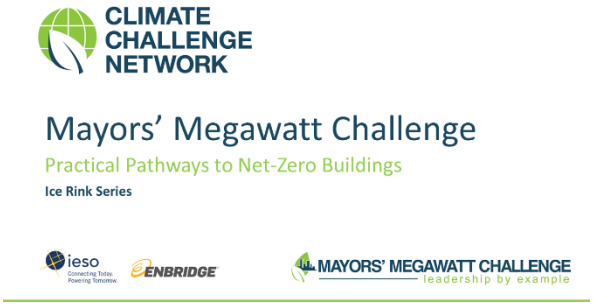
Net Zero Ice Rink Retrofit—Union Arena Webinar

February 19, 2020

Introduction

The Mayors' Megawatt Challenge webinar conducted on February 19, 2020 is the first in **a series of webinars focused on ice rinks**. In this series, we will be profiling experts that have extensive experience working with ice rinks to reduce their energy consumption and incorporate heat recovery and renewables, and will share their stories of piloting the pathway to net zero.



The Union Arena in Woodstock, Vermont is the first existing ice rink in North America to be retrofitted to achieve net zero (utility cost). This webinar shares the Union Arena team's business case and approach, results, and lessons learned. The goal and the process are scalable and can apply to the 8000+ arenas across Canada.

Union Arena project summary

- Project goal: reach net zero operating cost for the rink to alleviate financial pressure on operations and provide better service to the community
- Key priorities: ice quality, space comfort, and customer satisfaction
- Results so far: 2 out of 4 phases of the net zero project have been completed, reducing energy consumption by more than 50% and generating **>$100,000** in annual cost savings

Key takeaways

- **A scalable process:** Bringing in experts, discussing the goals, then following a systematic approach to investigate possibilities
- **Scalable components:** Knowing the right questions to ask, investigations using sharable tools, and examples of wording that be used in RFPs.
- For net zero to make sense, need to consider **total lifecycle cost** (including operations and maintenance) and not just simple payback
- **Align goals** with key stakeholders, designers, experts and operations team
- Keep **regular communications** to make day-to-day decisions in an integrated process

The process of investigation, generating solutions, implementation and operation can be applied by any rink considering such a retrofit. MMC will lead the development of accessible and useful tools that can guide individual rinks through the investigation, working with municipalities to map out the practical pathways leading to net zero ice rink facilities.

Background—Mayors' Megawatt Challenge (MMC)

Since 2003, the Mayors' Megawatt Challenge (MMC) program has been working with municipalities across Ontario to reduce the energy usage in their own portfolio of facilities, including town halls, community centres (pools and rinks), libraries, EMS stations and fire halls.

In 2019, more than 400 municipalities across Canada declared climate emergency, many setting aggressive goals to reach net zero emissions. MMC is spearheading an initiative to bring together the leading experts in North America and globally, working closely in **an integrated process** with municipalities (energy managers, facility managers, operators, procurement, asset management, councillors etc.) to develop a **feasible roadmap to net zero for existing buildings**.

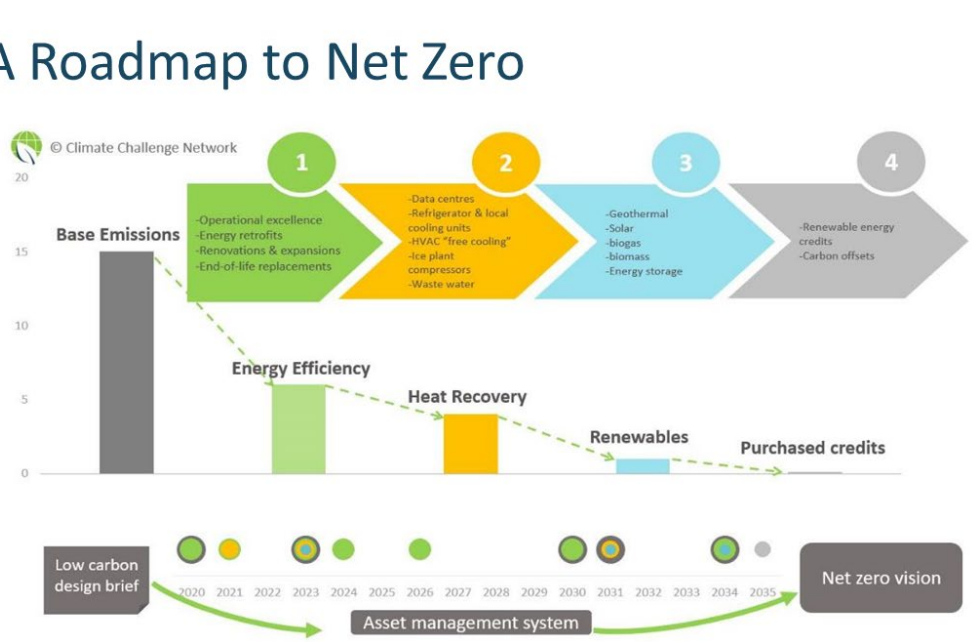
A major component of the program is the sharing of knowledge through webinars, emails, online and offline groups. We are moving from energy/cost savings and business cases, to **practical climate solutions and carbon reduction strategies** that can be integrated into current processes and **engaging stakeholders to take practical actions**.

Municipalities are stepping up as leaders to show that "**this can be done**", going from commitments to action "**we are doing this together, starting now"**.

CLIMATE CHALLENGE NETWORK

CLIMATE CHALLENGE NETWORK
is a non-profit umbrella corporation housing large-scale collaborative, data-driven programs aimed at rapid scaling up of emissions reductions in commercial, institutional and multi-residential buildings, and working with like-minded organizations and academia to meet shared goals.

MMC's Net Zero Roadmap

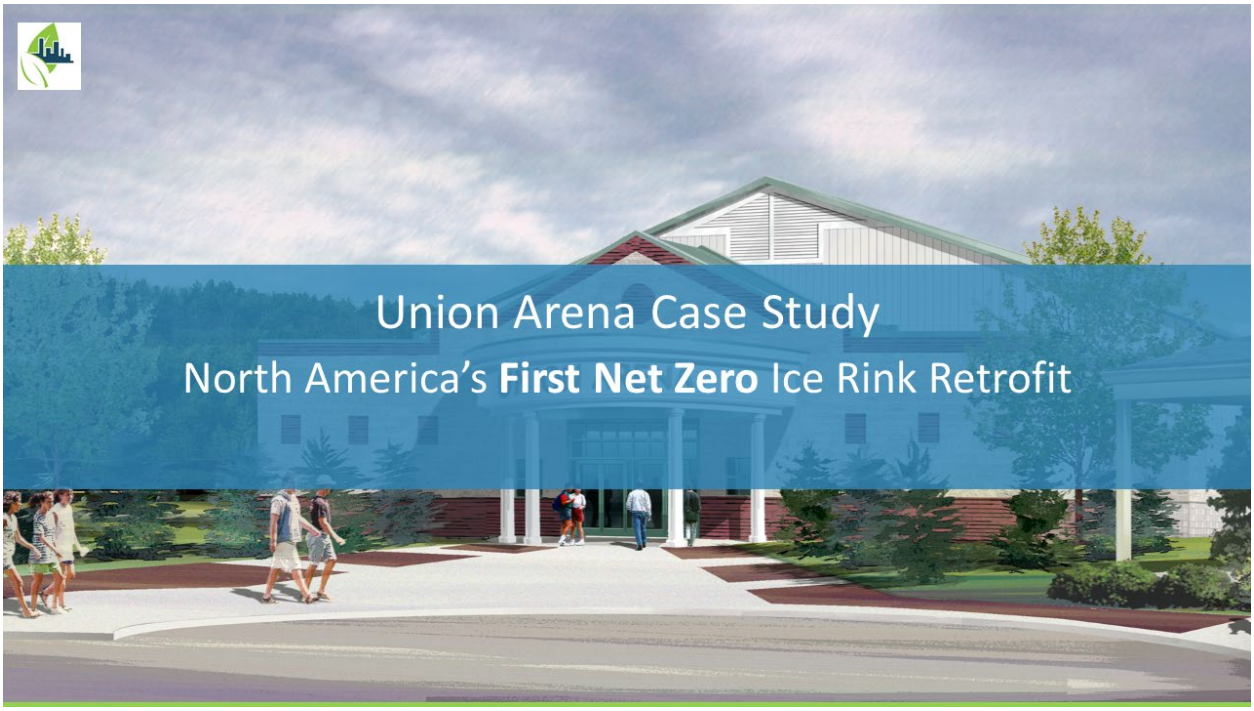


Mayors' Megawatt Challenge uses a net-zero roadmap approach (developed by Climate Challenge Network). The approach incorporates a **4-step process** and Rocky Mountain Institute's Zero-Over-Time concept:

1. Energy efficiency
2. Heat recovery
3. Renewables
4. Carbon offsets and purchased credits

The Net Zero Roadmap paints an end picture of a net zero facility integrating the 4 steps above, **then instead of replacing like-for-like**, each piece of capital equipment will be replaced and renewed to the end vision. In the timespan of 10 to 15 years, all facilities can reach net zero while only incurring **incremental cost** that can have attractive business cases.

Union Arena Case Study



Union Arena Case Study

EJay Bishop

- Executive direction (6 years), Union Arena Community Centre
- 18 years of Municipal Recreation and Parks experience – Director

Harold Mayhew

- 25 years in ice rink design
- Architect
- Engineer
- Designed the first LEED-certified ice rink in North America
- Onto the 2nd net zero ice rink retrofit project

Mike Sorano

- Vice President at Friar Architects

The Story in Brief

Ice rinks typically use 20%-30% of the total energy in a municipal portfolio, and utility costs are the biggest share of annual operating cost in rink facilities. For Union Area, a single-pad facility in Woodstock, Vermont built in 2003, maintenance costs were adding up to a significant amount.

When EJay Bishop was hired as the Executive Director of Facilities for Union Arena Community Centre in 2014, the facility was struggling financially to stay open. Utility costs were $140,000 a year, and close to one-third of the annual operating budget. The rink is run by a non-profit private organization, funded by income from programs and private donors.

Harold Mayhew is an engineer with Friar Architects who originally designed the rink. As a local resident, Harold got involved with the arena management in 2014, and introduced the vision of reducing arena's utility costs to zero. To plan the project, he used a realistic, evidence-based method, staging the project in phases that use cost savings from initial stages to fund the subsequent stages. By 2020, the first 2 phases were complete, generating over $100,000 in cost savings per year and reducing energy usage by more than 50%. The savings are funding the next 2 phases of the project and providing more programming for the community.

What was the most interesting part of this project?

Mike Sorano: *"Actually recognizing that there are huge savings in front that is mostly untapped and being at the forefront of this is very exciting. The Union Arena approach of using energy savings at the beginning phases to fund subsequent phases completely makes sense."*

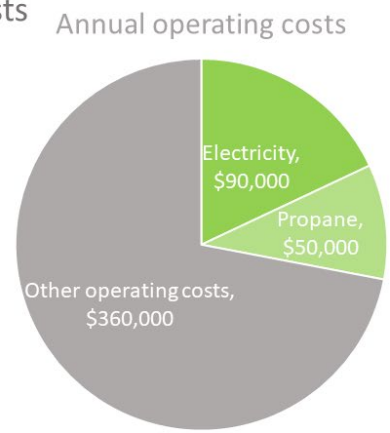
EJay Bishop: *"As a lay person, learning a lot of cool things about saving energy that I didn't know existed was very interesting. As a facility manager, taking a facility that was losing money and on the brink of closing to now a few years later flipping that completely around. Financially we are a lot more stable, and putting aside money for the future to keep the facility moving forward."*

Harold Mayhew: *"Facing a lot of disbelief, engaging major stakeholders and eventually being able to prove that it works, is very satisfying. It was a similar process back when I designed the first LEED-certified rink, and doing it again now in the middle of a climate crisis and proving the case to move things forward is very exciting."*

The Union Arena

- Run by a non-profit organization
- At the brink of closing due to rising utility costs

"Utilities is what kills the rinks." –chairman of the Board of Governors for Falmouth Youth Hockey in Massachusetts

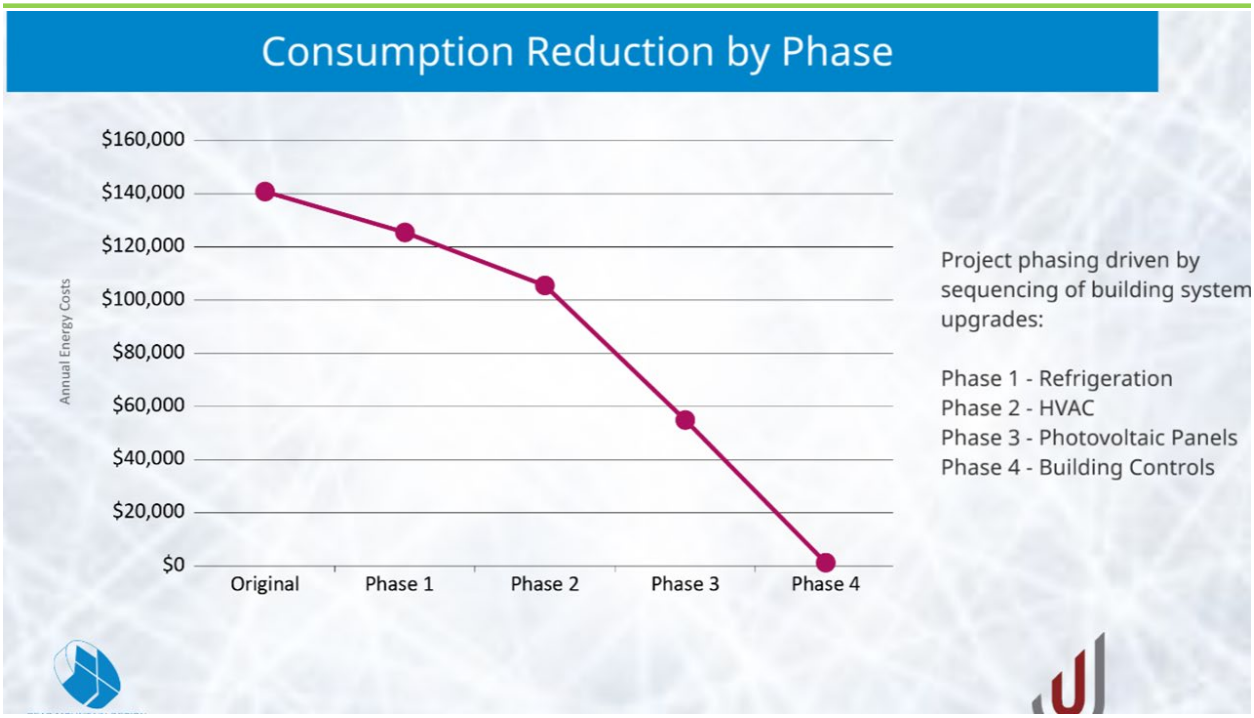


The building

- **Location**: Woodstock, Vermont
- **Building size:** 30,000 ft2
- **Refrigeration system:** CIMCO 110-ton indirect ammonia shell and tube system
- **Main rink space environment:** heated and dehumidified
- Refrigeration winter schedule: 160 days
- Refrigeration summer schedule: 40 days
- Annual electrical consumption and cost: 520,000kWh/$90,000
- Annual fuel consumption and cost: 30,000 gal LP/$50,000

Strategic goals

- Make the arena sustainable for future generations
- Become a “net zero” facility with no annual energy costs for fuel and electricity
- Use a large portion of the money saved to significantly reduce the cost for youth and family skating programs
- Use a portion of the savings to build a newer endowment for the arena to ensure future financial obligations are covered, including the long-term maintenance of the facility
- Get to net zero without sacrificing the **quality of the ice**, the **user’s experience** or best maintenance practices
  - Maintain ideal ice temperature
  - Continue to utilize hot water resurfacing
  - Utilize interior ice melting system
  - Continue to heat the main rink and spectator areas



Phase 1 – $132,695: rebuild and update

- Main refrigeration system
  - Rebuilt compressors
  - Replaced pressure relief valves
  - Implemented new refrigeration digital control system
  - Added time delay to the compressor cooling stop relay
  - Installed a new metering orifice on high side float
  - Insulated all new refrigeration lines
- Brine
  - Added brine system air purge extensions (warm & cold floors)
  - Installed new jumbo sized cold floor brine filter/separation of bine loops
  - Rebuilt brine pump
  - Brine tank leak repaired
- Cooling tower
  - Installed new cooling tower water treatment
  - Replaced cooling tower
- Other
  - Re-piped oil return systems with dirt leg and clean floats
  - Addressed leak in warm floor system

Phase 1 retrofit - 2016

In most rinks, after 10 years of operation, the equipment will need calibration and setpoint adjustments, so the first phase of retrofits at Union Arena was focused on rebuilding and updating existing equipment. The cooling tower was replaced due to its age and a VFD was added. To bring the system up to current operating standards, site staff worked with contractors to add pressure release valves, re-build the compressors, add inhibitor in the brine, and add a few new components.

The current refrigeration system is a Cimco indirect system. The brine circulates through the slab to cool the ice and goes back to be cooled by the ammonia in the compressors. This system is very well-built, simple, stable and efficient when maintained properly. A re-commissioning and update of the refrigeration system saved 10%-15% of electricity use, at no additional cost above required maintenance. This kind of re-commissioning can be done by a competent service provider familiar with the refrigeration system.

EJay Bishop, the facility's Executive Director, gained a lot of knowledge, working with a team of experts to rebuild the compressors. Since the entire refrigeration system did not need to be shut down, the process was a fairly smooth one. Art Sutherland and Greg Hillman of Accent Refrigeration, selected for this work, were very knowledgeable, understood the system well, and uncovered and addressed numerous issues in course of their month-long rebuild of the refrigeration system. The team worked together and communicated on a regular basis to make the best decisions for the arena.

Phase 2-$541,832: HVAC & heat recovery

- Replaced aged dehumidifier and HVAC system
- Added refrigeration heat recovery system supplying preheated water to boilers
- Replaced boiler system with high efficiency system
- Extended ducting in main arena to improve air flow efficiency

Phase 2 retrofit – 2018-2019

Phase 2 replaced the boiler system with a condensing boiler and new hot water tanks. The arena had a commercial hot water system which was upgraded to an industrial-level system that meets the building demand. The system was installed by local contractors.

A heat exchanger was added to the refrigeration system, harnessing the waste heat to pre-heat the domestic hot water.

The dehumidifier was replaced with a more efficient desiccant system (Munters unit) fueled by propane (the facility does not have a natural gas connection). It is more efficient in the following ways:

- The modulating furnace is demand-controlled by the CO2 level in the space, significantly reducing the heating requirements for fresh outside air
- This phase ran extended ductwork down both sides of the rink, improving the airflow and comfort in the space (the old system only popped through the walls and the air duct was too short)
- The regeneration wheel is 75% more efficient than the existing system

Since the goal of the project is net zero cost, fuel dehumidification was chosen instead of an electric dehumidifier due to the cost of energy. Electricity cost in Vermont is 5 times more expensive for the same unit of energy compared to Ontario. In the future phases, when renewables (solar panels etc.) are in place, longer-term costs and benefits will be considered.

Future phases

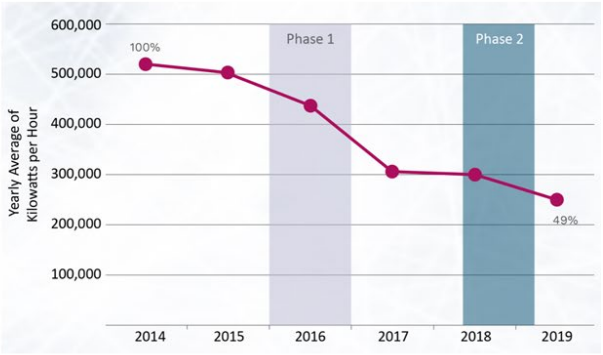
- HVAC, lighting, and refrigeration improvements
  - Replace brine pump motor with variable frequency drive
  - Revise demand controls
  - Add to heat recovering storage volume
  - Add to soft starters on compressor drive motors
  - Replace existing lighting with higher efficiency lighting
  - Upgrade to lighting controls
  - Replace or refurbish existing chiller
  - Solar PV to provide the remaining electricity required for the building once the energy consumption reduction measures are completed

Future phases

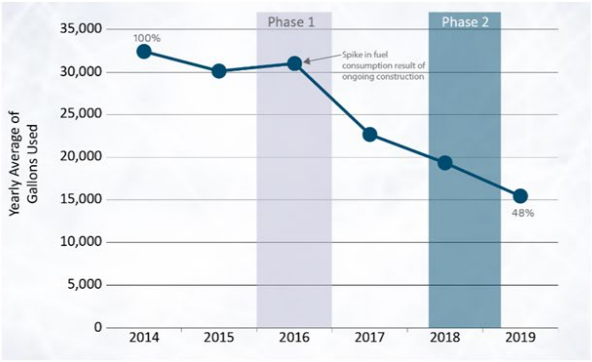
Projects with longer payback (e.g. lighting, building envelope upgrades, solar additions etc.) are being considered for the next 2 phases, being funded by energy cost savings in the beginning stages.

Results so far

Electricity



Fuel



Lessons learned

- Ice quality CAN be improved while lowering energy consumption
- Each ice rink presents unique challenges based on its location, programs and existing systems
- All system set points have to be coordinated to provide ideal rink conditions while reducing energy consumption
- Expensive renovation costs are mitigated by operation cost savings for years to come

For further information

Contact us

Kathryn Wilson

Program Manager

Climate Challenge Network

416-915-1530 x201

kwilson@climatechallengenetwork.org

Wen Li

Program Analyst

Climate Challenge Network

416-915-1530 x217

wjli@climatechallengenetwork.org

https://mayorsmegawattchallenge.com/