is the first such application in Ontario. The project is also implementing the blackPAC™ DERMS platform and Powerconsumer platform to activate flexibility and monitor the system's performance providing real-time visibility, along with a measurement and verification component to determine electricity savings potential, greenhouse gas reductions, ultimately gaining insight to cost effectiveness of this application.

3. Tools to enable demand flexibility:

Control integration between blackPAC™ DERMS with Powerconsumer's activation API call platform (for SNC), provides a new energy management tool and approach demonstrating system flexibility at Confederation College site for SNC's distribution network to address system needs.

Confederation College facilities will be enhanced with the infrastructure and energy management systems becoming a demonstration site that will be used for educational purposes at the post-secondary level and support local training needs.