Discover the opportunities of CO₂ refrigeration

Safe – Efficient - Green

One natural and efficient system for all your cooling and heating needs

refrigerants.danfoss.com/co2
Why choose CO$_2$ transcritical refrigeration?

With the implementation of refrigerant regulations like the Kigali amendment to the Montreal Protocol (Global) and F-gas regulative (Europe), the quest for alternative solutions is accelerating. CO$_2$ is now recognized as the most viable and efficient solution among natural refrigerants in food retail.

Today, CO$_2$ refrigeration has matured and is widely used in all types of stores from hyper and supermarkets to convenience stores and discounters. Every day, progress is being made to invent components and configurations for sustainable and viable CO$_2$ refrigeration; not only in cold climates where heat reclaim has proved to be an excellent business case, but also in warmer climates, where technology like ejectors constantly improve the energy efficiency of CO$_2$ systems.

Danfoss leads the development of solutions and components for CO$_2$ refrigeration and offers a wide range of products specifically designed for CO$_2$ transcritical systems. Furthermore, Danfoss provides training, design tools and consulting services to promote the use of CO$_2$ and to support the development of forward thinking solutions in all parts of the value chain.

Global

CO$_2$ - one solution across all climates
With heat reclaim, parallel compression and ejector technology, CO$_2$ has become highly efficient in all climates.

Sustainable

CO$_2$ – lowest possible Global Warming Potential (GWP)
Zero ozone depletion and lowest possible GWP (equal to one).
Energy Efficient Proven

CO₂ – smart solutions for high efficiency
With the latest technology, transcritical booster systems outperform traditional HFC systems on energy efficiency in all climates.

Danfoss has provided controls to more than 10,000 transcritical CO₂ systems worldwide
Danfoss commercialized the first transcritical controls 10+ years ago and uses the experience to continue to bring robust and innovative solutions to the market.

Facts about CO₂

- Environmentally friendly with up to 4,000 times lower GWP than traditionally used synthetic refrigerants, non-toxic and non-flammable
- Superior thermo-physical properties and high volumetric efficiency
- High heat transfer efficiency

Historical agreement

In 2016, negotiators from 197 countries reached a historic agreement to reduce emissions of HFCs that contribute to global warming. The Kigali pact represents a major expansion of the 1987 Montreal Protocol, which curbed the use of ozone-depleting CFC gases. With European F-gas and American SNAP regulation already in place, the Kigali agreement will further push the development of alternative refrigerants, where CO₂ already holds a strong position in several cooling applications that are safe for the climate as well as for the ozone layer.

Worldwide:
- Global HFC phase down under the Montreal Protocol from 2019 ending with 85% cut down in 2047
- National tax schemes on HFC
- National incentives and subsidies
- Multilateral Fund supports low GWP projects
- Extended new framework law promoting low GWP refrigerants

SNAP delisting of several HFC refrigerants like R404A starting in 2016
HFC phase-down starting in 2015 ending with 79% cut down 2030

North America
Europe
Africa
Middle East
Asia
Japan
10,000+
Transcritical CO₂ racks installed with Danfoss controls
Transcritical CO$_2$ - Reduce complexity with one, global solution

Today, CO$_2$ has proved itself as a highly reliable and cost effective solution in all climates. For retailers, this means that transcritical CO$_2$ low and medium temperature refrigeration can be applied across the store, reducing complexity and cost during design, operation and maintenance.

For a decade or more, the potential of CO$_2$ in supermarket refrigeration has been recognized in colder climates. In recent years, however, the interest from forward-thinking retailers has fueled the invention of new technologies that make transcritical CO$_2$ systems in warmer climates both viable and profitable. New technologies are rapidly emerging as highly energy efficient solutions that help retailers reduce complexity and meet current and future regulation on traditional refrigerants.

Simplify – apply CO$_2$ to save costs

- Design replication across sites
- Lower service costs
- Easy knowledge sharing inside the organization and with external partners
- Same KPIs, maximum transparency across the store
- Enabling one install for Refrigeration, Heating and Air-condition
The warmer the better – Danfoss Multi Ejector opens new frontiers in CO₂ refrigeration

The ejector solutions are the next promising technologies for optimization of transcritical refrigeration in warm climates. The Multi Ejector allows retailers to go beyond ambient temperature limitations and use transcritical CO₂ across the globe.

The energy saving potential of the Multi Ejector solution is up to 10% on an annualized basis compared to the previous generation of transcritical booster systems. The greatest savings occur in the warmest ambient conditions. Compared to first generation systems, savings during the hottest hours of the year are up to 30%, meaning that significant savings in installed compressor capacity can be achieved, potentially reducing the overall cost of the system. In areas with variable electricity rates or with demand charges, the coincidental peak power savings are not to be ignored. Ejector technology is erasing the so-called CO₂ equator, making transcritical CO₂ technology more efficient than state-of-the-art HFC rack systems in all regions of the world.

Danfoss has tested the new ejector technology in labs and in more than 100 store installations. The test installations have returned significant energy savings compared to traditional HFCs.
10% saved on your refrigeration energy bill in the warmest climates
Now, thanks to a cooperation between Danfoss and Sønderborg District Heating, the Danish supermarket chain SuperBrugsen in Høruphav on the island of Als, Denmark, is also a district heating supplier. Residents living near Super Brugsen have their district heating supplied from the recovered surplus heat from the cooling system in SuperBrugsen, and thereby help contribute to reducing CO₂ emissions.
Maximize energy efficiency with transcritical CO$_2$ and heat reclaim

CO$_2$ is by nature a highly suitable refrigerant for heat reclaim, and resilient solutions already return significant energy savings to food retailers. New ejector technology for transcritical CO$_2$ systems already allows total optimization of the refrigeration system with integration of auxiliary functions like air condition and high temperature heat recovery.

In theory, 100% heat reclaim from the transcritical refrigeration system in many cases provides sufficient heat to fulfil demands for space heating and hot tap water in many climates.

Supermarkets become energy suppliers
CO$_2$ transcritical refrigeration opens new perspectives, where supermarkets, when connected to a district heating system, can play an important role in the local energy supply. With only minor investments, the supermarket can be connected to the local heating network and the supply of reclaimed heat can generate yet another revenue stream for the retailer.
Synthetic refrigerants like HCFCs and HFCs have global warming potentials between 2,000-4,000 times higher than that of CO₂. All too often, refrigerant leakages from supermarkets result in harmful gas escaping to the atmosphere. If grocery stores across the world switched from synthetic refrigerants to CO₂, it would have the same environmental benefit as taking 10 million automobiles off the road.

A lot of forward-thinking retailers have already made the move to CO₂. Are you the next? Danfoss has implementation-ready CO₂ solutions that will help you boost the energy efficiency of your stores and the green image of your brand, services to promote the use of CO₂ and to support the development of forward thinking solutions in all parts of the value chain.
Italy’s Largest Hypermarket Opt for CO₂ Refrigeration

Iper in Italy opted for transcritical CO₂ in their latest hypermarket in Milan. "Electricity for refrigeration makes up 50 % of the total energy consumption of the hypermarket, and Iper has an ambition to cut down this consumption year by year as part of their sustainability program. Another ambition is to switch to natural refrigerants to cut the carbon footprint. In order to fulfil these goals, we proposed a transcritical CO₂ solution. It is a large installation with several hundred cabinets and cold rooms operating under ambient temperatures up to 38°C," says Enrico Zambotto, Technical Support Manager from Arneg, a world leader in the production of complete refrigeration solutions for the retail industry.

CO₂ - safe for the climate and ozone layer

- Commercial refrigeration accounts for more than 30 % of the total refrigerant emissions in the world.
- 50 million tons of carbon dioxide equivalent emissions could be saved every year if all supermarkets worldwide were to switch to CO₂ as refrigerant.
Join us – and take the next step in CO$_2$ refrigeration

CO$_2$ has become industry standard in food retail refrigeration. Proven technology and components for transcritical refrigeration are readily available today.

- Which refrigerant gives us the best return on investment?
- Can we achieve full integration of our energy requirements?
- Should we do a full retrofit with CO$_2$ or just part of the system?
- Should we invest in heat reclaim?
- Should we go for CO$_2$ ejectors?

The questions are many when food retailers have to navigate the highly dynamic and competitive market of today.

There is no one-size-fits-all answer and solution; the final decision always depends on specific and site-related circumstances. The Danfoss team of CO$_2$ champions is ready to guide and support you in your decision-making.

Your **benefits at a glance**

- CO$_2$ optimized controls for a multitude of systems, including the ability to dynamically optimize transcritical CO$_2$ performance
- Integrated heat recovery solution enabling delivery of full store demand for space heating and sanitary hot water
- Full line of valves and automatic controls capable of standstill pressures (90Bar/1300psi) and transcritical pressures (140Bar/2000psi) for trouble-free operation
- Industry leading application support and guidance to choose the best solution

Want to learn more about CO$_2$ refrigeration?

**Danfoss offers a series of e-lessons:**
- Introduction to Carbon Dioxide: Properties and Impact
- Advantages of Carbon Dioxide as a Refrigerant
- System understanding
- Phase change
- Food Retail Systems and product selection
Danfoss has launched a Mobile CO₂ Training Unit with equipment and components for CO₂ solutions. The Unit is manned by dedicated Danfoss CO₂ champions, and visitors can view demonstrations and experience hands-on training with actual systems and interactive panels.
Full product portfolio for $\text{CO}_2$ refrigeration

**Multi Ejector**
The Danfoss Multi Ejector is the latest edition to the Danfoss portfolio and ensures that transcritical CO$_2$ applications for retailers become energy efficient in any climate.

**AK-PC 782A**
A multi suction group transcritical pack controller, offering supreme system performance and integrity by combining many years of experience in transcritical control with market leading innovative control features.

**AKVH**
AKVH together with the AK-CC 550A evaporator controller is the most used solution in commercial CO$_2$ refrigeration systems. Fail safe and filter build in.

**CCMT**
A high pressure regulating valve fitting transcritical CO$_2$ systems offering unmatched regulating and benefits through full serviceability, including both a filter and a pressure transmitter.

**ICMTS**
The most used transcritical CO$_2$ control valve. Featuring full serviceability and offering hand held magnet control.

**CTR**
The 3 way heat reclaim valve for CO$_2$ applications enables energy savings by reclaiming heat in e.g. supermarket applications. This valve provides the tightest seal on the market, while at the same time ensuring the most accurate control and even the possibility for modulation between two heat exchangers.

Our pledge to low-GWP refrigerants
Danfoss actively pursues development and use of low-GWP refrigerants to help slow the process of global warming while helping to ensure continued global well-being, economic development and future viability of our industry. We will enable our customers to achieve their low-GWP goals while continuing to enhance the energy efficiency of refrigeration and HVAC systems in food retail.

Find out more about products and scan the QR code
Transcritical Booster System with Multi Ejector

The latest generation of systems combines parallel compression and ejector technology to make transcritical CO₂ an efficient choice.
Danfoss is committed to supporting food retailers working to achieve climate-friendly and energy efficient solutions. As a market leader with more than 50,000 food retail installations worldwide, Danfoss leads the development of food retail solutions. Our CO₂ technologies are part of the Danfoss Smart Store concepts developed based on 30 years of close cooperation with the global community of food retailers.

Danfoss continuously develops its portfolio of components, controllers and advanced algorithms with the long-term ambition to create net-zero stores or even stores that give more energy than they take. Together with forward-thinking retailers around the world, we take sustainable solutions to the next level through constant development of sustainable technologies and service concepts.

Visit Danfoss Smart Store at: smartstore.danfoss.com

Read more about trending CO₂ technologies for food retail refrigerants: danfoss.com/co2