Next Generation Building HVACR Sustainability

Emerson CO_2 Heat Pump Solution

VILTER™

EMERSON™

Greening Our Buildings

High Efficiency Heat Pump Technology: A Path to Sustainable Buildings

The United Nations Sustainable Development Group has identified climate change as a significant risk to the global economy in the future. Over recent years, we have witnessed the growing importance of sustainability and ESG (environmental, social, governance) as organizations continue to take strides to ensure business practices are sustainable and minimize environmental impact. One of the priority areas for improving sustainability is within the building sector, which according to the International Energy Association (2020), accounts for 30% of total energy consumed around the world, or 3100 Mtoe, including 55% of global electricity consumption and 28% of CO_2 emissions. With global building floor area expected to double by 2070, the decarbonization and electrification of heating and cooling systems will play an important role in achieving net zero emissions by 2050 in Canada and USA.

In major heating regions such as Canada, Europe, United States, and China, the high seasonal performance factor (COP) of heat pumps (300% – 400%) is attractive from a sustainability and total cost of ownership standpoint when compared to traditional heating and cooling technologies. Although initial capital costs associated with heat pumps are generally higher, proper integration within building environments (simultaneous heating and cooling) can create efficiencies that greatly reduce annual energy consumption and carbon footprint. As global leaders and facility managers look for solutions to improve sustainability in their facilities, it is expected that heat pumps will play a key role. In short, heat pumps yield the following benefits:

- Significant reduction in greenhouse gas (GHG) emissions
- Substantial increase in energy efficiency
- Lower total lifecycle cost of ownership than comparable technologies

> *Heat pumps could satisfy 90% of global heating needs with a lower carbon footprint than gas-fired condensing boilers*
>
> *International Energy Agency, 2021*

Going Green
NORTH AMERICAN ESG TARGETS

USA

- Net zero emissions by 2050
- 100% clean energy grid by 2035

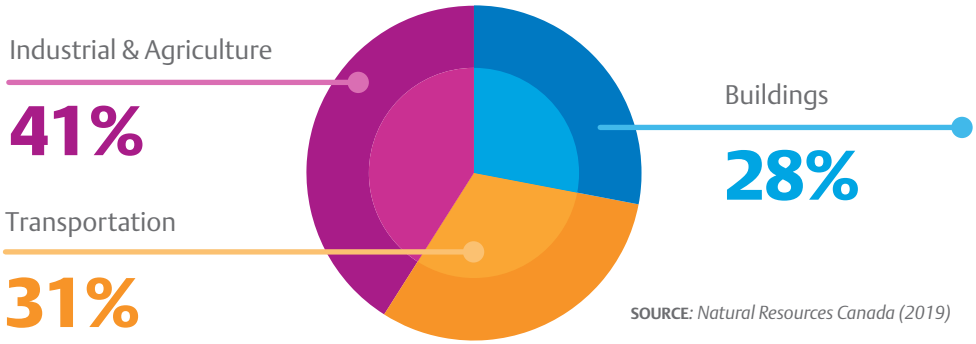
SOURCE: *The White House, April 2021*

CANADA

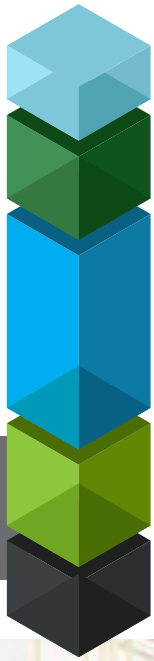
- Net zero emissions by 2050
- Heat pumps standard by 2030 in residential and commercial space and water heating

SOURCE: *Treasury Board of Canada & NRCAN, February 2021*

ENERGY CONSUMPTION BY SECTOR



SOURCE: *Natural Resources Canada (2019)*



Fast Fact: *Heating represents 64% – 83% of energy use in buildings and is the* ***largest direct source of emissions.*** – SOURCE NRCAN 2018.

Heat Pump Applications

Heat pumps are sustainable, efficient replacements for natural gas and electric boiler-based water and space heating/cooling systems. An excellent technology candidate for building retrofits and new facilities, heat pumps can be utilized within food processing, industrial manufacturing, district heating, and building HVAC applications for:

- Hydronic heating
- Space heating
- Sanitization

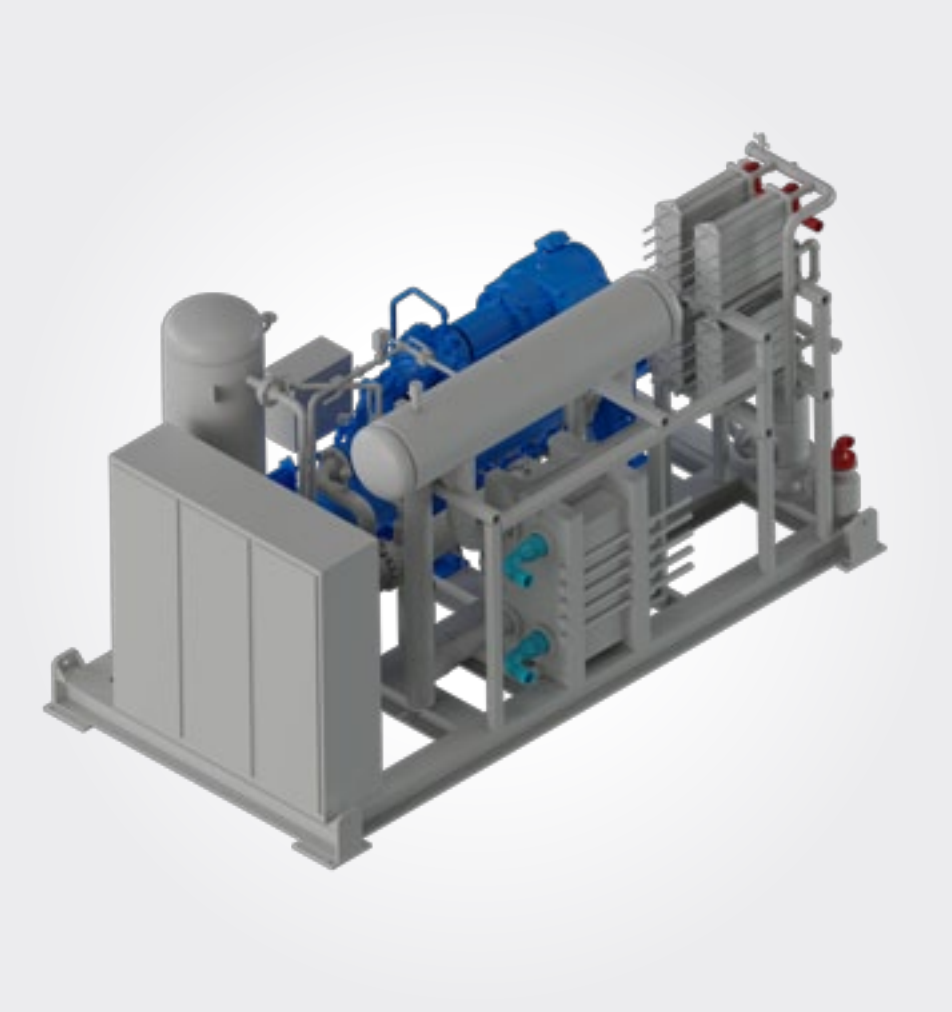
CO_2 Heat Pump Solution

Designed to help large building owners and operators reduce greenhouse gas emissions and improve energy efficiency, the Emerson CO_2 Heat Pump Solution is a single system that provides high-efficiency simultaneous heating and cooling for building HVAC processes. Heat is captured from a heat source (within the building or externally), upgraded by the heat pump and transferred to water storage tanks for use in domestic hot water, space heating, and chilled water applications. An integrated mechanical design with thermal storage provides additional benefit in lowering peak demand. This solution has the following key features:

- **High-Efficiency Simultaneous Heating & Cooling**
  Combined coefficient of performance (COP) is 6.4* which is approximately 3x as efficient as the combined COP of traditional boiler/chiller systems
- **Environmentally Friendly A1 Refrigerant**
  Future proof low-GWP refrigerant with highest safety class. 99x less harmful on the environment than R-134A or R-513A refrigerants
- **Integrated Control System with Demand Response Functionality**
  Emerson Machine Automation Solutions (MAS) control system optimizes operational performance and reduces peak demand which translates to significant energy savings
- **Innovative Vilter™ Single-Screw Compression Technology**
  An industrial-grade compressor designed for high-pressure CO_2 applications

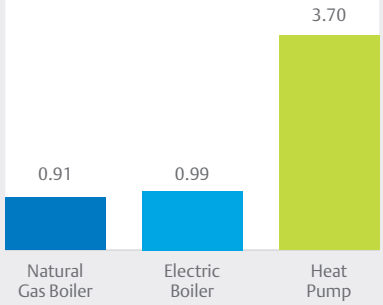
VILTER™	EMERSON CO_2 HEAT PUMP
System Configuration	Water to Water, Single Stage
Refrigerant	R744 (CO_2)
Controls	Emerson MAS (BACnet compatible BAS)
Certifications	UL & CSA with CRN
Typical Installations	Commercial space heating/cooling and domestic hot water, industrial process heating/cooling
Heat Source Inlet Temperature	50°F to 70°F
Heat Sources	Lake/sea/river, ground water loop, building Internal loads, waste heat recovery
Heat Sink Outlet Temperature	Up to 160°F
Capacity Per System	Heating: Up to 1,700 kW (5.9 MMBtu/h) Cooling: Up to 1,300 kW (4.3 MMBtu/h)
Efficiency (COP)	Up to 6.4 (combined heating and cooling)*
Dimensions (m)	3.0 H x 3.0 W x 6.0 L

**Under normal heating conditions at 65° F heat source water and 140°F heat sink requirement. Efficiency may vary depending on the type of heat exchangers utilized.*

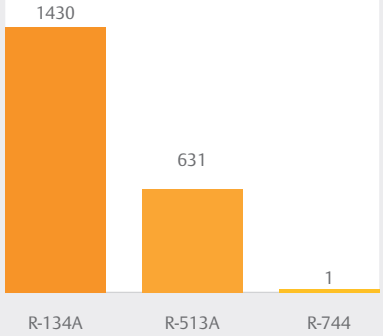


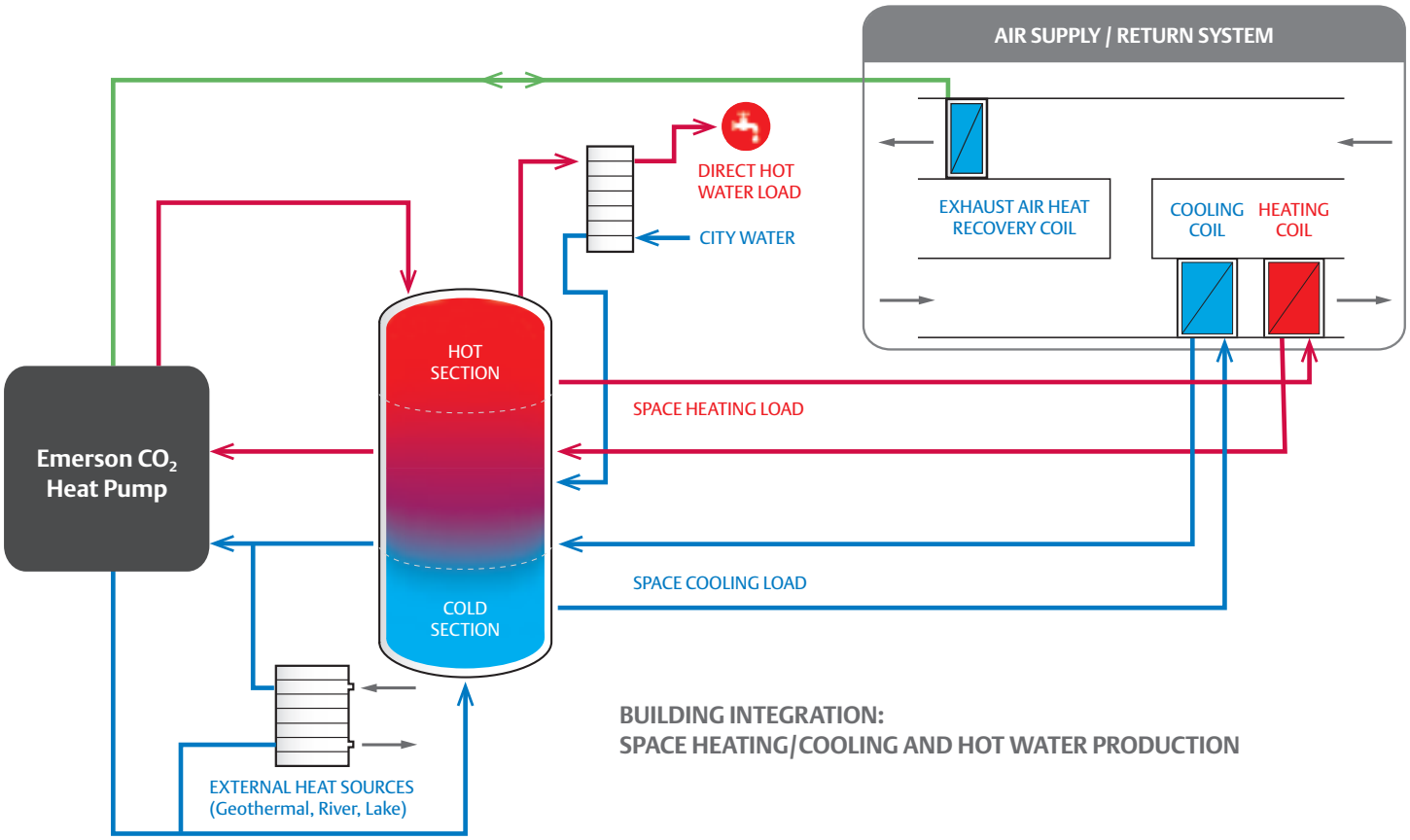
SUSTAINABILITY METRICS

Heating Efficiency (COP)



Global Warming Potential





BUILDING INTEGRATION:
SPACE HEATING/COOLING AND HOT WATER PRODUCTION

Performance Validation at Hydro Quebec Energy Technologies Laboratory (LTE)

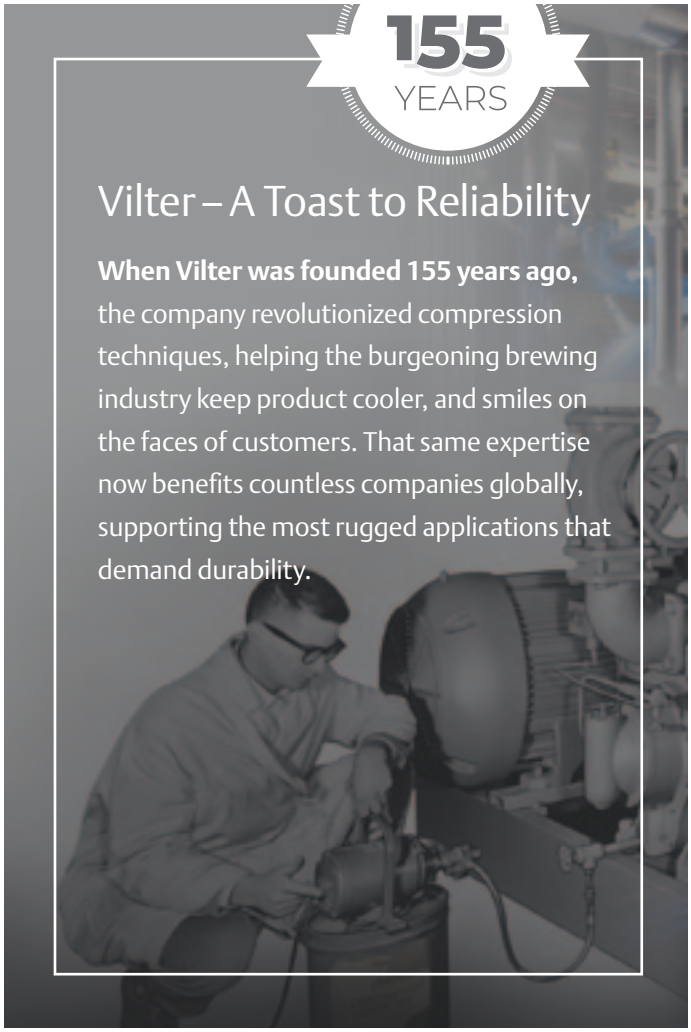
The heat pump was developed, tested and optimized in a live environment at the Hydro Quebec Energy Technologies Laboratory in Shawinigan, Quebec, Canada over a span of 3 years (2020 – 2022). By operating the system at real conditions (building heating and cooling loads) and combining it with thermal energy storage, Emerson and Hydro Quebec have been able to validate heat pump performance characteristics.

Hydro Québec

Emergence of CO_2

HVACR has been in the environmental spotlight for more than a decade, especially as leakage studies have revealed the true effects of hydrofluorocarbon (HFC) emissions. In response, many new refrigerant options and system architectures have appeared—both on paper and in practice—creating tricky choices for decision makers. The significant environmental advantages of R744 (CO_2) have guaranteed its position as a leading option for future HVACR systems. It has demonstrated favorable results in different system configurations over many years, particularly in Europe, Australia and Canada.

Initially high investment costs are now on a downward trend, while innovations in component technology and application methods continue to reveal potential performance gains. Tightening regulations are impacting the choices for refrigerants in the future, and CO_2's inherent characteristics as a low-GWP, non-toxic and non-flammable refrigerant make it an excellent choice for use in commercial buildings and public facilities. This is why there is growing widespread adoption of CO_2 in supermarkets, industrial processing facilities, data centers and ice rinks, with over 35,000 transcritical systems installed globally (Shecco, 2020).



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