TOROMONT | CIMCO

Sustainable CO_2 Solutions

The Future of Refrigeration

As the climate crisis evolves through the world, governments are coming together to reduce and reverse the damage being done. CIMCO Refrigeration strongly believes that natural refrigerants are the best choice for customers that want to do their part in fighting global warming. Their appeal stems from the high efficiency, optimal performance and low environmental impact they offer. We have taken our experience installing 6000 ice rinks worldwide and perfected our CO2 system for the ice rink market. CIMCO has now installed over 75 CO2 ice rinks across North America; with our experience, expertise, and commitment to quality, you can rest easy knowing that CIMCO is the best option for your next CO2 installation.

Why consider CO2 as your Refrigerant

ALL NATURAL

Natural refrigerant with global warming potential (GWP) of 1 and ozone depleting potential (ODP) of 0

FUTURE PROOF

Low environmental impact – unlikely that environmental legislation will prohibit its use or lead to phaseouts

SAFE

Classified as an A1 refrigerant (low toxicity and flammability)

HIGH EFFICIENCY

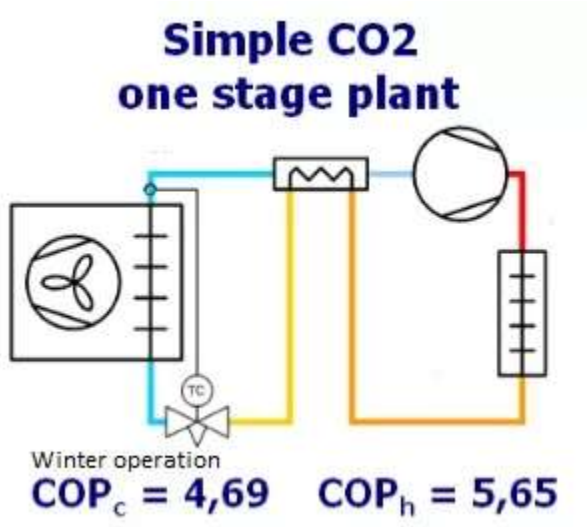
High potential for heat reclaim, which lowers plant operation cost.

NON-CORROSIVE

Inert and stable substance – no chemical reactions with polymers

CO2 (R-744) has proven to be a highly advantageous refrigerant for the cooling industry. It has minimal impact on the environment, produces reduced waste, is highly efficient and safe. As far as refrigerant options are concerned, CO2 is a leader in many aspects.

GWP	**01**
ODP	**0**
Safety Classification	**A1**
Toxicity	**30000 PPM**
Flammability	**0**
Retrofit	**Excellent**
Heat Reclaim	**High & Mid Grade**
Cost of Refrigerant	**Low**



CIMCOs CO_2 Cooling Solution

CIMCO has been at the forefront of CO_2 cooling in terms of innovation and experience, so we are equipped to develop the perfect system for your arena. With a highly experienced team and over 75 CO_2 installations across North America, we can recommend and create the perfect fit for you. Taking into account various factors such as maintenance, replacement, environment, ice quality, and total cost of ownership, CIMCO's CO_2 solution proves itself a powerhouse of efficiency, performance and sustainability.

KEY FEATURES

Energy Efficiency

- Energy savings between 15% - 40% depending on the type of system and location
- Superior quality allows energy stability
- Reliable and accessible solution for different weather conditions, with features for warmer climates
- Will maintain high COP and performance with seasonal operations
- Special features for year-round operation
- Superior ice quality
- Consistent ice temperature and quicker reaction to load with direct system
- High heat transfer in evaporators and condensers
- Smaller heat exchanger
- Allows low discharge floating head operation in colder climate
- Lower compression ratios leading to higher compressor isentropic efficiency
- Outlasts conventional installations
- Less impact on loss of efficiency cause by pressure drop in piping - almost no impact

Cost Efficiency

- Cost savings of 15% - 40% year after year (dependent on type of system and location)
- Reduced capital and operating costs
- Reduced cost of replacement equipment, low maintenance
- System components easily available, normally off the shelf
- Quicker installation
- Ease of operation, maintenance and start-up
- Fully integrated control system

Options available

- Multiple pieces package to fit in existing mechanical room
- Separate pump packages
- Calcium Chloride or Ethylene glycol
- DDC controls and monitoring
- Infrared camera for ice temperature control
- Adiabatic gas cooler for warmer climate
- Parallel compression and ejector for warmer climate
- Standard package size available for consultant and owners design requirements

Heat Recovery

Using heat recovery is environmentally friendly and lowers operating costs by re-purposing waste energy. In the past, ice rink refrigeration systems would reject waste heat into the atmosphere. Overtime, they have undergone improvements in terms of both equipment performance and waste heat recovery. Recovering and using the waste heat can reduce energy consumption and costs by over 40% and GHG emissions by 80% (based on the assumption that the waste heat recovery replaces the fuels used for space heating and domestic hot water). High discharge temperatures in CO_2 system offer good potential for high grade heat recovery requirement. It also offers substantial medium grade heat recovery for various building heat requirements. Taking into account the impact they have on operating costs and GHG emissions, energy efficiency and heat recovery are essential in new facilities or when renovating or replacing existing systems.

Most common uses for recovered heat

High grade heat

- Hot water for showers and resurfacer
- Hydronic hot water heating elements

Medium grade heat

- Fresh air intake heating
- Room heat , hydronic or air
- Infloor radiant in concrete floor, bleachers , walkways, showers, parking area

Lower grade heat

- Slab underfloor heating
- Snow melting

Safety

Classified as A1, which indicates non-toxicity and non-flammability, CO_2 tops the safety charts for all refrigerants.

CO_2 operates at high pressures, which is one of its main deterrents. However, this risk can easily be countered by appropriate design, construction and commissioning of the system. High quality stainless steel fusion welded pipes ensure the safety and quality of the installation. CO_2 is present all around us; it is non uncommon to have CO_2 in the atmosphere. Gas detection is installed and prevents the low floor area from completely replacing oxygen with CO_2 in case of a major leak.

The CIMCO Advantage

CIMCO Refrigeration is North America's largest supplier of thermal solutions, providing full-service capabilities including design, engineering, installation and after-market service. Since 1913, CIMCO has been at the forefront of the refrigeration industry, leading innovative solutions and resource expertise. With over 75 installations across North America, we are in a unique position to find the right CO2 solution for your needs and to support you through the operation of your arena.

We can help in the development of your CO2 ice rink project with

- Strong validated business cases that take into consideration the initial costs, energy consumption, maintenance and total cost of ownership
- Technical designs
- Engineered solutions
- Installation services
- Building integrations
- Facility tours
- Ongoing preventative maintenance
- Widespread geographic presence throughout North America
- Experienced Service teams

Ed Meagher Arena at Concordia University, Quebec

Project Brief:

Complete upgrade of the refrigeration system and installation of a new rink surface.

Major Considerations:

The refrigerant choice had to align with the clients sustainability initiative of environmental impact, energy efficiency and safety. It also had to be a financially viable option bringing in energy and maintenance savings.

Recommendation by CIMCO:

The refrigeration system recommended by CIMCO was a "**direct CO2 system**", where the CO2 is circulated within the refrigerated floor slab. It is a **transcritical CO2 system**, meaning that there is no condensation; instead, the refrigerant leaves the compressor as a gas and remains a gas (albeit at a cooler temperature) when it rejects heat to the atmosphere. The **refrigerated floor** for the system acts as the chiller where CO2 is overfed and evaporates in the floor. This allows the refrigerant to operate at a constant temperature throughout the floor, providing consistent, superior ice quality. The refrigeration system has (5)

Ed Meagher Arena at Concordia University, Quebec

CO2 transcritical compressors which will operate with discharge pressures up to 1500psi and remove 90 TR of heat. The system also has two stages of **heat reclaim**; high-grade heat available for all hot water applications, and low-grade heat available for space heating requirements.

The patented heat recovery through **ECO CHILL technology** adds to the energy savings, and Concordia University has savings of **$40,000 per year on energy and maintenance costs.**

> **"Ultimately, this renovated infrastructure will promote physical activity among university students and the Montreal community, enable further development of sports excellence at Concordia University, ensure quality services to its national and international users, and facilitate the sustainability of sports facilities at the Loyola Campus, always from a sustainable development perspective**
>
> Kathleen Weil
> Quebec Liberal Party

Shipyards Commons Skate Plaza, North Vancouver

Project Brief:

Supply and install the refrigeration system for the ice rink.

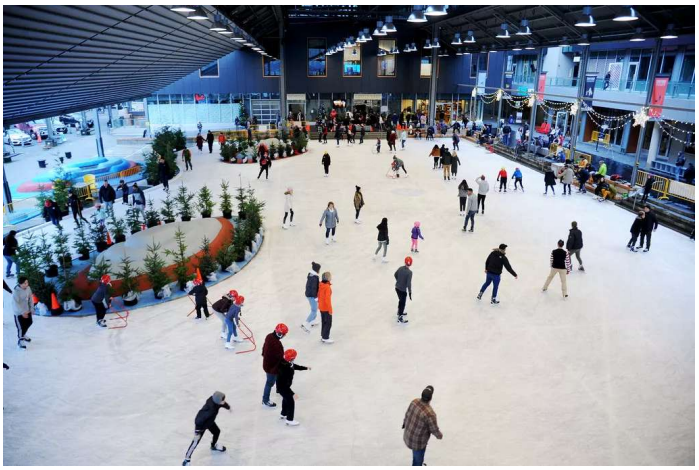
Major Considerations:

North Vancouver has committed to achieving net zero emissions by 2050. The warmer temperatures in Vancouver provide unique challenges for outdoor ice rinks; considerations included ensuring the rink was optimal for the local climate and met the 2050 net zero target.

Recommendation by CIMCO:

Keeping the goals in mind, the city proceeded with a CO_2 system that has no negative impact on the environment, costs roughly half as much to operate as other options, and offers heat recovery through the unique ECO CHILL technology. This allows the city to use waste heat from the refrigeration system to heat nearby buildings via the district energy system. In keeping with the overall sustainability vision, even the Zamboni is 100% electric.

This forward-thinking environmental mindset will help North Vancouver achieve its net zero targets.



Shipyards Commons Skate Plaza, North Vancouver

> This is, in my opinion, the jewel in the crown for the city. This just allows for the public to get outside, use the community as their backyard and it provides lots and lots of social opportunities to connect with one another, in events that are programmed for free.
>
> Mayor Linda Buchanan

Barbara Ann Scott Ice Trail, Toronto

Project Brief:

Supply and install the first refrigeration system of its kind in the world – the first transcritical carbon dioxide system for an outdoor ice trail.

Major Considerations:

TransformTO was unanimously approved by the City Council in 2017 and lays out long-term, low-carbon goals and strategies for the city to reduce local GHG emissions. These reduction targets, based on 1990 levels, are:

- 30 per cent by 2020,
- 65 per cent by 2030,
- Net zero by 2050 (or sooner)

Recommendation by CIMCO:

When Toronto contracted CIMCO to supply and install the refrigeration system, they knew a CO_2 system was the best solution. It has no negative impact on the environment and costs roughly half as much to operate as other options. Every tonne of refrigeration requires less HP to produce – in fact, it requires up to 50 – 60% less than alternative refrigerants. The system's capacity is 50TR, which is enough HP to maintain the ice surface in all conditions, yet the piping and the CO_2 pumps are much smaller and more efficient than standard rink systems.

Shipyards Commons Skate Plaza, North Vancouver

The pipes in this system are just 2" in diameter, while standard rinks are 6" or 8" across. A CO_2 detection system sends out an alert if it senses high levels of CO_2, and then automatically turns on an exhaust fan.
The CO_2 system has another advantage; it is more efficient because it is a direct system. Instead of removing heat at multiple steps, the refrigerant in this system goes straight to the ice floor, removes the heat from it, then uses the same refrigerant to carry it and remove it.

> The College Park revitalization is an excellent example of the well-designed public spaces we can create when we work together with a focus on community and what we know our residents want.
>
> Mayor John Tory

Watch how the Barbara Ann Scott Ice Trail was a major step in sustainability

ICE RUNS IN OUR VEINS

AT CIMCO, WE ENGINEER WORLD-CLASS TECHNOLOGY AND DELIVER OUTSTANDING SERVICE TO PROVIDE YOU WITH THE MOST EFFECTIVE, EFFICIENT AND RELIABLE ICE SYSTEMS AVAILABLE. WE'VE BEEN NORTH AMERICA'S ICE EXPERTS FOR OVER 100 YEARS, AND OUR PASSION IS ONLY GETTING STRONGER.

For more information:

cimcorefrigeration.com

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Sustainable CO_2 Solutions: THE FUTURE OF REFRIGERATION