Commercial Chillers and Heat Pumps

with Natural Refrigerants

2025 Edition

Europe 2025

ATMO Intelligence

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Europe 2025

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About Us

Founded in 2007 as shecco, ATMOsphere is a global, independent market accelerator for clean cooling and heating solutions using natural refrigerants and refrigerant-free technology. The company's global team is located in Europe, the United States and Japan and boasts more than 50 years of industry experience.

The core team includes journalists, analysts, engineers, event organizers, designers and other highly skilled individuals with diverse backgrounds. As industry experts in this field, the team offers unique insights into trends and market size. This domain expertise is augmented by the power of ATMOsphere's wider network of like-minded experts who share an ambition for scaling up the global clean cooling and heating economy.

ATMOsphere's business includes news, a product marketplace, a directory, events and market research. As of December 2025, the company has held 89 events around the world. In 2022, ATMOsphere launched its natural refrigerants label, which serves as a global gold standard highlighting best-in-class manufacturers and contractors of natural refrigerant systems and components. Since 2025, the natural refrigerants label has included data on avoided TFA emissions.

Overall, the ATMOsphere platform offers a one-stop solution for investors, end users, original equipment manufacturers, component manufacturers, contractors and others with the goal of scaling up clean cooling and heating solutions. However, the real power of the ATMOsphere brand lies in its network.

It spans the globe and includes more than 50,000 industry stakeholders – including policymakers, end users, academics and manufacturers. ATMOsphere is not just a company but a community of people who believe that the future of cooling and heating is clean and natural.

For more information, visit atmosphere.cool

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THE GREEN CHOICE MADE IN ITALY
AND STANDARD TRUSTED BY GLOBAL OEMS
R290
LARGEST EUROPEAN PRODUCER:
R290, R600A, R600
UNMATCHED QUALITY:
PURITY UP TO 99.99%
CERTIFIED SUSTAINABILITY:
ZERO IMPACT PRODUCTION AND
SUPPLY OF BIO REFRIGERANTS
(ISCC PLUS CERTIFIED)

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Publisher's Note

Right Refrigerants, Right Time

Natural refrigerants have been the future for commercial chillers and heat pumps in Europe for more than a decade now. In the mid-2010s manufacturers were touting propane chillers and heat pumps as direct replacements for HFC-based chillers and heat pumps. Companies working with CO_2 focused on the efficiency gains that could be achieved through system integration. Advances in low-charge ammonia provided the ability for the refrigerant to move from the industrial to the commercial sector.

While the logic was sound and systems were available, these were the right refrigerants at the wrong time. First cost was still a concern given that propane requires safety equipment to account for its flammability and CO_2 needs components rated for high pressures. The 2014 EU F-gas Regulation, though a watershed moment in refrigerant regulation, did not take aim at commercial chillers and heat pumps specifically.

What a difference a decade makes. The timing is finally right for natural refrigerants in commercial chillers and heat pumps in Europe.

The 2024 revision to the EU F-gas Regulation sent a clear message to the market that HFCs have no future in the European HVAC&R sector beyond 2050. The PFAS restriction proposal currently being considered by the European Chemicals Agency could slam the door shut on HFOs, too. More manufacturers have piled into the market and introduced new products, while those that made the first move have added to their lineups.

Natural refrigerant chillers and heat pumps have proven themselves in a wide range of commercial applications across Europe. The question is no longer whether propane chillers can safely provide space cooling for office buildings (they can) or if CO_2 chillers and heat pumps are efficient enough to justify the higher capital expenditures (they are), but rather how quickly will the shift to naturals be.

This report sets the foundation for answering that question. It does this by providing an overview of the market availability of commercial chillers and heat pumps with natural refrigerants as well as by estimating how many of these systems have been installed to date. This report also contains interviews with leading manufacturers and case studies detailing their work with these technologies.

The timing is finally right for commercial chillers and heat pumps using natural refrigerants in Europe, and this report shows why.

Jan Dusek
Co-Founder and COO
ATMOsphere

"The timing is finally right for commercial chillers and heat pumps using natural refrigerants in Europe, and this report shows why.

Lead Author's Note

Laying the Groundwork

Numbers don't lie, and the data we've gathered for this report shows that commercial chillers and heat pumps using natural refrigerants have arrived in Europe, albeit not in great quantities. Naturals represent a fraction of the market for commercial chillers and heat pumps for reasons my colleague Jan Dusek touched on in his note to readers.

That said, the groundwork has certainly been laid for the transition to naturals.

It started with regulation, with manufacturers pressuring the European Union to do more about f-gas emissions. Once regulators sent a signal that tougher measures against synthetics were in the works, manufacturers responded and began releasing new commercial chillers and heat pumps with natural refrigerants.

Production only increased once the 2024 EU F-gas Regulation became law. By our count there are more than 300 natural refrigerant-based commercial chillers and heat pumps available in Europe from more than 65 manufacturers. That figure will likely be much greater by the time you read this.

In addition to more products on the market, manufacturers have more experience with commercial HVAC, domestic hot water and process heating and cooling. This is evident in the "Deep Dives" featured in this report, which are combinations of Q&As and case studies with companies that are leaders in this space or are working to become one. These companies walk the walk by sharing the projects they've worked on, which includes a propane chiller that cools office workers and IT equipment at a newly built Berlin office tower and an integrated CO_2 system built for an Italian winemaker that delivers process cooling and useful heat.

However, for every end user unafraid to work with hydrocarbons or that sees the value in investing in CO_2 there are those operating on outdated information who still see synthetics as the only option. This report will hopefully serve as a first step toward setting the record straight and showing that the groundwork has indeed been laid for the transition to natural refrigerants in commercial chillers and heat pumps.

Michael Hines
Lead Author
ATMOsphere

Methodology

This report focuses on commercial chillers and heat pumps in Europe using natural refrigerants. It takes a dual focus and provides estimates on the market availability of these systems along with the total installed base as of December 2025.

This dual focus is intended to paint a more complete picture of the market. Relying on product availability alone would not provide an idea as to how these products have been received by end users. Showing just installation data would not indicate to what extent manufacturers have invested in natural refrigerant-based commercial chillers and heat pumps.

This report defines commercial chillers and heat pumps as those with a cooling or heating capacity between 30 to 400kW (8.5 to 113TR) per unit. Data on market availability and installations was gathered for products within this range.

Natural refrigerants in this report include CO_2 (R744), ammonia (R717), propane (R290), isobutane (R600a), butane (R600) and water (R718). For the purposes of this report, “Europe” encompasses the European Union, the U.K., Norway, Switzerland, Iceland, the non-EU Balkan states, Ukraine, Belarus, Moldova and the European portion of Russia.

The data gathering for this report was guided by the ATMO Model, which features a database of hundreds of clean cooling and heating companies and thousands of products. In addition to the database, the model features a proprietary algorithm for calculating the impact natural refrigerant-based heating and cooling solutions have on lowering CO_2 and TFA (trifluoroacetic acid) emissions.

Market Availability Data

ATMOsphere conducted desk research to gather data on the number of commercial chillers and heat pumps on the market in Europe. Data was gathered from the websites and product brochures of more than 65 companies, and the complete database includes more than 300 products split into four types: chillers, heat pumps, reversible heat pumps and four-pipe/polyvalent heat pumps. This data is an estimate as of August 2026.

Installation Data

Data on the installed base of commercial chillers and heat pumps in Europe was gathered from surveys and interviews with manufacturers. Desk research was also conducted, with information gathered from news articles, year-end financial and sustainability reports, as well as marketing material. Note that this data is an estimate as of December 2025.

Executive Summary

This report focuses on commercial chillers and heat pumps in Europe using natural refrigerants. It provides an estimate of both the number of natural refrigerant-based commercial chillers and heat pumps on the market today as well as the installed base of these systems (as of December 2025). It also features in-depth interviews with manufacturers and case studies profiling their work.

This report defines “commercial” with regard to capacity, which is from 30 to 400kW per unit. These products can serve a wide range of applications, including: commercial HVAC, process cooling and heating, and domestic hot water production.

CO_2, propane and ammonia commercial chillers and heat pumps have been available in Europe for more than a decade. They've been used in a variety of applications, from air-conditioning hotels to process cooling in the food and beverage industry. However, their growth has been limited by concerns around safety (the flammability of propane and toxicity of ammonia) and higher first costs compared to synthetic systems.

The market for natural refrigerant-based commercial chillers and heat pumps began to develop in the mid-2010s as more manufacturers entered the space. EU-funded research projects and the rise of CO_2 in commercial refrigeration drove further technological advancements. In the early 2020s regulators began signaling that Europe would enact stricter f-gas legislation, which encouraged more manufacturers to enter the market. The 2024 revision to the EU F-gas Regulation, with its total ban on HFCs in new equipment by 2050 and earlier GWP limits for commercial chillers and heat pumps, further accelerated product development.

The market for natural refrigerant-based commercial chillers and heat pumps could receive a further boost if the proposed universal restriction on PFAS (per- and polyfluoroalkyl substances) currently under consideration by the European Chemicals Agency is implemented. The proposal defines PFAS broadly as any substance containing at least one fully fluorinated methyl or methylene carbon atom. Under this structural definition, most HFO refrigerants used or proposed for use in commercial chillers and heat pumps (for example R1234yf, R1234ze and blends built on them) fall within the proposal's scope, as do many HFC/HFO blends.

Where the market currently stands shows that, while there is broad manufacturer support for natural refrigerant commercial chillers and heat pumps, there is no critical mass of installed equipment. As of August 2026, ATMOsphere estimates there are more than 300 commercial CO_2, ammonia and propane chillers and heat pumps on the market in Europe from more than 65 manufacturers.

As of December 2025 ATMOsphere estimates there were 27,000 commercial propane chillers and heat pumps installed in Europe (the installed base). In addition, ATMOsphere estimates there were 1,000 commercial CO_2 chillers and heat pumps installed in Europe.

300+	**27,000**	**1,000**
PRODUCTS ON THE MARKET FROM 65+ MANUFACTURERS, AUG. 2026	PROPANE CHILLERS AND HEAT PUMPS INSTALLED, DEC. 2025	CO_2 CHILLERS AND HEAT PUMPS INSTALLED, DEC. 2025

DEEP DIVES

Five manufacturers on where the market is headed

While this data tells the story of where the market currently is, this report also contains in-depth interviews with leaders at five manufacturers that provide insight into where it's headed. Refra, SCM Frigo, Secon, Systemair and TEKO were all interviewed for the report.

REFRA · SECON

Hydrocarbon heat pumps and chillers, with the F-gas Regulation driving demand

Refra and Secon spoke about their work with hydrocarbon heat pumps and chillers, and both acknowledged the role the 2024 EU F-gas Regulation has played in driving demand for their products. For its case study, Refra highlighted how its propane and isobutane heat pumps helped a town in England decarbonize its district heating network, while Secon focused on a propane chiller it provided to a newly built Berlin office building that cools workers and IT equipment.

Refra Deep Dive → Secon Deep Dive →

TEKO · SCM FRIGO

CO_2 across a wide swath of applications, from winemaking to comfort cooling

TEKO and SCM Frigo both work with CO_2, with the former offering heat pumps and chillers and the latter currently in the process of rolling out its first-ever CO_2 heat pump. Both see demand for CO_2 across a wide swath of applications; TEKO is particularly bullish on commercial buildings with simultaneous demand for heating and cooling. That said, its case study focused on a chiller with heat recovery it built for an Italian winemaker to provide process cooling, while SCM Frigo detailed one of the first installations of its CO_2 heat pump at the factory of a Norwegian heat exchanger manufacturer where it provides space heating and comfort cooling.

TEKO Deep Dive → SCM Frigo Deep Dive →

SYSTEMAIR

An air-handling unit with an integrated CO_2 heat pump

Systemair is also working with CO_2 but hasn't built a heat pump or chiller. Instead it is going to market with an air-handling unit (AHU) with an integrated CO_2 heat pump. The company sees big potential for its AHU with hotels, wellness facilities and hospitals. Its case study details the in-house testing of its AHU, which is providing space heating, comfort cooling and ventilation at one of its production plants.

Systemair Deep Dive →

Chapter 1

Technology & Market Overview

1. Technology and Market Overview

1.1 Introduction and Scope

This chapter provides an overview of the technology and market that are the focuses of this report: commercial natural refrigerant chillers and heat pumps with a capacity of 30–400kW (8.5–113TR). The chapter covers technology first and then takes a brief look at the various applications for commercial natural refrigerant chillers and heat pumps. It continues with a short history of these technologies in Europe before moving onto opportunities for them in two emerging sectors.

1.2 Chillers

Chillers provide cooling by removing heat from a secondary fluid loop, typically water, water–glycol or brine. The system operates on a vapor-compression cycle: A liquid refrigerant absorbs heat from the building's fluid loop inside an evaporator, causing the refrigerant to evaporate into a low-pressure gas while chilling the secondary fluid. A compressor then pressurizes this gas, raising its temperature so that a condenser can reject the accumulated heat to the environment, reverting the refrigerant back into a liquid – in the transcritical cycle CO_2 (R744) is a supercritical fluid – to repeat the cycle.

Chillers can be either air-cooled or water-cooled. The difference is how the heat from the refrigerant is rejected to the environment:

Air-cooled chillers

Air-cooled chillers reject heat directly into the atmosphere by drawing ambient air across finned condenser coils. Typically installed on rooftops to ensure unobstructed airflow. Hydrocarbon chillers are generally air-cooled due to the refrigerant's flammability.

Water-cooled chillers

Water-cooled chillers use a condenser water loop to reject heat from the refrigerant. Usually housed indoors within mechanical rooms, they offer superior cooling capacity per footprint compared to air-cooled units. They depend on external heat rejection infrastructure: cooling towers, traditionally, but increasingly dry coolers to conserve water.

1.3 Heat Pumps

Heat pumps work by moving heat from a source, such as the ambient air or a nearby river or lake, to a sink, which is most often water or water–glycol. The natural refrigerants used in these heat pumps boil at extremely low temperatures, which enables heat pumps to gather heat even at exceedingly low ambient temperatures.

The system operates on a vapor-compression cycle: A liquid refrigerant absorbs heat from the ambient air or a water source, causing the refrigerant to evaporate into a low-pressure gas. A compressor then pressurizes the gas, raising its temperature. The high-heat gas is rejected into the heat sink via the condenser, reverting the refrigerant back into a liquid – in the transcritical cycle, CO_2 is a supercritical fluid – to repeat the cycle.

Because they use electricity to produce heat, heat pumps are a crucial technology for decarbonizing buildings and industry, two sectors that have historically used fossil-fired boilers to produce heat. Crucially, natural refrigerants allow modern heat pumps to achieve the high flow temperatures required by existing commercial radiator networks without a severe penalty to efficiency.

In addition to air- and water-source heat pumps there are also ground-source heat pumps. Across all three, the heat sink is almost exclusively water in a secondary loop or buffer tank. Within these groupings, further distinctions can be made between monobloc or split systems.

1.3 Heat Pumps — three source types

Air-source heat pumps

Air-source heat pumps use the ambient air as their heat source and are installed outdoors, although what enters the building depends on the design. In monoblocs, only the facility water loop, heated after the refrigerant rejects its heat to it in the condenser, enters the building. This setup is designed to work around the flammability of hydrocarbon refrigerants. In split systems, the refrigerant travels indoors and rejects its heat to a hydrobox.

Water-source heat pumps

Water-source heat pumps use water as a heat source, which includes river water, lake water and even wastewater. They are usually installed inside, and manufacturers have addressed safety concerns regarding flammable refrigerants in several ways. This includes splitting the system's refrigerant charge across multiple circuits and installing the heat pump inside a ventilated enclosure equipped with additional safety features.

Ground-source heat pumps

Ground-source heat pumps use the earth or groundwater as a constant-temperature heat source. In commercial applications with limited footprints vertical boreholes are drilled deep into the ground that contain closed-loop pipes filled with brine. The brine absorbs geothermal heat and carries it to the evaporator. Alternatively, open-loop groundwater setups draw water directly from an underground aquifer to transfer heat to the refrigerant before returning it to the ground.

A reversible heat pump can provide both heating and cooling but not at the same time. Employing an internal four-way reversing valve, the system changes the direction of the refrigerant flow. When switched to cooling mode, the heat source and sinks are reversed: The indoor heat exchanger functions as the evaporator, and the outdoor heat exchanger takes the condenser role, with the heat from the facility water loop rejected to the ambient air, water source or ground.

A four-pipe/polyvalent heat pump can heat and cool simultaneously. When operating in cooling mode alone, it rejects heat to the external source/sink using dedicated heat exchangers. When there is a simultaneous demand for cooling and heating, the heat extracted from the cold water loop is redirected directly into the building's hot water loop.

1.4 Natural Refrigerants in Commercial Chillers and Heat Pumps

CO_2

CARBON DIOXIDE · R744

CO_2 is unique compared to naturals and synthetic refrigerants because of its low critical temperature of around 31°C (87°F). When CO_2 rejects heat above that point it does not condense but remains a supercritical fluid that simply cools as it gives up heat. Rejecting heat at high pressure requires robust compressors and components. For years these components were scarce and expensive, and while they are more readily available today, they still carry a higher upfront cost than components rated for lower pressures.

However, that same behavior makes CO_2 unusually versatile across temperature extremes. In heat pumps, the gradual cooling of the supercritical fluid matches the gradual warming of a water loop especially well, letting CO_2 units deliver high flow temperatures without the efficiency penalty that condensing refrigerants incur. This is a particular strength in producing high-temperature heat and in heat recovery. In chillers, CO_2 performs well at low evaporating temperatures, making it a natural fit for sub-zero process cooling.

C_3H_8

PROPANE · R290

Hydrocarbons, chiefly propane (R290), are highly efficient refrigerants that are flammable. As such, charge sizes are limited by safety standards, and units are generally installed outdoors or in ventilated enclosures so that any leak disperses safely. Their operating pressures and thermodynamic behavior otherwise sit close to those of the synthetic refrigerants and they share some of the same components as well.

Propane's efficiency and its use of many of the same components as synthetic-based chillers make it a straightforward substitute, from a thermodynamic standpoint, in air-cooled comfort and process cooling applications. In heat pumps, isobutane (R600a), butane (R600) and pentane (R601) deliver high flow temperatures at moderate operating pressures, matching or exceeding CO_2's high-temperature capability without its high-pressure cost.

NH_3

AMMONIA · R717

Ammonia (R717) is incredibly efficient but it is toxic and mildly flammable. As such, it has historically been confined to large, water-cooled plants housed in dedicated machinery rooms and run by trained personnel. The advent of low-charge ammonia — which substantially reduces the charge size compared to a traditional system — has been the key to downsizing the technology, and manufacturers now offer packaged and even air-cooled ammonia units at commercial capacities.

In chillers, ammonia is the long-standing workhorse of industrial and process cooling, and low-charge designs now bring that efficiency into commercial-scale units. In heat pumps, it is well established in industrial systems but less common at commercial scale.

1.5 Applications

1.5.1 Process Cooling

Process cooling involves the removal of heat from industrial equipment and materials. A chilled fluid, often water or water–glycol, cools the equipment or material, with the heat transferred to the chiller's refrigerant loop and rejected to either the ambient air or a cooling tower.

Process cooling is essential to many industries, including:

Plastics

Plastic products are formed by melting and molding liquid plastic, pellets or flakes. The mold must be quickly cooled, such as in a water bath or by a spray, to meet the requirements of the product's design and its performance. Cooling and recovery accounts for up to 80% of the manufacturing time to produce a single molded plastic item.[1]

Brewing and winemaking

Process cooling is used in breweries and wineries prior to and during the fermentation process, with vats wrapped in "cooling jackets" containing pipes filled with chilled fluid. Sub-zero glycol temperatures are often required, particularly during cold stabilization.

Pharmaceutical production

Synthesizing active pharmaceutical ingredients requires precise temperature control of the vessels they're made in. For example, the heat generated by tablet pressing machines needs to be managed because it can degrade the active ingredients in pills or melt their binders.

Ammonia is a natural fit for the heaviest process-cooling loads, and low-charge units now extend that reach to commercial-scale applications. Hydrocarbon chillers are a practical fit for plastics manufacturing, pharmaceutical production and other industries with above-zero process cooling needs. CO_2 chillers are better suited to applications requiring sub-zero glycol temperatures, such as brewing and cold stabilization in winemaking.

1.5.2 Process Heating

Process heating involves delivering heat directly to industrial equipment and materials using hot water or steam. In heat pump systems, heat is absorbed from a low-temperature source, such as ambient air, wastewater or waste heat, and upgraded by the refrigerant loop before being transferred to the process fluid.

At the commercial scale covered in this report, heat pumps are mostly used for smaller, distributed process heating needs rather than large centralized industrial loads. Relevant applications include:

Food and beverage processing

Hot water is used for blanching, scalding and cleaning-in-place (CIP) systems that sanitize processing equipment between batches. CIP cycles often require water at 60–85°C (140–185°F) to meet food safety standards.

Small-scale textile finishing

Dyeing and washing processes in smaller facilities require a sustained hot water supply at similar temperature ranges.

Brewing and dairy processing

In addition to their process cooling needs, breweries and dairies require hot water for cleaning, pasteurization support and other batch processes, often in the 60–85°C range.

CO_2 heat pumps are especially well suited to this scale of process heating, efficiently delivering water at 90°C (194°F) or higher for the hottest applications. Hydrocarbon heat pumps are an efficient option for moderate process temperatures at similar capacities. Ammonia heat pumps remain less common at this scale, having historically been concentrated in larger industrial installations above 400kW.

1.5.3 Commercial HVAC: Comfort Cooling

Chillers can provide comfort cooling in offices, hotels, airports and other large residential and non-residential buildings. A chilled water loop is circulated through the building to air-handling (AHU) or fan coil units. The heat transferred to the water is cooled by the chiller's refrigerant loop and rejected to the ambient air or a cooling tower.

Hydrocarbon chillers have been deployed safely in commercial comfort cooling applications (see Secon's "Deep Dive"). Low-charge ammonia chillers are increasingly offered for comfort cooling as well. For buildings requiring seasonal flexibility, a reversible heat pump can replace a standard chiller, switching between comfort cooling in summer and space heating in winter without separate systems.

1.5.4 Commercial HVAC: Space Heating and Domestic Hot Water

Heat pumps are used for space heating and domestic hot water production in commercial buildings. Using ambient air or a water source, the heat pump warms the building's water loop up to 70°C (158°F) and distributes it to either AHUs or fan coils units. Buildings with underfloor heating require lower temperatures of up to 45°C (113°F). Domestic hot water is heated to 60°C (140°F). Heat pumps are also used in district heating systems. Commercial-scale heat pump units can be deployed in parallel or cascaded configurations to serve smaller district heating networks.

70°C BUILDING WATER LOOP	45°C UNDERFLOOR HEATING	60°C DOMESTIC HOT WATER

CO_2 heat pumps are particularly effective for producing domestic hot water. Hydrocarbon heat pumps deliver high flow temperatures efficiently at lower operating pressures, a complementary fit for space heating across the building's water loop.

1.5.5 Commercial HVAC: VRF

Variable refrigerant flow (VRF) systems use a single outdoor unit with inverter-driven compressors and electronic expansion valves to modulate refrigerant delivery to multiple indoor units simultaneously, enabling independent zone-by-zone heating or cooling across large commercial buildings. VRF circulates refrigerant directly to each indoor unit, eliminating the intermediate water loop and reducing the system's overall footprint. Reversible VRF configurations function as heat pumps, extracting heat from outdoor air for space heating.

The path to natural refrigerants in VRF remains uncertain. The only manufacturer to have publicly committed to a natural refrigerant VRF product is Daikin, which unveiled a CO_2 VRV (variable refrigerant volume, its trademark for VRF) system for the European market at ISH 2025 in Frankfurt.[2] At the time of this writing Daikin has not provided an update on the launch of its CO_2 VRV system or shared details regarding sales or installations.

1.5.6 Data Center Cooling

Data centers have historically been air-cooled, but the rise of high-performance computing and artificial intelligence has pushed server rack density from 15–30kW to more than 100kW. At these densities air cannot be circulated fast enough to dissipate the heat, and data center operators have turned to liquid-cooling systems, which leverage fluids that have a heat-carrying capacity thousands of times higher than air. These fluids are typically cooled by chillers.

Although natural refrigerant chillers remain a small fraction of the data center cooling market, hydrocarbon and CO_2 units are gaining traction as end users face growing pressure to reduce refrigerant emissions and improve energy efficiency at scale. Ammonia chillers are used as well.

1.5.7 Integrated Systems

Integrated systems meet simultaneous demand for heating and cooling by recapturing waste heat from the cooling process. A chiller with heat recapture, for example, can cool a building's IT equipment while using the recovered heat for space heating. Hotels and hospitals similarly recapture waste heat from comfort cooling or refrigeration to produce domestic hot water.

Both hydrocarbon and CO_2 technologies are used in these configurations. Hydrocarbon systems can recover heat for use within a localized circuit to preheat domestic hot water, for example. CO_2 systems can extract heat from a cooling loop and upgrade it to the higher temperatures required for space heating or hot water distribution across larger networks. Ammonia integrated systems are more common in industrial settings than at the commercial scale covered in this report where recaptured waste heat warms water and cleans and dries process equipment.

1.6 Commercial Chillers and Heat Pumps with Natural Refrigerants in Europe: A Brief History

1.6.1 The First Chiller and Heat Pump

1922

The chiller was invented by Willis Carrier in 1922, with the first installations providing comfort cooling for department stores and movie theaters in the United States.[3] While Carrier used ammonia in some of its early commercial air-conditioning systems in the U.S., its chillers used the synthetic refrigerant dilene.

1938

The history of the heat pump is almost equally as long as that of the chiller. In 1938,[4] the world's first heat pump was installed at the Zurich town hall.[5] The water-to-water heat pump was manufactured by Escher Wys (now Friotherm) and used the Limmat river as its heat source. Along with space heating in the winter it provided comfort cooling in the summer and used R12 refrigerant.

1930s

CO_2, propane and ammonia were used in HVAC&R in the early 1900s, but the rise of synthetic refrigerants in the 1930s pushed CO_2 and propane to the sidelines. Ammonia didn't face the same fate and continued to be a force in industrial refrigeration. In commercial chillers and heat pumps, however, synthetics would be the only option for decades to come.

1.6.2 The Reemergence of Natural Refrigerants

mid-1990s

In the mid-1990s Gustav Lorentzen's research into CO_2 and subsequent development of the transcritical cycle revived interest in CO_2 as a refrigerant. In 2001 the transcritical CO_2 cycle showed its potential in Japan with the launch of the first Eco Cute hot water heat pump, designed for residential applications.[6] By the end of the decade transcritical CO_2 had begun to carve out a niche in the European commercial refrigeration sector.

late 1990s

The late 1990s saw the groundwork laid for commercial hydrocarbon heat pumps. Swedish manufacturer NIBE and German manufacturer Alpha Innotec (AIT) began building propane heat pumps to provide residential space heating and domestic hot water.[7] The '90s also saw the development of low-charge ammonia systems, which enabled the refrigerant to be used in a wider range of industrial applications, including smaller-scale process cooling.[8] Italian manufacturer Zudek and Scottish manufacturer Star Refrigeration were two of the pioneers of this technology.

1.6.2 continued

2006

The development of the market for transcritical CO_2 refrigeration systems led to an increased availability of compressors and other components specifically designed to withstand high pressures. In 2006 Star Refrigeration built a CO_2 chiller to cool servers at the London branch of the Dutch bank ABN Amro.[9] The Scottish industrial refrigeration manufacturer supplied a 300kW chiller to cool the bank's "15 high-performance servers."

2006–11

It was around this time that European manufacturers began developing commercial propane chillers. Italy-based Euroklimat entered the market in 2006, and in 2010 Secon was founded in Germany with the goal of manufacturing chillers that only use natural refrigerants, specifically hydrocarbons. The Lithuania-based refrigeration systems manufacturer Refra began building natural refrigerant-based chillers in 2011.

The commercial heat pump market developed slower due to a variety of factors. For CO_2 this included the aforementioned lack of availability of components rated for high pressures – mostly compressors – along with the perception that the transcritical cycle was efficient only in specific applications.[10] A lack of components, specifically scroll compressors, was also an impediment to the development of commercial propane heat pumps, as were fears of the refrigerant's flammability, which impacted allowable charge levels.

1.6.3 Institutional and Regulatory Support Accelerates the Industry

2012

Support for this nascent market came from the EU in the early 2010s. The EU-funded NxtHPG project was launched in 2012 with the goal of developing "several reliable, safe, high efficiency and high capacity heat pumps working with the two most promising natural refrigerants: hydrocarbons and CO_2."[11] The project wrapped in 2016 with the successful development of five prototype units, including reversible systems, ranging in capacity from 30kW to 60kW (8.5TR to 17TR).

2014

Natural refrigerants received a boost with the 2014 revision to the EU F-gas Regulation, which included an f-gas quota system and GWP (global warming potential) limits for HFCs (hydrofluorocarbons) in new equipment (see Chapter 2).[12] While this signaled that HFCs were in the sights of regulators, the 2014 F-gas Regulation did not contain GWP limits for commercial chillers and heat pumps, and synthetic refrigerants continued to dominate the market.

FIGURE 1.1 · 2023 EUROPEAN CHILLER MARKET, >50KW

€1.9bn

($2.1 billion), with the market experiencing double-digit growth from prior years.

74% HFCS

17% HFC/HFO BLENDS

7% HFOS

1% NATURALS

In 2023 the European market for chillers with a cooling capacity over 50kW (14.2TR) was estimated at €1.9 billion ($2.1 billion), with the market experiencing double-digit growth from prior years.[13] Air-cooled and water-cooled chillers were both driving the market, but just 1% of chillers used natural refrigerants, with HFCs accounting for 74% of the total, HFC/HFO (hydrofluoroolefins) blends 17% and HFOs 7%.

The 2024 revision to the EU F-gas Regulation established a ban on the use of HFCs in new HVAC&R equipment beginning in 2050.[14] This includes phased-in GWP limits for commercial chillers and heat pumps. The regulation does not account for HFOs, a class of synthetic refrigerants with zero ODP and GWP values at or near zero.

However, the universal PFAS (per- and polyfluoroalkyl substances) restriction proposal currently being considered by the European Chemicals Agency (ECHA) would ban the use of HFO refrigerants considered PFAS. As of July 2026, the ECHA has yet to submit its final opinion on the restriction proposal to the European Commission, with the regulatory process potentially running through 2028 (see Chapter 2).

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150–400 kW cooling capacity**

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QUICK INSTALL

Only need to connect to water and electrical network.
Oil charged.
CO_2 pre-charged.

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Premium quality thanks to standardization.

* water 35/75 °C; ambiant -5 °C
** water 12/7 °C; ambiant +35 °C

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1.7 Opportunities in Comfort Cooling and Data Centers

1.7.1 A Firm Foothold in Process Cooling

There were an estimated 400,000 air-to-water and 80,000 water-to-water chillers with a capacity of or less than 400kW in the European industrial process cooling sector in 2016.[15] In 2024, ATMOsphere estimated there were 6,650 industrial sites – a site could use one or more chillers – in Europe with hydrocarbon-based chillers as of December 2024, an increase of 33% from the previous year.[16]

While hydrocarbon chillers would be just 1% of the total number of chillers in European process cooling, their year-over-year growth from 2023 to 2024 shows that adoption is increasing among end users. CO_2 has also found its footing in process cooling, including from some big name end users. U.S. food processing company Cargill said in 2022 that it was moving from HFC to CO_2 chillers for applications ranging from 100 to 500kW (28.4 to 142TR) at its European plants.[17]

Low-charge designs have made ammonia more of a fit for smaller-scale process cooling. Manufacturers have moved to serve this range — Enex Technologies, for example, expanded into low-charge ammonia chillers through acquisition and now offers air-cooled ammonia units alongside its hydrocarbon and CO_2 lines.

6,650	+33%
EUROPEAN INDUSTRIAL SITES WITH HYDROCARBON CHILLERS, DEC. 2024	INCREASE FROM THE PREVIOUS YEAR

1.7.2 Commercial Comfort Cooling

In 2016 there were an estimated 310,000 air-to-water chillers and 90,000 water-to-water chillers with a capacity of or less than 400kW used for comfort cooling in non-residential buildings. Natural refrigerant-based chillers make up less than 1% of this total, but that being said, propane and CO_2 chillers and heat pumps have been used successfully in commercial comfort cooling applications for years.

1.7.2 Commercial Comfort Cooling — in the field

2017

In 2017 a METRO supermarket in Padua, Italy, installed two propane chillers from Euroklimat with a total cooling capacity of 510kW (145TR) to provide air-conditioning and sub-cooling for the store's CO_2 refrigeration system.[18]

2018

In 2018 a hotel in the Belgian town of Lommel installed a 113kW (32.1TR) propane TripleAqua heat pump to provide comfort cooling and space heating for 47 rooms and several common areas.

2024

More recently, in 2024 Chinese manufacturer LYD said it provided CO_2 heat pumps to a photovoltaic panel factory in Switzerland that provide both comfort cooling and space heating.[19]

2025

In 2025 a Swedish furniture company installed water-to-water and air-to-water propane heat pumps at its store in Riddes, Switzerland, manufactured by Secon.[20] The water-to-water unit provides simultaneous heating and cooling, with a 400kW heating capacity and a 315kW (89.6TR) cooling capacity. The air-to-water unit provides 260kW (73.9TR) of heating capacity.

250+

BLUE CO_2 AHUS INSTALLED ACROSS DENMARK AS OF 2025

Natural refrigerant-based heat pumps have also made their way into air-handling units. Danish manufacturer Unic Air has been developing AHUs with integrated CO_2 heat pumps for commercial comfort cooling since 2018, with more than 250 of its BLUE CO_2 AHUs installed across Denmark as of 2025.[21] Unic is currently developing an AHU with a CO_2 heat pump that can provide both cooling and heating. Swedish manufacturer Systemair also has an AHU with an integrated CO_2 heat pump (see the Systemair "Deep Dive").

Natural refrigerant-based chillers and heat pumps are becoming more visible in commercial comfort cooling, but they still face challenges in gaining a greater market share. For hydrocarbons the chief area of concern is still flammability, while CO_2 chillers and heat pumps carry a higher initial cost due to their high operating pressures. Despite this, Danfoss forecasts that hydrocarbons specifically will become the main refrigerant in "commercial A/C [and] scrolls including reversible units" from 30–400kW of capacity in Europe by 2028.

1.7.3 Data Center Cooling

€176bn

A total of €176 billion ($201 billion) is forecasted to be invested in new European data center construction from 2026 to 2031.

At the moment, that demand is largely being met by chillers using HFC and HFO refrigerants.

Natural refrigerants are struggling to make inroads in part because of the same concerns leveled in the commercial comfort cooling sector: flammability for hydrocarbons and higher upfront costs for CO_2 systems. However, like with comfort cooling, natural refrigerant-based chillers and heat pumps have overcome these concerns and established a small foothold in data centers.

Hydrocarbons

Both Secon and Danish manufacturer Fenagy have shown that hydrocarbon-based chillers can compete on a cost basis with chillers using synthetic refrigerants – in the Nordics and in Austria, Germany and Switzerland.[23] Secon has provided hydrocarbon chillers for more than 30 data centers, while Fenagy is just entering the segment. Its first project, located in Kajaani, Finland, points to what could be the future for data centers: a chiller–heat pump that recovers the waste heat for use in the local district heating network.

Ammonia

Outside of hydrocarbons, ammonia chillers have also been used for data center cooling. Italian manufacturer Zudek replaced an R407C chiller at a German data center with a low-charge ammonia chiller that was 43% more efficient.[24]

43%

MORE EFFICIENT THAN THE R407C CHILLER IT REPLACED

CO_2

CO_2 chillers are also used, though in greater numbers in North America with Canadian manufacturer M&M Carnot leading the way.

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The Policy, Regulatory and Standards Landscape

Chapter 2

02

The Policy, Regulatory and Standards Landscape

2.1 Introduction and Scope

This chapter maps the policy, legal and standards framework that governs the design, sale, installation and servicing of commercial chillers and heat pumps in Europe. The framework operates on three interlocking levels: (1) international agreements that set the overall trajectory for the refrigerant phase-down, (2) EU-level regulations and directives that translate that trajectory into binding market rules and (3) technical standards that determine what is practically buildable and installable under those rules.

Because natural refrigerants sit at the intersection of climate policy, chemicals policy and product safety, developments at any one of these levels can materially change the competitive position of natural refrigerant-based equipment relative to synthetic alternatives.

2.2 International Framework: The Montreal Protocol and the Kigali Amendment

The regulatory starting point for the entire refrigerants sector is the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer, which phased out chlorofluorocarbons (CFCs) and, later, hydrochlorofluorocarbons (HCFCs) on the basis of their ozone-depleting potential.

The hydrofluorocarbons that came afterward had no ozone-depleting potential but carried high global warming potential. Their rapid market growth after the HCFC phase out prompted the 2016 Kigali Amendment to the Montreal Protocol, under which parties committed to a phase down of HFC production and consumption. The EU, as an early mover, front-loaded its own HFC phase-down well ahead of the Kigali schedule through successive f-gas regulations.

The Kigali Amendment is important to the use of natural refrigerants in commercial chillers and heat pumps in Europe for two reasons. First, it sets a global floor. Countries outside the EU are also reducing HFC availability, which supports the long-term investment case for natural refrigerant technology even in markets where near-term EU-style GWP bans do not yet apply. Second, it created the diplomatic and technical infrastructure – national HFC quota systems, reporting obligations, technology and safety standard exchange – that the EU's own F-gas Regulation builds directly upon.

2.3 The EU F-gas Regulation

2.3.1 The 2006 and 2014 Regulations

The EU's first F-gas Regulation in 2006 introduced containment, leak checking, recovery and technician certification obligations for equipment using f-gases but did not restrict their use directly. Its containment provisions required operators of stationary refrigeration, air-conditioning and heat pump equipment to have systems checked for leaks, to keep records of the type and quantity of f-gas held in each system, and to use only certified technicians for installation, maintenance, servicing and decommissioning. Equipment above defined charge thresholds also had to be fitted with automatic leak-detection systems checked annually.

The 2014 revision to the EU F-gas Regulation was the first to impose a hard EU-wide HFC supply quota and phase-down schedule, alongside targeted equipment bans and an obligation for technician certification training to include general information and safe handling practices for alternative refrigerants, including naturals. The quota system allocated annual, tradeable allowances to individual HFC producers and importers in bulk, calculated from each undertaking's historical share of the EU market, with the EU-wide cap reduced in a series of discrete steps through to 2030.

From 2017 the same quota system was extended to cover HFCs pre-charged in imported refrigeration, air-conditioning and heat pump equipment. This first phase down was designed to cut EU HFC supply by 79% between 2015 and 2030 on a CO_2-equivalent basis and is what began pushing synthetic refrigerant costs upward and creating space for commercial natural refrigerant chillers and heat pumps.

2.3.2 The 2024 EU F-gas Regulation

The 2024 revision to the EU F-gas Regulation is the single most impactful piece of legislation to the market for commercial chillers and heat pumps using natural refrigerants. The 2014 regulation's trajectory, while assertive for its time, was calibrated against a weaker set of international and domestic commitments than the ones the EU had signed up to by 2020. Furthermore, the 2014 regulation had enforcement gaps, especially when it came to illegal trade.

The 2024 revision to the EU F-gas Regulation added the customs-integration and refillable-container rules specifically to close that gap. The quota systems hitting pre-charged equipment were tightened, and 23 additional f-gases were brought into scope.

THE ACCELERATED PHASE DOWN · EU-WIDE HFC QUOTA

82.3
million metric tons CO_2-eq
2023 baseline

42.9
million metric tons CO_2-eq
2025–2026 · a 48% cut versus 2023

21.7
million metric tons CO_2-eq
2027–2029, stepping down toward 2050

The 2024 EU F-gas Regulation has accelerated the HFC phase down considerably: The EU-wide quota falls from 82.3 million metric tons CO_2-equivalent (2023 baseline) to approximately 42.9 million metric tons CO_2-eq for 2025–2026 (a 48% cut versus 2023), roughly 21.7 million metric tons CO_2-eq for 2027–2029 and continues stepping down toward a full ban on placing HFC equipment on the market from 2050.

Beyond the overall quota, Annex IV of the Regulation sets a series of GWP-based placing-on-the-market bans that directly impact commercial chillers and heat pumps:

ANNEX IV · GWP-BASED PLACING-ON-THE-MARKET BANS

750 from Jan 2027	Stationary chillers with a rated capacity of above 12kW (3.4TR): GWP limit of 750 starting January 2027, unless the equipment is required to meet safety requirements at the installation site.
150 from Jan 2027	Self-contained air-conditioning equipment and monobloc heat pumps with a capacity of 12–50kW (3.4–14.2TR): GWP limit of 150 from January 2027.
150 from Jan 2030	“Other” self-contained air-conditioning equipment and heat pumps (broadly, larger self-contained/monobloc units and units outside the 12–50kW band): GWP limit of 150 from January 2030 with a fallback GWP limit of 750 where site safety requirements preclude the use of a lower-GWP refrigerant.
750 → 150 2029 → 2033	Split air-conditioning systems and split heat pumps above 12kW: GWP limit of 750 from 2029, tightening to 150 from 2033.

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- REFRIGERATION CONDENSER

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- R290 AIR TO WATER/BRINE TO WATER
- STEAM HEAT PUMP

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These thresholds are the primary driver of the technology transition this report tracks. They set the dates by which HFC- and most HFC/HFO-blend chillers and heat pumps above the relevant GWP ceiling can no longer be legally placed on the EU market, and they explain why manufacturers are reengineering product lines around natural refrigerants.

For manufacturers of natural refrigerant equipment, the practical effect of the 2024 EU F-gas Regulation is to convert what was, under the 2014 version, a gradually rising cost and compliance burden on synthetic refrigerants into a series of hard market-access deadlines. The heat pump capacity thresholds in Annex IV align closely with the 30–400kW capacity range that is the focus of this report, and which for chillers is even narrower.

This means that by the early 2030s the large majority of new commercial chillers and heat pumps sold in this range will need to use a refrigerant with a GWP at or below 150. This is a ceiling that synthetic HFC/HFO blends may struggle to meet without moving into PFAS-scrutinized HFO territory.

2.4 The EU PFAS Restriction Under REACH

The F-gas Regulation does not itself restrict HFOs, which with a near-zero GWP are capable in principle of meeting the aforementioned GWP≤150 thresholds. A separate, parallel regulatory process, the proposed universal restriction on PFAS under the EU's REACH Regulation, is what makes the medium-term future of HFOs considerably less certain.

The restriction proposal, submitted to the European Chemicals Agency on January 13, 2023, by the national authorities of Denmark, Germany, the Netherlands, Norway and Sweden, defines PFAS broadly as any substance containing at least one fully fluorinated methyl or methylene carbon atom. Under this structural definition, most HFO refrigerants used or proposed for use in chillers and heat pumps (for example R1234yf, R1234ze and blends built on them) fall within the proposal's scope, as do many HFC/HFO blends.[1]

The proposal has moved through two rounds of scientific committee review since submission:

Mar–Sep 2023 — The first six-month public consultation ran from March 22 to September 25, 2023, generating a large volume of stakeholder input (more than 5,500 comments).

Mar 2, 2026 — ECHA's Committee for Risk Assessment (RAC) adopted its final opinion on March 2, 2026, endorsing a broad, comprehensive restriction. It rejected industry calls to exclude volatile f-gases and fluoropolymers on the grounds that their manufacturing and end-of-life emissions present an unmanageable long-term environmental risk.

Mar 10, 2026 — The ECHA's Committee for Socio-Economic Analysis (SEAC) announced a draft opinion on March 10, 2026, and published it for a second, 60-day public consultation on March 26, 2026. It confirms that a broad restriction is appropriate but reframes several sector-specific derogations proposed by the original dossier submitters on proportionality grounds. This includes derogations for refrigerants in low-temperature refrigeration and HVAC&R equipment installed in buildings where national safety standards or building codes prohibit the use of alternative (e.g., flammable or toxic) refrigerants.

Several legal commentators note that the SEAC's draft opinion found the HVAC&R-specific derogations proposed by the dossier submitters “not justified” as drafted. This was on the basis that a blanket safety-standard carve-out would be too broad and administratively unworkable. The SEAC has instead proposed narrower, time-limited derogations. The general-use HVAC&R derogation that industry associations had sought, allowing the continued use of PFAS refrigerants wherever national safety codes prevent the use of a flammable or toxic alternative is, in the draft opinion as published, narrower and more conditional than initially proposed.

The SEAC is expected to finalize its opinion by the end of 2026. It will be transmitted along with the RAC's final opinion to the European Commission, which is then to prepare a draft amendment to Annex XVII of REACH. This is expected to occur within three months of receipt, and it will lead to a qualified-majority vote by member states in the REACH Committee (55% of member states representing at least 65% of the EU population).

Restrictions adopted under this route typically apply 18 months after entry into force, subject to whatever transition periods and derogations are ultimately agreed. On this timeline, a REACH Annex XVII PFAS restriction affecting refrigerant HFOs could realistically enter into force toward the end of this decade.

The interaction between the F-gas Regulation's GWP≤150 thresholds and a prospective PFAS restriction on HFOs is the single most important source of regulatory uncertainty facing commercial chillers and heat pumps with synthetic low-GWP refrigerants. If both instruments proceed broadly as currently drafted, manufacturers of commercial chillers and heat pumps would face a narrowing set of compliant synthetic options by the early-to-mid 2030s.

> **Given this, natural refrigerants would not be a compromise or a niche fallback option but rather the technology best positioned to meet both regulatory challenges at once, cutting climate impact and eliminating persistent chemical pollution in a single transition.**

2.5 Ecodesign and Energy Labelling

Chillers and heat pumps are subject to EU product efficiency legislation under the Ecodesign framework and the Energy Labelling Regulation. These set minimum energy performance requirements and, for many product categories, a comparative efficiency label. They interact with refrigerant choice because seasonal efficiency calculations are sensitive to the thermodynamic properties of the refrigerant used and to how systems are tested.

Two different regulatory categories, or lots, are most relevant to this report's scope:

ENER Lot 1

Space and combination heaters, which cover hydronic heat pumps used for space heating, including many of the systems installed in multifamily and non-residential buildings.

ENER Lot 2

Water heaters and hot water storage tanks, which cover heat pump water heaters providing domestic hot water in the same building types.

Both regulatory pairs date to 2013 and are currently under review. The revision is expected to tighten minimum efficiency requirements, extend scope to hybrid heat pumps and modernize test methods.[2]

A separate, related workstream covers commercial refrigeration and, indirectly, chillers: a public consultation on Ecodesign and Energy Labelling requirements for commercial refrigeration opened on December 4, 2025, and industry associations have pressed the Commission to keep scope, test conditions and label design consistent across the heater, water heater and chiller/cooling dossiers, including proposals to extend combined heating-and-cooling products up to 1MW (284TR) heating and 2MW (568TR) cooling capacity under a single framework.

None of this legislation restricts refrigerant choice directly, but because natural refrigerant systems, particularly CO_2 transcritical and propane units, can post efficiency advantages at part-load and in free-cooling operation, the specific test methods and load profiles ultimately adopted will influence how competitive natural refrigerant equipment appears on the resulting energy label.

2.6 Buildings and Energy Policy

2.6.1 The Energy Performance of Buildings Directive (Recast)

The modified Energy Performance of Buildings Directive (EPBD) entered into force across the EU on May 28, 2024. Member states were required to incorporate it into national law by May 2026.[3] It is the principal EU instrument driving demand for commercial heat pumps through several mechanisms.[4]

2028 · 2030	A phased zero-emission building requirement: New public buildings from 2028 and all new buildings from 2030 must meet a zero on-site emissions standard, which in practice pushes new-build heating and cooling toward electric heat pumps.
2025 · 2040	An end to public financial incentives for new stand-alone fossil-fuel boilers from January 2025 and a requirement for each member state's national building renovation plan to include a roadmap toward a full phase out of fossil fuel boilers by 2040. This is an indicative rather than binding EU-wide date, but one several member states have already chosen to bring forward nationally.
2028 · 2030	Whole-life carbon (embodied plus operational) reporting requirements, phased in for large new buildings from 2028 and all new buildings from 2030, which will increasingly draw attention to refrigerant-related emissions (both direct leakage and the embodied footprint of refrigerant manufacture) alongside operational energy use. This framing favors natural refrigerants' negligible or zero direct-emissions profile relative to high-GWP alternatives.
Dec 31, 2026	Mandatory national building renovation plans, due in final form by December 31, 2026, which set out member states' pathways for the non-residential and multifamily building stock.

2.6.2 The Renewable Energy Directive and Heat Pumps as Renewable Heat

The revised Renewable Energy Directive sets a binding EU-wide target of at least a 49% renewable energy share in the buildings sector by 2030 and requires member states to increase the share of renewable heating and cooling annually. Ambient heat captured by heat pumps counts toward this target.

The REPowerEU Plan's target of at least 30 million additional heat pump installations by 2030 is the clearest statement of the political priority placed on heat pump deployment. It is one reason the 2024 F-gas Regulation includes a safeguard mechanism specifically for heat pump HFC supply rather than applying the phase down uniformly across all equipment categories.

49%	30m
Renewable energy share in the buildings sector by 2030	Additional heat pump installations by 2030 under REPowerEU

2.6.3 REPowerEU and the Heat Pump Action Plan

REPowerEU, launched by the European Commission in May 2022 in direct response to the loss of Russian gas, is the broader energy security program within which the 30 million heat pump target sits. REPowerEU also called for a doubling of the annual heat pump deployment rate relative to the pre-2022 baseline and was accompanied by a dedicated EU Heat Pump Action Plan. This included non-regulatory measures, skills and training support, streamlined permitting for renewable heating installations and a call for member states to reduce electricity taxes and levies relative to those on gas to narrow the running-cost gap between heat pumps and fossil boilers.[5]

REPowerEU functions less as a source of binding equipment requirements than as the political anchor that other instruments discussed in this chapter refer back to. It is cited in the F-gas Regulation as a constraint on how aggressively the Commission can allow HFC supply to tighten. Funding for member states' recovery and resilience plans allocated under REPowerEU has co-financed national heat pump subsidy schemes that sit alongside other EU-level frameworks.

2.6.4 EU ETS2: Carbon Pricing for Building Heat

A second emissions trading system (ETS2) extends EU carbon pricing for the first time to fuel combustion in buildings and road transport sectors. ETS2 is an upstream system: The obligation to surrender allowances falls on fuel suppliers rather than on building owners or occupiers directly. However, the cost is expected to pass through to end users via fuel prices, giving oil- and gas-fired heating a rising carbon cost compared to natural refrigerant heat pumps running on electricity.[6]

ETS2 was originally due to become fully operational, with certificate surrender obligations, from 2027. In late 2025 the Council of the EU and European Parliament agreed to postpone this to 2028, citing concerns about energy affordability. Monitoring and reporting obligations did begin in 2025, and full auctioning and price discovery are expected from 2027 ahead of the first compliance surrender in 2028. A Social Climate Fund, financed in part by ETS2 auction revenue, will be used partially to co-finance building renovation and clean-heating investments, including heat pumps.[7]

ETS2 is best understood as a demand-side complement to the F-gas Regulation's supply-side restrictions. Where the F-gas Regulation constrains what refrigerant a new chiller or heat pump may use, ETS2 is designed to make the fossil-fired alternative to a heat pump progressively more expensive to run, reinforcing the underlying investment case for electrified, natural refrigerant-based equipment.

2.6.5 The Net-Zero Industry Act

The Net-Zero Industry Act (NZIA), adopted in 2024 as part of the Green Deal Industrial Plan, designates heat pumps and geothermal energy as one of eight priority “strategic net-zero technologies.” They are eligible for the Act's fastest permitting tracks, “net-zero strategic project” status and preferential access to public and private financing instruments. The NZIA sets an EU-wide ambition of manufacturing at least 40% of the strategic net-zero technologies the EU needs domestically by 2030.[8]

The NZIA is industrial rather than product policy. It does not set GWP limits, efficiency requirements or safety rules and does not by itself favor natural over synthetic refrigerant equipment. Formally classifying heat pump manufacturing as strategically important gives EU heat pump and chiller manufacturers (including natural refrigerant specialists) a claim on streamlined permitting for new or expanded factories, on public procurement and financing criteria.

40%

Of the strategic net-zero technologies the EU needs, to be manufactured domestically by 2030

1 of 8

Heat pumps and geothermal energy among the priority strategic technologies

2.7 Safety and Performance Standards

Regulation sets what refrigerants may be placed on the market and by when. Standards determine how equipment using those refrigerants may be safely designed, installed, operated and serviced. Because most natural refrigerants used under this report's scope are either flammable, toxic in high concentrations or operate at high pressure, standards compliance is often the binding constraint on deployment even where the underlying refrigerant is fully compliant with the F-gas Regulation and REACH.

2.7.1 EN 378 and the Refrigerant Safety Classification System

EN 378 is the principal European safety standard for stationary refrigeration and heat pump equipment. It sets maximum refrigerant charge limits by occupancy category and machinery room ventilation requirements, based on the ISO 817/ASHRAE 34 safety classification system.[9] Under this classification, CO_2 is A1 (non-flammable), propane and isobutane are A3 (higher flammability), and ammonia is B2L (toxic, lower flammability).

EN 378's charge limits historically constrained propane and ammonia systems to relatively low refrigerant charges in occupied spaces, which pushed early natural refrigerant chiller and heat pump designs toward smaller, modular or outdoor-only configurations. EN 378 is periodically revised to reflect updated risk assessments and field experience, and recent revisions have progressively raised permissible charge limits for flammable refrigerants in several applications.

A1

CO_2 — non-flammable

A3

Propane and isobutane — higher flammability

B2L

Ammonia — toxic, lower flammability

2.7.2 IEC 60335-2-40 and Product Safety

IEC 60335-2-40 sets the detailed appliance-level safety requirements that apply alongside EN 378's system-level requirements. These include maximum charge, leak detection, ventilation and ignition-source control for flammable refrigerants. Successive editions of the standard have specifically addressed the growing use of flammable refrigerants in heat pumps and air-conditioning equipment, and manufacturers' ability to bring higher-charge propane or flammable HFO/HFC-blend systems to market has depended directly on these editions keeping pace with F-gas Regulation-driven refrigerant transitions.[10]

2.7.3 F-Gas Technician Certification

Both the 2014 and 2024 F-gas Regulations require technicians who install, service, maintain, repair or decommission equipment containing f-gases to hold a national certification. The 2024 regulation extended this certification logic to alternative refrigerants used as substitutes, requiring member states to ensure appropriate training is available for technicians working with flammable, toxic or high-pressure natural refrigerants. Industry associations have flagged this as a practical bottleneck to natural refrigerant deployment. Notwithstanding the underlying equipment regulation, the scale of retraining required across the existing HVAC&R installer base is formidable.

2.7.4 ATEX and Explosion-Protection Requirements

Chillers and heat pumps using hydrocarbon refrigerants at charges or in configurations where EN 378's ventilation and charge-limit provisions alone are not judged sufficient to eliminate an explosive atmosphere risk fall additionally within the scope of the EU's ATEX framework and Directive 1999/92/EC on employer obligations for workplaces where explosive atmospheres may occur.

In practice, most commercial hydrocarbon chillers and heat pumps in the 30–400kW range are designed to keep refrigerant charge and ventilation within EN 378 limits specifically so as to avoid ATEX-rated component costs. ATEX classification becomes a live design consideration for larger hydrocarbon charges, indoor plant rooms with limited ventilation or non-standard installation configurations.

2.7.5 National and Local Variation in Safety Requirements

EN 378 and IEC 60335-2-40 set EU-harmonized minimum requirements. Member states, and in several cases individual municipalities or fire authorities, still retain discretion to impose additional local requirements on flammable or toxic refrigerant equipment. These could include stricter machinery room location rules for ammonia systems near occupied buildings, additional permitting for hydrocarbon charge thresholds or fire brigade notification requirements for larger installations.

This local layer is the practical mechanism behind the safety-requirement exemptions referenced throughout the F-gas Regulation's Annex IV thresholds and, prospectively, in the PFAS restriction's HVAC&R derogation debate. Where a national or local safety authority will not permit a flammable or toxic natural refrigerant charge sufficient for a given application, a synthetic refrigerant with a higher GWP limit remains available under both regimes. National and local safety code variation is therefore one of the more durable sources of country-level difference in natural refrigerant uptake, independent of the EU-level regulatory trajectory described elsewhere in this chapter.

Notes

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2 European Commission, December 1, 2025, "Ecodesign and Energy Labelling: Commission Consults on Revised Rules for Space and Water Heaters," https://energy.ec.europa.eu/news/ecodesign-and-energy-labelling-commission-consults-revised-rules-space-and-water-heaters-2025-12-01_en

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Chapter 3
Market Data

3. Market Availability and Installation Data

3.1 Introduction and Scope

This chapter examines the market availability of commercial chillers and heat pumps using natural refrigerants. Data on market availability was gathered from the websites and product brochures of manufacturers who sell their products in Europe. In total data was gathered on more than 300 products from more than 65 manufacturers. Note that these are estimated totals as of August 2026.

Market availability data is broken down into four equipment types: chillers, heat pumps, reversible heat pumps and four-pipe/polyvalent heat pumps. Note that the classification of products is based on how manufacturers advertise them on their websites and in their catalogs. This means that some products are counted in multiple categories if a manufacturer explicitly advertises them as such: for example a heat pump that is also available in a reversible or four-pipe configuration.

This chapter also provides estimates on the number of commercial natural refrigerant chillers and heat pumps installed in Europe (the installed base) as of December 2025. These estimates were informed by data gathered from manufacturers through surveys and interviews. In addition, desk research was also conducted, with data gathered from news articles, year-end financial and sustainability reports, and marketing material.

THE CHAPTER IN NUMBERS

Market availability was surveyed from manufacturer websites and product brochures across Europe, with estimated totals as of August 2026. The installed-base estimates that close the chapter are as of December 2025.

300+	65+	4	28k
PRODUCTS SURVEYED	MANUFACTURERS	EQUIPMENT TYPES	INSTALLED BASE, DEC. 2025

3.2 Market Availability: Commercial Chillers with Natural Refrigerants

ATMOsphere found 131 commercial chillers using natural refrigerants available in Europe. These chillers were placed on the market by more than 40 different manufacturers. Propane (58.8%) and ammonia (33.6%) are the top refrigerants used, and there are more air-cooled chillers (68%) than water-cooled chillers (32%). Propane is the dominant refrigerant choice in air-cooled chillers (66%) while ammonia is the dominant refrigerant choice in water-cooled chillers (57%).

The infographics below show the coverage across the 30–400kW capacity range by refrigerant for both air- and water-cooled chillers. The entire range is well-served by natural refrigerants across both air-cooled and water-cooled chillers. Despite the flammability risk, propane is prominent throughout the capacity spectrum for water-cooled chillers in the lower and mid-tier range, with ammonia asserting itself at the higher end (300kW+).

ATMOsphere Commercial Chillers and Heat Pumps Product Database, August 2026.

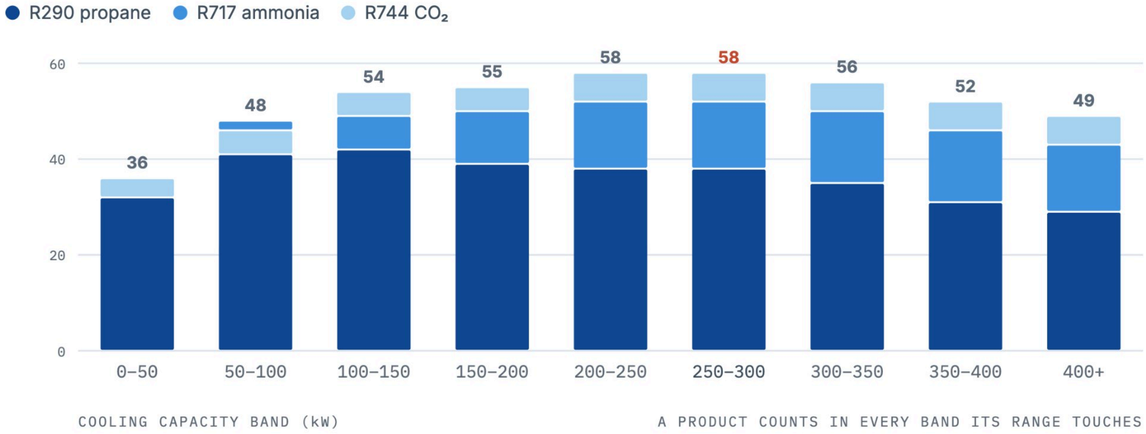
FIGURE

Air-cooled chillers

Cooling capacity coverage by refrigerant

58

products can serve the 250–300 kW band — the best-covered band for this equipment type.



ATMO sphere

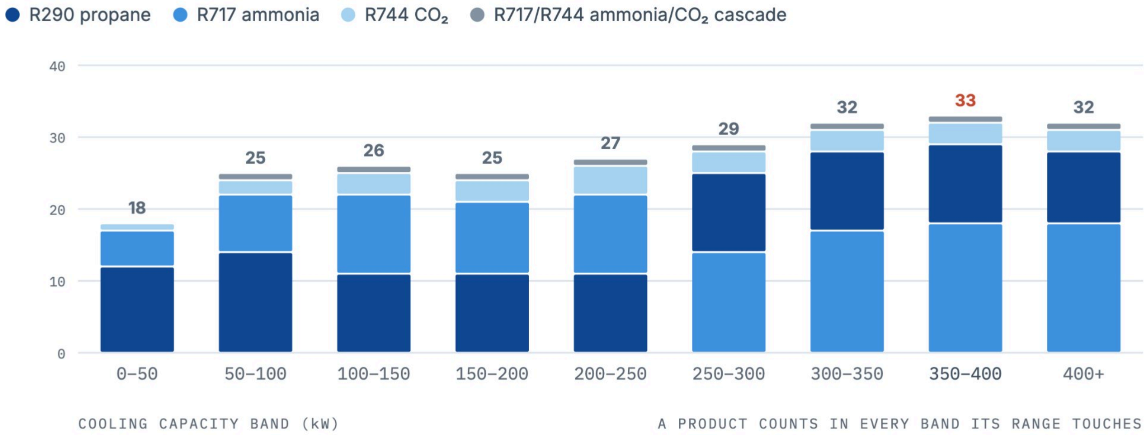
FIGURE

Water-cooled chillers

Cooling capacity coverage by refrigerant

33

products can serve the 350–400 kW band — the best-covered band for this equipment type.



ATMO sphere

ATMOsphere Commercial Chillers and Heat Pumps Product Database, August 2026. Ranges are assumed continuously achievable within a product line, consistent with the modular/stepped design common in this market; coverage in the upper bands (350kW+) is somewhat less certain as manufacturer model steps tend to widen at higher capacities.

3.2.1 MANUFACTURER SPOTLIGHT

Enex Technologies

Enex Technologies is the parent company of eight different HVAC&R equipment manufacturers, including several that specialize in natural refrigerant chillers and heat pumps. In 2022 it acquired the Emicon Group, which manufactured propane heat pumps and chillers.[1] That same year it acquired ammonia chiller manufacturer Samifi France,[2] and in 2023 it expanded its ammonia offerings with the acquisition of EOS Refrigeration, which produced ammonia heat pumps and chillers.[3]

Enex Technologies' current product lineup includes low-charge air-cooled ammonia chillers, air-cooled and water-cooled propane chillers, and an air-cooled CO_2 chiller. It also offers air-to-water propane and air-to-water and water-to-water CO_2 heat pumps.

In August 2025 Massimiliano Sfragara, Enex Technologies' Product Management Director, said the company was keeping an eye on trends in low-charge propane and ammonia chillers.[4] The year before it presented the results of a simulation at the Data Center Nation event in Milan showing the energy efficiency of ammonia chillers in data center cooling applications.

Enex Technologies has been building commercial chillers and heat pumps for more than a decade. In 2017 it provided CO_2 chillers for Italian wineries used for process cooling and heating along with comfort cooling in offices.[5] In 2022 four of its CO_2 heat pumps with a total capacity of 1.6MW (455TR) were installed at a hotel in Sicily and provided space heating, air-conditioning and domestic hot water.[6]

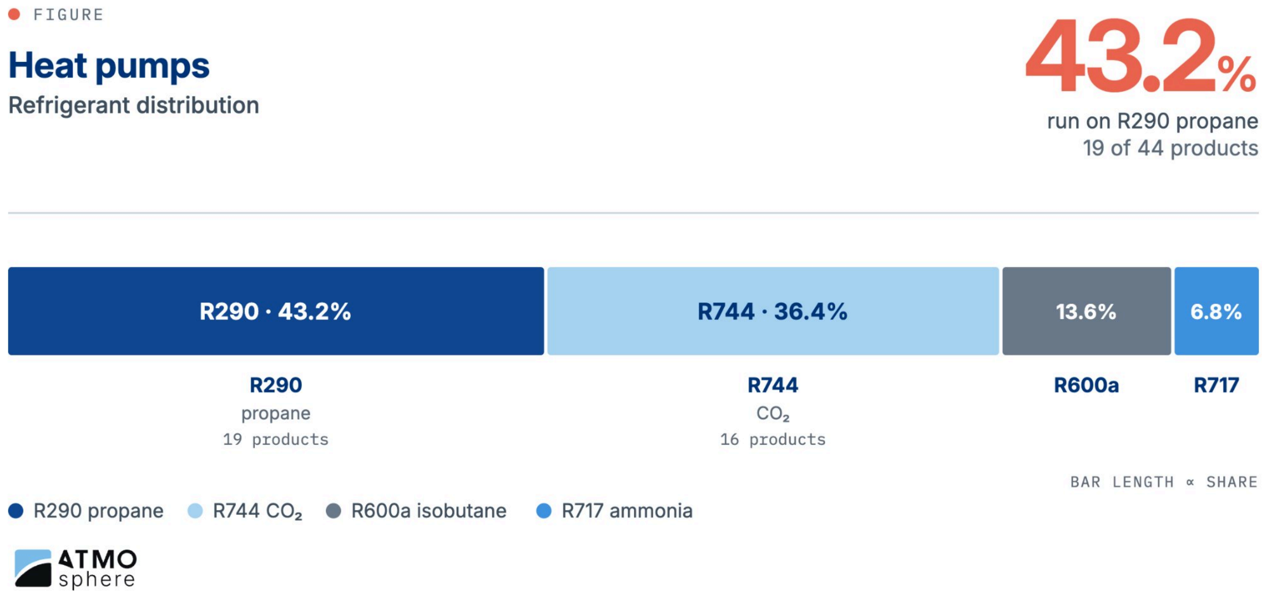
3.3 Market Availability: Commercial Heat Pumps with Natural Refrigerants

ATMOsphere found 44 commercial natural refrigerant-based heat pumps from 23 different manufacturers available in Europe. Unlike with chillers, there is a much higher diversity of refrigerants: propane (43.2%), CO_2 (36.4%), isobutane (13.6%) and ammonia (6.8%). The split between air-source and water-source heat pumps was 66% to 34%.

3.3 continued — refrigerant mix by source type

Propane (55%) and CO_2 (41%) are the top refrigerants for air-source heat pumps, and for water-source heat pumps the top refrigerants are isobutane (33%), CO_2 (26%) and ammonia (20%). The refrigerant mix for heat pumps is much more diverse than for chillers in general, although it becomes less so when split out among air-source and water-source heat pumps.

Notably, though, there are far fewer commercial heat pumps with natural refrigerants on the market (heating only) than chillers. While the entire 30–400kW capacity range is covered, it's by only a few manufacturers and a relative handful of heat pumps.



ATMOsphere Commercial Chillers and Heat Pumps Product Database, August 2026.

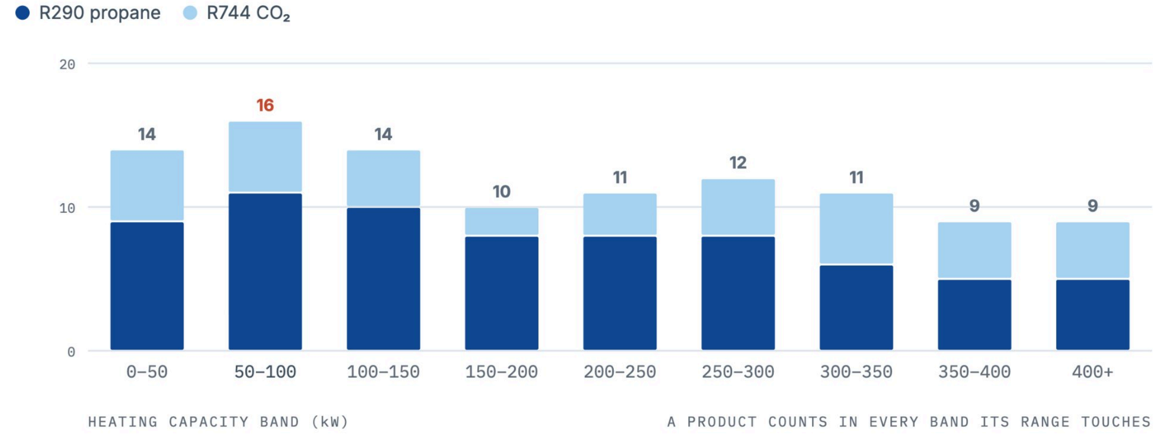
FIGURE

Air-to-water heat pumps

Heating capacity coverage by refrigerant

16

products can serve the 50–100 kW band — the best-covered band for this equipment type.



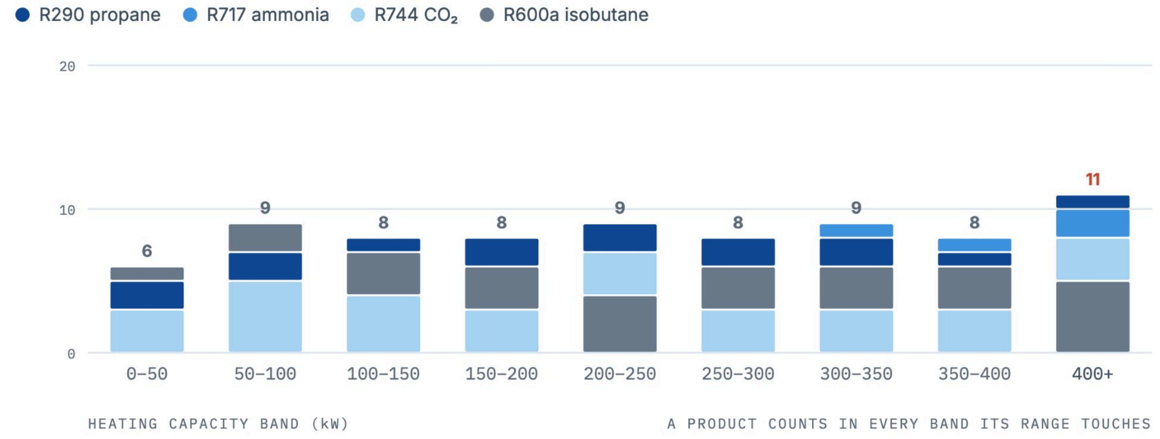
FIGURE

Water-to-water heat pumps

Heating capacity coverage by refrigerant

11

products can serve the 400+ kW band — the best-covered band for this equipment type.



ATMOsphere Commercial Chillers and Heat Pumps Product Database, August 2026. Ranges are assumed continuously achievable within a product line, consistent with the modular/stepped design common in this market; coverage in the upper bands (350kW+) is somewhat less certain as manufacturer model steps tend to widen at higher capacities.

3.3.1 MANUFACTURER SPOTLIGHT

Mitsubishi Heavy Industries

When Mitsubishi Heavy Industries established a European office in London in 2013, very few companies were selling commercial CO_2 heat pumps.[7] Despite this MHI saw an opportunity for the Q-ton, a CO_2 heat pump designed to produce domestic hot water in commercial buildings.

The Q-ton quickly found a market. At ATMOsphere Europe 2015 MHI said it had installed Q-tons in an office block in Germany, hotels in Spain and the U.K., and a student residence in the U.K.[9] The company said its sales grew by 40% between 2021 and 2022,[10] and ATMOsphere estimates more than 100 Q-tons have been installed in Europe as of 2025.

The Q-ton has a capacity of 30kW, and up to 16 units can be coupled together to increase its total heating capacity to 480kW (136TR).[8] It can produce hot water at 90°C (194°F) in ambient temperatures as low as –25°C (–13°F).

More recently three Q-tons with a capacity of 90kW (25.5TR) were installed at a newly built Adagio Hotel in London to provide domestic hot water to its 140 rooms.[11] The hotel's hot water system had to meet local regulations around carbon and NOx emissions along with Adagio's own sustainability goals, which is why MHI's CO_2 heat pumps were chosen.

THE Q-TON AT A GLANCE

Mitsubishi Heavy Industries' CO_2 heat pump for commercial domestic hot water, as described above — capacity when cascaded, delivery temperature at its lowest rated ambient, and ATMOsphere's estimate of European installations.

480kW	90°C	100+
16 UNITS COUPLED	HOT WATER AT –25°C AMBIENT	Q-TONS INSTALLED IN EUROPE, 2025

3.4 Market Availability: Commercial Reversible Heat Pumps with Natural Refrigerants

ATMOsphere found 91 reversible commercial heat pumps using natural refrigerants from 37 different manufacturers available in Europe. Propane (97.8%) is the top refrigerant for this equipment type. The split between air-source and water-source is 74% to 26%.

All reversible air-source heat pumps in the database use propane refrigerant. Propane (86%) is also the dominant refrigerant among reversible water-source heat pumps.

The infographics below show the heating and cooling capacity ranges of the reversible heat pumps in the database. There are similar patterns between the two heat pump types. There are more air-source units in the lower capacity ranges than water-source units, and the number of heat pumps in each capacity band drops off sharply for both at the 150–200kW capacity band.

FIGURE

Reversible heat pumps

Refrigerant distribution

97.8%

run on R290 propane

89 of 91 products

R290

propane

89 products

Remainder: R744 CO_2 1.1% (1 product) · R717 ammonia 1.1% (1 product)

BAR LENGTH ∝ SHARE

● R290 propane ● R744 CO_2 ● R717 ammonia

ATMOsphere Commercial Chillers and Heat Pumps Product Database, August 2026.

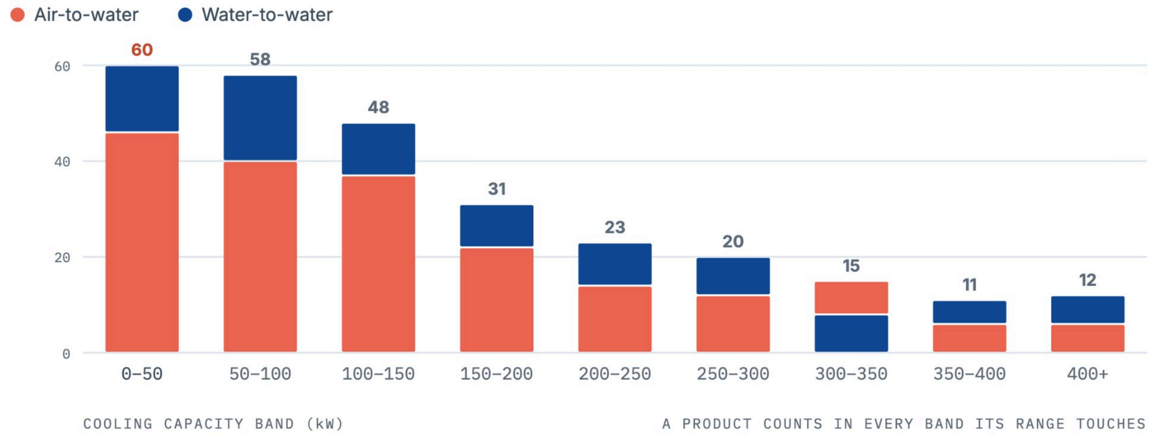
FIGURE

Reversible heat pumps

Cooling capacity coverage by source type

60

products can serve the 0–50 kW band — the best-covered band for this equipment type.



ATMO sphere

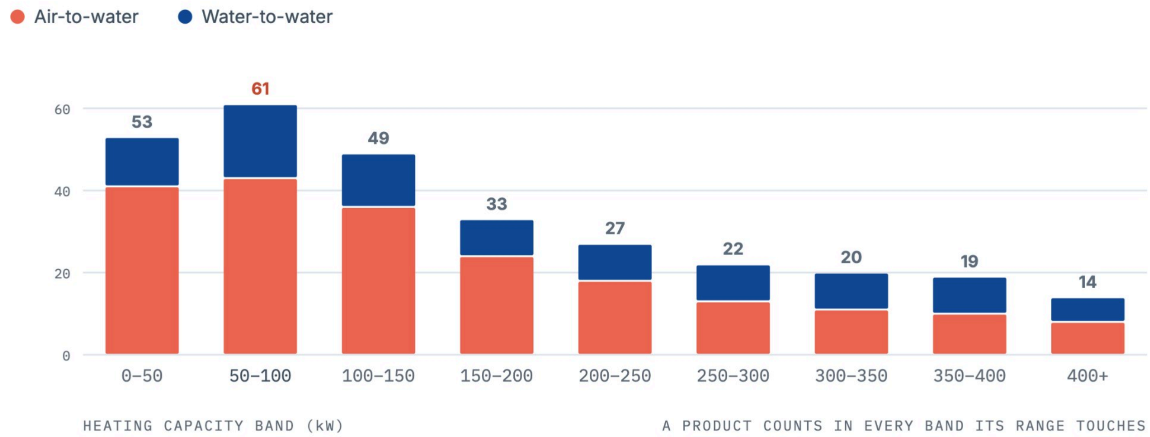
FIGURE

Reversible heat pumps

Heating capacity coverage by source type

61

products can serve the 50–100 kW band — the best-covered band for this equipment type.



ATMO sphere

ATMOsphere Commercial Chillers and Heat Pumps Product Database, August 2026. Ranges are assumed continuously achievable within a product line, consistent with the modular/stepped design common in this market; coverage in the upper bands (350kW+) is somewhat less certain as manufacturer model steps tend to widen at higher capacities.

3.4.1 MANUFACTURER SPOTLIGHT

Enerblue

Enerblue built its first commercial CO_2 heat pump in 2012 and first propane chiller in 2013. Since then the company has gone on to sell more than 1,000 commercial propane chillers and heat pumps globally as of 2024.[12]

The first installation of an Enerblue propane system was in 2014 at a hotel in the Nordics, and as of 2024 more than 220 of its propane chillers and heat pumps were installed in the region, including six at the university of Oslo.[13] In 2025 another Enerblue propane chiller was installed in Oslo as part of the net-zero retrofit of a Radisson hotel for comfort cooling.[14]

900kW

SPACE HEATING, FOUR CASCADED PROPANE HEAT PUMPS, 2025

In 2025 four of the company's air-to-water propane heat pumps were connected in cascade to provide 900kW (255TR) of space heating to a 27,000m² (290,630ft²) railway maintenance hub in Europe.[15] The heat pumps replaced a gas boiler and, in conjunction with existing solar panels and insulation upgrades, cut the facility's annual CO_2e emissions by up to 90%.

3.4.2 MANUFACTURER SPOTLIGHT

Skadec

In 2013 the Kratschmayer Gruppe, a German HVAC&R installer, began researching natural refrigerant chillers and heat pumps. The company commissioned its first propane chiller in 2016 and in 2018 it founded Skadec, which exclusively manufactures commercial propane and isobutane heat pumps and chillers.

Its units range in size from a compact water-cooled chiller with 13kW (3.6TR) of cooling capacity to an air-cooled chiller with 1.5MW (426TR) of cooling capacity. Skadec also manufactures several water-cooled chillers and water-source heat pumps, pushing back on the notion that flammable refrigerants can't safely be used indoors. In July of 2025 the company said its most-popular products included four-pipe heat pumps for commercial applications, compact indoor chillers in cascade setups and systems specified with free cooling and heat recovery.[16]

1.4MW

HEATING PLUS 970KW COOLING, THREE REVERSIBLE PROPANE HEAT PUMPS, NORWAY

Skadec's propane products have been installed across Europe, with recent projects in Vienna and Norway.[17] In Vienna an air-source Skadec propane heat pump offering simultaneous heating and cooling replaced the gas heating system at Vienna's Austrian Museum of Folk Life and Folk Art. In Norway three Skadec reversible propane heat pumps provide 1.4MW (398TR) of heating and 970kW (275TR) of cooling at a retail shopping center.

3.5 Market Availability: Commercial Four-Pipe/Polyvalent Heat Pumps with Natural Refrigerants

ATMOsphere found 41 commercial natural refrigerant-based four-pipe/polyvalent heat pumps from 24 different manufacturers available in Europe. This equipment type is split between three refrigerants: CO_2 (56.1%), propane (36.6%) and ammonia (7.3%). The split between air-source and water-source is 65% to 35%.

There is a split between propane (51%) and CO_2 (48%) for air-source four-pipe/polyvalent heat pumps. For water-source four-pipe/polyvalent heat pumps the refrigerant mix is: CO_2 (71%), ammonia (21%) and propane (7%).

For air-source four-pipe/polyvalent heat pumps CO_2 and propane are present across the capacity spectrum. The majority of cooling and heating capacity is on the lower-to-middle part of the spectrum from 50–250kW. Ammonia joins CO_2 and propane in the refrigerant mix for water-to-water four-pipe/polyvalent heat pumps, albeit in small numbers, with this equipment category made up primarily of systems using R744. However, like with heat pumps, the total sample size is small relative to other equipment types mentioned in this chapter.

FIGURE

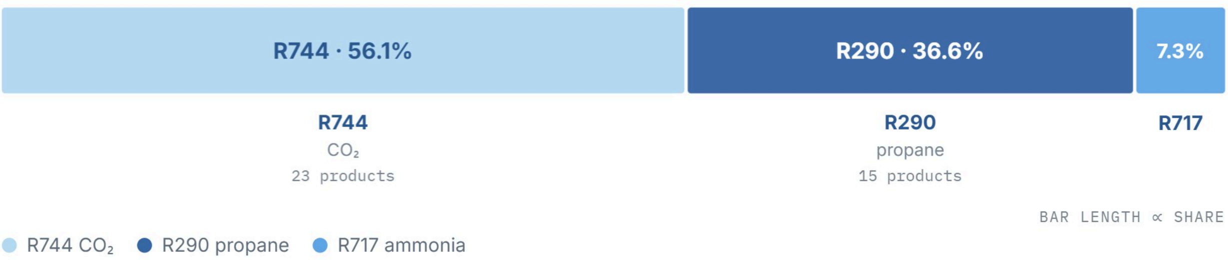
Four-pipe/polyvalent heat pumps

Refrigerant distribution

56.1%

run on R744 CO_2

23 of 41 products



ATMOsphere

ATMOsphere Commercial Chillers and Heat Pumps Product Database, August 2026

ATMOsphere Commercial Chillers and Heat Pumps Product Database, August 2026.

3.5 continued — capacity coverage by refrigerant

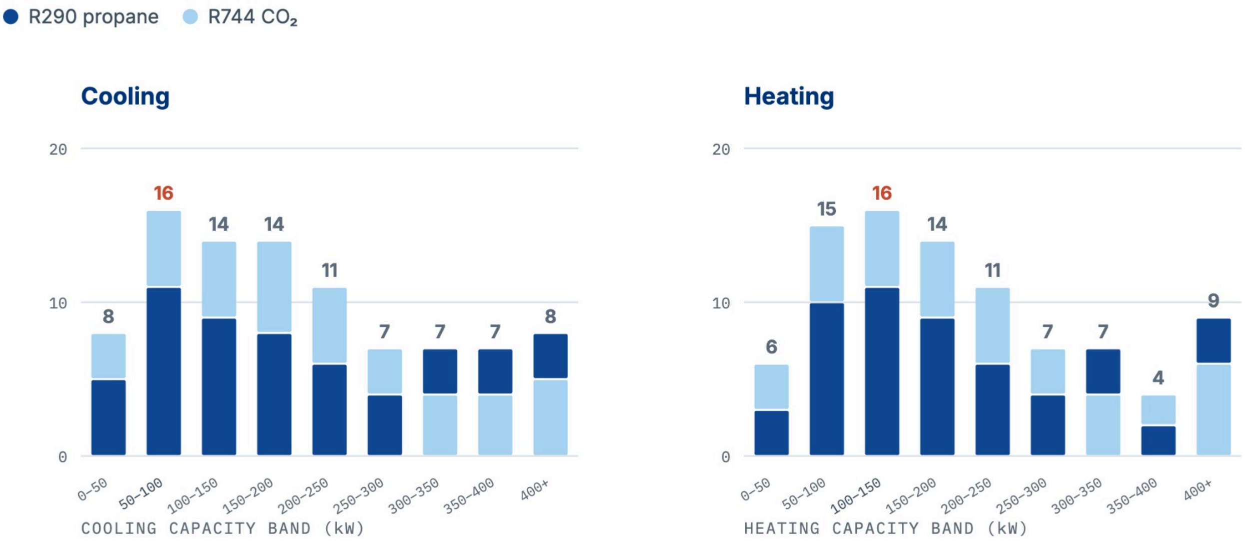
FIGURE

Air-to-water four-pipe/polyvalent heat pumps

Capacity coverage by refrigerant

16

16 products can serve the 50-100 kW cooling band, and the same number cover 100-150 kW for heating.



A PRODUCT COUNTS IN EVERY BAND ITS RANGE TOUCHES

ATMOsphere Commercial Chillers and Heat Pumps Product Database, August 2026. Ranges are assumed continuously achievable within a product line, consistent with the modular/stepped design common in this market; coverage in the upper bands (350kW+) is somewhat less certain as manufacturer model steps tend to widen at higher capacities.

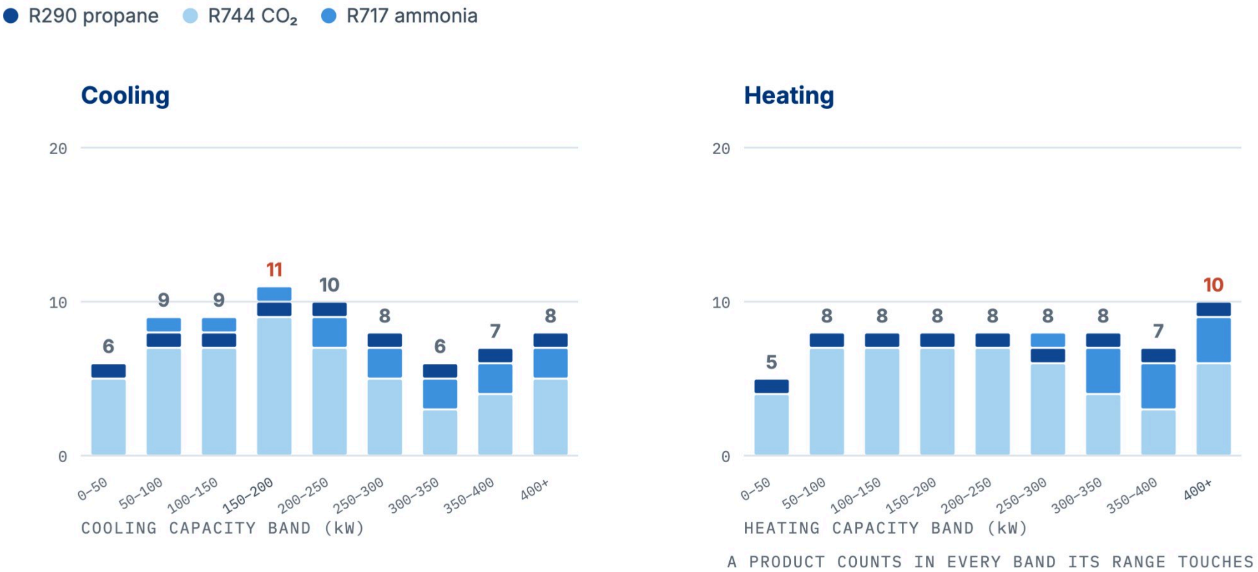
FIGURE

Water-to-water four-pipe/polyvalent heat pumps

Capacity coverage by refrigerant

11

11 products can serve the 150–200 kW cooling band; heating coverage peaks at 10 products in the 400+ kW band.



ATMOsphere Commercial Chillers and Heat Pumps Product Database, August 2026. Ranges are assumed continuously achievable within a product line, consistent with the modular/stepped design common in this market; coverage in the upper bands (350kW+) is somewhat less certain as manufacturer model steps tend to widen at higher capacities.

3.5.1 MANUFACTURER SPOTLIGHT

Euroklimat

At Chillventa 2024, Italian manufacturer Euroklimat announced that it had sold more than 3,000 commercial propane chillers and heat pumps in Europe in total.[18] The company began manufacturing propane chillers in 2006 and today it offers a full range of R290 air-cooled chillers with capacity ranges from 30–1,000kW (8.5–284TR).

Euroklimat built its first propane heat pump in 2018, which debuted at that year's Chillventa. Today it manufactures air-to-water heat pumps and water-to-water heat pumps – both reversible and four-pipe/polyvalent units – with capacity ranges from 30–700kW (8.5–199TR). Michele Bedin, CEO of Euroklimat, said in 2024 that the company has not had a problem or accident involving one of its propane products.

End users of Euroklimat's propane chillers and heat pumps in Europe include cheese producers, pharmaceutical companies and supermarkets.[19] In 2024 Celine Lach, President of the CTA Group, the parent company of Euroklimat, presented a case study of a Euroklimat propane heat pump used at a Heineken production facility in Puglia, Italy.[20]

3.5.1 continued — the Heineken case study

The beer manufacturer previously used a gas boiler and city water to meet the simultaneous heating and cooling demand of a pasteurization tunnel. A Euroklimat four-pipe water-to-water propane heat pump with a heating capacity of 185kW (52.6TR) and a cooling capacity of 135kW (38.3TR) was installed. Hot water is produced at 70°C (158°F) and cold water at 26°C (78°F), and the unit has a COP of 3.77. The propane heat pump has reduced the pasteurization tunnel's annual energy costs by 50%.

Celine Lach, President of the CTA Group, presenting the Heineken case study.

THE INSTALLED UNIT

The Euroklimat four-pipe water-to-water propane heat pump serving Heineken's pasteurization tunnel in Puglia, as described above.

185kW	135kW	3.77	–50%
HEATING CAPACITY	COOLING CAPACITY	COP	PASTEURIZATION TUNNEL ANNUAL ENERGY COSTS

3.6 Installation Data: Commercial Chillers and Heat Pumps with Natural Refrigerants

As of December 2025 ATMOsphere estimates there were 27,000 commercial propane chillers and heat pumps and 1,000 commercial CO_2 chillers and heat pumps installed in Europe. Combined these figures represent fewer than 5% of the total installed base of commercial chillers and heat pumps in Europe. Data could not be gathered for ammonia commercial chillers and heat pumps.

As propane and synthetic chillers share similar operating pressures, thermodynamic behaviors and components, R290 has thus become the go-to natural alternative in commercial chillers, especially in process cooling. The high-temperature heat recovery capabilities of CO_2 have made it a fit in integrated HVAC systems, and R744 has also established itself in commercial hot water heat pumps.

While propane and CO_2 commercial chillers and heat pumps have been on the market for more than a decade, the market conditions required to stoke their growth have only been present for a few years. The installed base of commercial natural refrigerant chillers and heat pumps should expand in the coming years as manufacturers seek future-proof and efficient equipment to replace aging HFC-based systems.

FIGURE · INSTALLED BASE

Propane

Commercial chillers & heat pumps installed in Europe

27,000

R290 · PROPANE

AS OF DECEMBER 2025 · MAP SHOWS EUROPEAN COVERAGE, NOT PER-COUNTRY DENSITY

ATMOsphere installed-base estimate, December 2025.

FIGURE · INSTALLED BASE

CO_2

Commercial chillers & heat pumps installed in Europe

1,000

R744 · CO_2

AS OF DECEMBER 2025 · MAP SHOWS EUROPEAN COVERAGE, NOT PER-COUNTRY DENSITY

ATMOsphere installed-base estimate, December 2025.

INSTALLED BASE · DEC. 2025

ATMOsphere's estimates for the European installed base, informed by manufacturer surveys and interviews alongside desk research. Data could not be gathered for ammonia commercial chillers and heat pumps.

27,000 PROPANE CHILLERS AND HEAT PUMPS INSTALLED, DEC. 2025	**1,000** CO_2 CHILLERS AND HEAT PUMPS INSTALLED, DEC. 2025	**<5%** OF THE TOTAL EUROPEAN INSTALLED BASE

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Deep Dive

Refra®

DEEP DIVE

After Sales Nearly Doubled in 2022, Demand for Refra's Propane Chillers and Heat Pumps Has Kept Growing

BY MICHAEL HINES

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100% of Refra's chiller and heat pump solutions are designed to operate with natural refrigerants.

IN CONVERSATION

Evaldas Kimso

Chief Commercial Officer, Refra

COMPANY PROFILE

Refra manufactures hydrocarbon-based chillers and heat pumps as well as transcritical CO_2 (R744) racks. The company was founded in 1994 and is headquartered in Vilnius, Lithuania.

FOUNDED **1994**	HEADQUARTERS **Vilnius, Lithuania**
HYDROCARBONS **R290 · R600a · R1270**	ALSO BUILDS **R744 racks**

40–50%

the rise in propane chiller and heat pump sales Refra recorded in 2022 against the previous year,

a near doubling of volume

For this Deep Dive ATMOsphere spoke with Evaldas Kimso, Chief Commercial Officer at Refra, about the company's chillers and heat pumps.

Can you briefly detail Refra's natural refrigerant chiller and heat pump lineup?

Evaldas Kimso: Refra offers a comprehensive portfolio of heat pumps utilizing propane [R290] and isobutane [R600a] as well as chillers based on propane and propylene [R1270]. Notably, 100% of Refra's chiller and heat pump solutions are designed to operate with natural refrigerants, reflecting the company's full commitment to environmentally responsible technologies.

What is currently driving demand for Refra's natural refrigerant chillers and heat pumps in Europe and why?

EK: Refra's natural refrigerant chillers and heat pumps are deployed across a broad spectrum of commercial and industrial applications, including manufacturing facilities, office buildings, educational institutions, HVAC systems, the automotive industry, district heating networks, processing plants and medical facilities.

Demand for these solutions has increased significantly over the past three to five years. Notably, 2022 marked a major inflection point, with sales of propane-based chillers and heat pumps increasing by approximately 40 to 50% compared to the previous year, a near doubling of volume. We've seen steady growth in subsequent years driven by rising demand for energy-efficient and sustainable solutions as well as evolving regulatory requirements.

What are the top drivers for the adoption of natural refrigerant commercial chillers and heat pumps in Europe?

EK: The adoption of natural refrigerant systems has been influenced by several key factors. Even prior to formal regulatory changes, market demand was driven by the superior energy efficiency and sustainability profile of these systems as well as rising costs and volatility associated with traditional heating fuels.

Additionally, growing awareness of the environmental impact of synthetic refrigerants and alignment with broader initiatives such as the European Green Deal have played a significant role. Following the latest updates to f-gas regulations, regulatory compliance has become an increasingly decisive driver, further accelerating adoption.

What are some of the barriers preventing the wider adoption of commercial natural refrigerant chillers and heat pumps, and how can these be overcome?

EK: Several challenges continue to influence the wider adoption of natural refrigerant systems. Safety concerns, particularly regarding the flammability of refrigerants such as propane and propylene, as well as the high operating pressures associated with CO_2 systems, have been the primary barriers. However, these concerns can be effectively mitigated through strict adherence to established safety standards, the integration of advanced safety mechanisms and a strong focus on manufacturing quality.

Another consideration is the higher initial investment compared to systems using synthetic refrigerants. While lifecycle cost benefits often offset this, upfront cost remains a factor in decision-making. Additionally, retrofitting existing infrastructure to accommodate natural refrigerant systems can present technical and logistical challenges. Addressing these barriers requires continued technological innovation, education and industry alignment on best practices.

One trend we've noticed is a growing demand for larger chillers and heat pumps from 500kW up to and exceeding 1MW. What is Refra's approach to meeting this demand: modularity or building larger individual units?

EK: Refra has long positioned itself as a highly flexible solutions provider with a core focus on delivering customized cooling and heating systems tailored to specific customer requirements. As such, high-capacity systems are a well-established area of expertise for the company.

In recent years, Refra has also introduced standardized product lines to reduce lead times and streamline procurement. These standardized units are designed with scalability in mind and can be modularized or configured in cascades to meet higher capacity demands. This hybrid approach, combining customization with modular standardization, enables Refra to efficiently address growing market needs in the 500kW [142TR] to 1MW+ [284TR+] range.

What trend or new development related to natural refrigerant chillers and heat pumps in Europe is Refra watching closely?

EK: Refra is closely monitoring the growing demand for high-temperature heat pumps utilizing natural refrigerants, particularly in the context of district heating applications. The company places strong emphasis on delivering verified, real-world performance, ensuring that systems can reliably achieve and sustain required outlet temperatures over extended periods rather than relying solely on nominal or catalog values. As a result, significant investment is being directed toward the development of robust, high-performance solutions capable of delivering consistent and uninterrupted heating.

In parallel, Refra is actively following developments in data center cooling, recognizing it as a rapidly evolving segment with increasing relevance for natural refrigerant technologies. These trends are directly shaping the company's product development roadmap and innovation priorities.

What do you see as the next industry in Europe to be disrupted by natural refrigerant commercial chillers and heat pumps and why?

EK: The next major disruption will likely be commercial building heating retrofits, especially hotels, offices, healthcare facilities, schools, public buildings and mixed-use properties moving from gas boilers and HFC chillers to R290 heat pump/chiller platforms.

Key Takeaways

- Refra saw a spike in sales of its propane chillers and heat pumps the same year the European Commission shared its proposal to revise the EU F-gas Regulation. The proposal, shared in April of 2022, included the phase out of HFCs in new equipment by 2050 and a cap on EU HFC production.

- Safety concerns about the flammability of hydrocarbon refrigerants and the high operating pressures of CO_2 remain barriers to adoption. Higher initial investment costs for natural refrigerant-based systems, despite their lower lifetime cost, remain a challenge as well.

- Refra's product roadmap is being shaped by two emerging applications for chillers and heat pumps, respectively: data center cooling and district heating.

Refra's propane heat pumps installed at the Solihull district energy network. Photo credit: 2025 Solihull Metropolitan Borough Council

CASE STUDY

Refra Provides Hydrocarbon Heat Pumps to Help an English Town Decarbonize Its District Heating Network

In 2025 six Refra hydrocarbon heat pumps totaling 1.6MW (454TR) of heating capacity were installed in the town of Solihull, England, to serve the town's district heating network. Five of the heat pumps are air-source and use propane refrigerant, and one is a water-source unit using isobutane.

INSTALLED HEATING CAPACITY

1.6MW

454TR across six heat pumps: five air-source propane units and one water-source isobutane unit

EXPANDABLE **to 3.2MW (909TR)**

HOT WATER TEMPERATURE

Up to 80°C

176°F

COMBINED SYSTEM COP

2.39

Powering the Commitment to Net-Zero

The heat pumps are part of a new district energy network that provides heat for space heating and domestic hot water, as well as electricity, to buildings within the Solihull town center. Solihull has a population of 126,000 and is located southeast of Birmingham.

Solihull has committed to reaching net-zero emissions by 2041, and the new district energy network is designed to help meet that goal. The heat pumps get their energy from a gas-powered combined heat and power (CHP) system, with the excess electricity distributed to customers.

FIVE PROPANE UNITS

171.6 kW

The five air-source propane heat pumps each have a heating capacity of 171.6kW (48.8TR) and a cooling capacity of 169.8kW (48.3TR). They have a COP of 4.64.

ONE ISOBUTANE UNIT

1.7 MW

The single water-source isobutane heat pump has a heating capacity of 1.7MW (483TR) and a cooling capacity of 1.3MW (370TR) with a COP of 4.48.

The system supplies hot water at 80°C (176°F) to the district heating network. To do so, the heat pumps work in a two-stage arrangement, with the propane units heating the isobutane heat pump's source water. Gas boilers are used as backup or to top-up the network as needed.

Challenges in the Urban Environment

The Solihull Energy Center is located within the town's center. As such, the heat pumps were subject to a noise limit of 60dB(A). The original plan to use three heat pumps was changed as the trio was too loud for the site, so five derated units were installed. Low-noise fans and double insulation helped get the heat pumps under the 60dB(A) limit while still delivering the required 1.6MW of heating.

Safety was also a concern given the use of flammable refrigerants in an urban area. The use of hydrocarbons required ATEX, DSEAR and EN 378 compliance along with certified gas detection and forced ventilation systems. The heat pumps Refra supplied were fully ATEX rated and included the necessary gas detection and ventilation systems, with the units tested in the factory and independently certified for DSEAR and EN 378 compliance.

Refra's propane heat pumps being installed at the Solihull district energy network. Photo credit: Absolutely Chilled

Room to Grow

The first phase of the project was completed in the spring of 2026 and involved the laying of 5km (3.1mi) of underground piping. Buildings supplied as part of the first phase of the project include Solihull College, a performing arts space and a leisure center.

Emissions will be reduced in the first phase of the project by 49%, and by the third and final phase the new district heating system could reduce annual CO_2 emissions by 6,000 metric tons. If needed, Refra can add more heat pumps to the district heating network to provide a maximum heating capacity of 3.2MW (909TR) – all without redesigning the system.

Key Technical Features

SYSTEM TYPE	5 × non-standard Solis air-to-water heat pumps	1 × non-standard water-to-water heat pump

REFRIGERANTS AND CHARGE

Propane

48kg per air-to-water unit

Isobutane

119kg, water-to-water unit

HEATING AND COOLING CAPACITY

171.6 kW / 169.8 kW

Heating (48.8TR) and cooling (48.3TR) per propane unit

1.7 MW / 1.3 MW

Heating (483TR) and cooling (370TR), isobutane unit

HOT WATER TEMPERATURE

Up to 80°C

176°F

COP AND COMBINED SYSTEM COP

4.64	4.48	2.39
PROPANE	ISOBUTANE	COMBINED

COMPRESSORS AND CONTROLLERS

Bitzer compressors and Siemens controllers

For both the propane and isobutane heat pumps

POTENTIAL EMISSIONS AVOIDED

Up to 6,000

metric tons annually

Deep Dive

SCM FRIGO

A BEIJER REF Company

DEEP DIVE

SCM Frigo Details Its Plans to Disrupt the European Commercial HVAC Sector with the CO_2 SMART Heat Pump

BY MICHAEL HINES

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> **It meant rethinking core functionalities from the ground up rather than simply relabelling a booster system as a heat pump.**
>
> IN CONVERSATION
>
> **Mirko Bernabei**
> OEM Segment Technical Director, Beijer Ref

COMPANY PROFILE

SCM Frigo is an Italian manufacturer of commercial and industrial refrigeration systems and is a subsidiary of Beijer Ref. In 2024 the company announced the launch of a range of CO_2 (R744) heat pumps developed in partnership with Danish heat pump and chiller manufacturer Fenagy.

GROUP	SERIES
Beijer Ref	**SMART Heat Pump**
REFRIGERANT	**CAPACITY**
CO_2 · R744	**30–300kW 8.5–85TR**

30 - 300 kW

the complete capacity range the SMART Heat Pump covers, with a

master–slave configuration for larger projects

SCM Frigo's Manfred Mahnert, International Business Development Director, and Mirko Bernabei, Beijer Ref OEM Segment Technical Director, spoke about the development of the SMART Heat Pump and their outlook on the commercial HVAC sector.

Why did SCM Frigo decide to develop a CO_2 heat pump, and why did it partner with Fenagy?

Manfred Mahnert: SCM Frigo's decision to develop a heat pump grew directly out of decades of experience in CO_2 refrigeration, heat recovery and false-load management for commercial and industrial applications. As that expertise matured, moving into heat pump technology was a natural next step: CO_2's ability to operate with a high delta-T and deliver high supply temperatures made it particularly well suited to heating applications, and we recognized an opportunity to apply our existing know-how to a new product category.

For the intelligence and software side of the project, we partnered with Fenagy because of their specific experience with CO_2 direct expansion heat pumps. Their strengths in software and control logic complemented our own in mechanical and refrigeration engineering.

What role did SCM Frigo's background in refrigeration play in the development of this heat pump?

Mirko Bernabei: Developing the SMART Heat Pump required considerably more than adapting existing refrigeration equipment. It meant rethinking core functionalities from the ground up rather than simply relabelling a booster system as a heat pump.

In particular, the hydraulic design and water-side engineering demanded close attention, and this is a fundamentally different discipline from traditional refrigeration work. Our CO_2 experience gave us the technical grounding and the confidence to take on the project, but building a genuine heat pump application meant developing new expertise and treating it as its own distinct engineering challenge, not an extension of an existing one.

The SMART Heat Pump is available in air-to-water and water-to-water models. Why did SCM Frigo decide to offer both?

MM: Our initial plan was to focus mainly on air-to-water units. As the project progressed, however, both our own market study and the demand we were seeing pointed clearly to a real need for water-to-water heat pumps as well, so we made the decision to develop both configurations in parallel.

At the outset we expected the split to land around 70% air-to-water and 30% water-to-water. Based on the requests we're receiving, that balance has shifted, and we currently expect something closer to a 50/50 split between the two. Offering both configurations lets us cover a much wider range of building types and applications across Europe than either model could address on its own.

Where is the SMART Heat Pump currently at in its development timeline, and where is demand coming from?

MM: The SMART Heat Pump is currently in serial status and approaching go-to-market, which we expect to complete at the beginning of next year. We already have a solid base of units operating in the field, with our first installation dating back to 2024, giving us real-world operating experience to draw on as we finalize the product ahead of a full commercial launch.

Demand is coming from a broad range of sectors. Multifamily residential buildings and offices form a strong core market, alongside process and industrial applications, including pharmaceutical facilities. Because our water-to-water units can be paired with buffer tanks, they are particularly well-suited to combined air-conditioning and heating needs, and we also see potential in smaller district heating systems. The SMART Heat Pump covers the complete 30–300kW [8.5–85TR] range, and a master–slave configuration allows several units to be linked together on a single project for larger capacity requirements.

What applications does SCM Frigo see CO_2 heat pumps being a better fit for compared to other natural refrigerants and why?

MB: CO_2's key advantage over other natural refrigerants is its ability to operate efficiently across a much wider temperature difference. Hydrocarbon and ammonia [R717] systems generally need to work within a comparatively narrow temperature spread, whereas CO_2 heat pumps handle high delta-T applications extremely well. This makes them best in class for producing hot service or tap water, heating from around 10°C up to 65°C [50°F up to 149°F] in a single pass.

Ammonia systems also tend to be reserved for larger-scale applications, whereas our SMART Heat Pump range starts at 30kW, making it a strong fit across a much broader span of project sizes, including smaller and mid-sized commercial installations. On top of that, CO_2 service technicians are considerably more widely available across Europe than ammonia specialists, a practical advantage for installation, servicing and long-term maintenance support.

What challenges or barriers are there to the widespread adoption of commercial CO_2 heat pumps in Europe, and how can these be overcome?

MM: The biggest barrier is a general lack of understanding of how the technology actually works, in particular its ability to operate across a much wider temperature spread than conventional heat pumps. Standard heat pumps are typically designed around a 5–10K temperature difference, while CO_2 heat pumps can comfortably handle 20 to 50K. That difference requires the HVAC industry to rethink some long-standing design assumptions.

Heat pump technology in general is still not that well known across much of Europe, and layering CO_2-specific technology on top adds a further degree of complexity for installers, specifiers and end users alike. We believe the way to overcome this is through targeted training, closer information-sharing across the industry and continued education to build familiarity and confidence with CO_2 heat pumps.

It's worth noting that the SMART Heat Pump's high delta-T capability also makes it a strong direct replacement for gas or oil boilers in buildings with lower return temperatures – such as those built after 1995 – which is exactly the kind of practical advantage that becomes clear once the technology is better understood.

What do you see as the next industry in Europe to be disrupted by natural refrigerant commercial chillers and heat pumps and why?

MB: Rather than pointing to one specific sector, we see natural refrigerant heat pumps having the potential to disrupt commercial HVAC broadly, because the SMART Heat Pump can be adapted to nearly any system where hot water is needed. Whether that means replacing an aging gas boiler or a conventional water-to-water chiller, natural refrigerant heat pumps are increasingly able to step into applications that have historically relied on other technologies.

Looking ahead, we are already developing the next generation of the SMART Heat Pump. We're targeting even higher performance and COP, and it's being designed to run at higher ambient temperatures as well as higher inlet and outlet water temperatures. It's this continued push to expand the operating envelope of CO_2 heat pump technology that we expect to keep unlocking new applications and drive disruption across an increasingly broad section of the commercial HVAC sector rather than any single niche.

Key Takeaways

- Building a CO_2 refrigeration system is not the same as building a CO_2 heat pump. Hydraulic design, water-side engineering, software and control logic are all areas of expertise that need to be developed – or acquired via partnership with an established heat pump manufacturer.

- There is a growing demand for commercial water-to-water heat pumps, with SCM Frigo seeing a 50/50 split in demand with air-to-water systems.

- There is still a knowledge gap regarding heat pump technology, and adding CO_2 to the mix can further complicate matters. This makes targeted training from manufacturers essential to the growth of commercial CO_2 heat pumps in Europe.

TTC Norge's facility in Slitu, Norway, where SCM Frigo installed two SMART Heat Pumps. Photo credit: SCM Frigo

CASE STUDY

From Prototype to Implementation – SCM Frigo's SMART Heat Pump Is Installed at a Heat Exchanger Factory in Norway

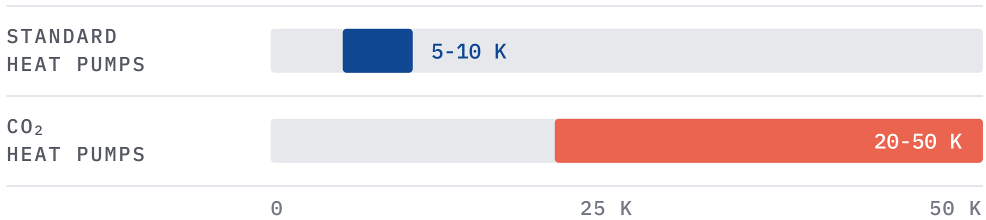
SCM Frigo supplied two water-to-water SMART Heat Pumps (SHP) to TTC Norge, a Norwegian heat exchanger manufacturer and fellow subsidiary of Beijer Ref, to provide space heating and comfort cooling for its factory in Slitu. Each unit has a heating capacity of 175kW (49.7TR), a cooling capacity of 111kW (31.5TR) and operates as a self-contained refrigeration circuit. With the necessary valves, pumps and controls in place, further SHPs can be integrated.

FIG. 01 · OPERATING ENVELOPE

CO_2 heat pumps work across four to five times the temperature spread

50 K

TOP OF THE CO_2 DELTA-T RANGE



Both bars share one 0-50 K axis. Coral marks the CO_2 range.

SOURCE · SCM FRIGO

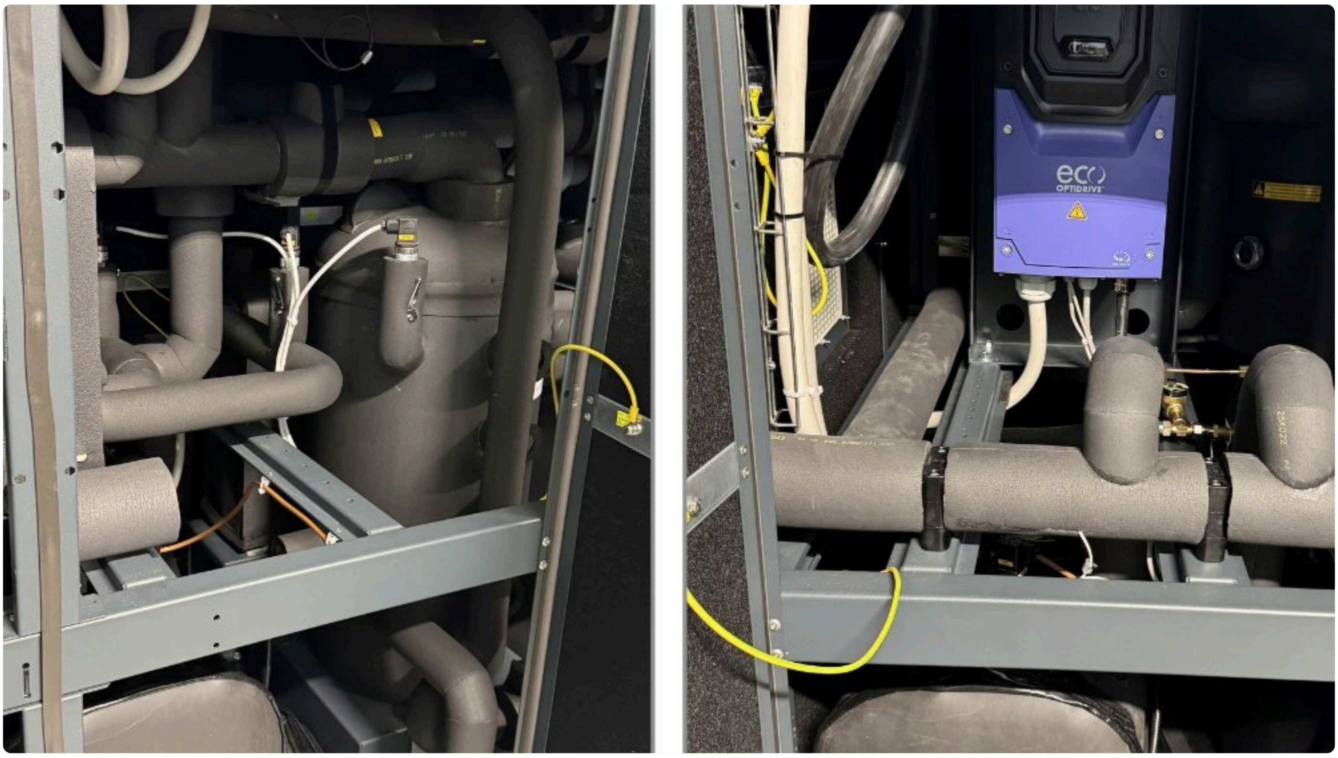
The SHPs replaced an existing heat generator using fossil fuels. The two units were commissioned in June 2025, marking one of the earliest installations of SCM Frigo's SMART Heat Pump. Although Norway sits outside the EU, it applies equivalent rules to the EU F-gas Regulation through the European Economic Area agreement and has its own long-standing national tax on HFC refrigerants. This is among the strongest in Europe, which further incentivizes natural refrigerant solutions like CO_2 heat pumps.

Under the Hood

The SHPs heat and cool a water/brine circuit on the secondary side, with the design point set at 65°C flow/40°C return (149°F/104°F) in winter and at an evaporation temperature of 5°C (41°F) in summer time. Each unit uses two Bitzer semi-hermetic reciprocating compressors (4FTEU-30K), one of which is speed-controlled via inverter, while Reftronix provided the embedded controls platform. Plate heat exchangers from Alfa Laval, SWEP and Kelvion serve the gas cooler, evaporator and internal heat exchanger. Safety-critical components include pressure switches from Emerson, an oil separator from Klimal and safety valves from Castel.

Efficiency is enhanced by two low-pressure ejectors per unit working in parallel to recover expansion energy that would otherwise be lost; because they share a single check valve on the common ejector suction line, the two ejectors always operate together rather than in sequence. At the winter design condition point, the SHP units are rated for a heating COP of approximately 3.1 calculated at an evaporation temperature of −9°C (15°F). The units are currently running without the ejector engaged, so this figure doesn't yet reflect the efficiency gain the ejector technology is designed to deliver.

Beyond individual component suppliers, the project reflects SCM Frigo's tripartite partnership model: Fenagy contributes the intelligence and software layer of the SMART Heat Pump while Beijer Ref acts as commercial integrator, connecting the technology to end customers such as TTC Norge across the Nordic market.



Inside one of the two SMART Heat Pumps installed at the TTC Norge facility in Slitu, Norway. Photo credit: SCM Frigo

Lessons Learned, Looking Ahead

This project came with the challenges of bringing a new heat pump platform from prototype to first implementation. One lesson learned: The units were designed with two operating modes, with and without the low-pressure ejector engaged, and switching between them requires an on-site adjustment to settings and valve positions rather than a remote change. In future projects, SCM Frigo is looking at ways to make that kind of reconfiguration simpler for field teams.

The project also underscored the importance of clearly defining hydraulic and controls scope between SCM Frigo and the customer. The units are configured as slave units, with the customer's team managing the water side. That division of responsibility is a useful reference point for how we structure similar projects going forward.

Looking ahead, SCM Frigo's priority is to bring the SMART Heat Pump to full commercial launch and scale it across the European market, building on its experience in the field in Norway and elsewhere. On the product roadmap, it's working on a 10-year plan to keep pushing performance and COP higher, including support for higher return temperatures and a reversible cycle that would let the same unit switch between air-to-water and air-to-air operation. It's also developing a split version of the air-to-water configuration, with the evaporator located outside and the compressors housed indoors, to widen the range of installation types the SMART Heat Pump can serve.

Key Technical Features

HEATING AND COOLING CAPACITY

175 kW

49.7TR per unit at a design calculation evaporation temperature of 5°C, W40°C–65°C quotation value (41°F, W104°F–149°F)

111 kW

Approximately 31.5TR per unit at a design calculation evaporation temperature of −9°C (15°F)

REFRIGERANT TYPE

CO_2

Transcritical

HEATING COP

3.1

At the winter design condition point, the SHP units are rated for a heating COP of approximately 3.1 calculated at an evaporation temperature of −9°C (15°F)

*An alternative calculation shows 157.6kW (44.8TR) per unit at a design calculation evaporation temperature of −9°C, with a heating COP of 3.1

CONTROLS

Embedded Reftronix controller

COMPRESSORS

2 × Bitzer 4FTEU-30K per unit

First compressor with variable frequency drive (inverter)

CAPACITY CONTROL

Stepless control via inverter on the lead compressor plus multi-stage control via the second compressor

EFFICIENCY FEATURES / COMPONENTS

Low-pressure ejector technology, plate heat exchangers for gas cooler and evaporator

The SMART Heat Pumps at TTC Norge. From left: Cristian Corato, After-Sales & Applications Manager, SCM; Henrik Andersen, R&D Engineer, Fenagy; Manuel Silvestrin, Sr. Service & Application Engineer, SCM; Jon-Henning Frost, Product Manager, Fenagy/SCM Frigo and Beijer Ref Support Norway.

Deep Dive

DEEP DIVE

Regulatory Certainty and Corporate ESG Mandates Are Driving Demand for Secon's Hydrocarbon Chillers and Heat Pumps in Europe

BY MICHAEL HINES

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For us, natural refrigerants are not a trend – they are in our DNA.

IN CONVERSATION

Joachim Schadt
CEO, Secon

COMPANY PROFILE

Secon is a German manufacturer of hydrocarbon heat pumps and chillers. The company was founded in 2010 and is headquartered in Gondelsheim. Secon also manufactures brine-cooled CO_2 (R744) racks for deep-freezing applications, as well as dry and adiabatic coolers.

FOUNDED **2010**	HEADQUARTERS **Gondelsheim, DE**
REFRIGERANTS **R290 · R1270 · R600a**	SERIES **STRATOS VP**

15

years of experience. Over the last three years Secon's **turnover has nearly doubled**

For this Deep Dive ATMOsphere spoke with Joachim Schadt, CEO at Secon, about the company’s products and its outlook on the commercial HVAC sector.

Can you briefly detail Secon's natural refrigerant chiller and heat pump lineup?

Joachim Schadt: Since our founding over 15 years ago, SECON has been a pure player in the industry: 100% of our chillers and heat pumps utilize natural refrigerants. We have never used synthetic gases and rely exclusively on pure hydrocarbons, such as R290 [propane], R1270 [propylene] and R600a [isobutane].

Our portfolio is one of the most versatile in the market, covering both water-cooled and air-cooled chillers with capacities ranging from just a few kilowatts up to 1.2 megawatts [341TR] per unit. In addition to our cooling solutions, we offer a wide range of air-to-water and water-to-water heat pumps as well as specialized booster heat pumps for high-temperature applications. For us, natural refrigerants are not a trend – they are in our DNA.

What is currently driving demand for Secon's natural refrigerant chillers and heat pumps in Europe and why?

JS: Demand is primarily driven by industrial process cooling – such as in the food and pharmaceutical industries – data center cooling and large-scale decarbonization projects. But we've also seen a significant surge in the HVAC sector where consultants and building operators are now standardizing on natural refrigerants for sustainable climate control.

In the past three to five years the market has shifted from niche interest to a mainstream mandate. This is reflected in our growth: Our turnover has nearly doubled over the last three years. This rapid expansion is fueled by the industry's push for PFAS [per- and polyfluoroalkyl substances]-free solutions and the need for future-proof investments that go beyond the tightening f-gas regulations. With 15 years of experience, we are perfectly positioned to meet this increased demand for high-capacity hydrocarbon systems.

What are the top drivers for the adoption of natural refrigerant commercial chillers and heat pumps in Europe?

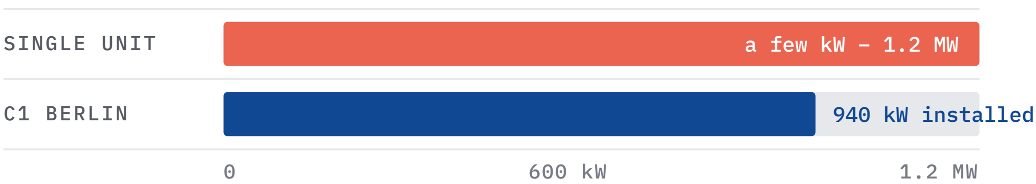
JS: The adoption in commercial HVAC is driven by a powerful combination of regulatory certainty and corporate ESG [environmental, social and governance] mandates. With the EU F-gas Regulation and ongoing PFAS discussions, investors are prioritizing future-proof assets that guarantee compliance over their entire 20-year lifecycle. Hydrocarbons like R290 and R1270 are no longer seen as alternatives but as the premium choice, offering excellent thermodynamic properties and high energy efficiency. For our customers, choosing natural refrigerants is a strategic decision to secure long-term investment safety while achieving top-tier environmental performance.

FIG. 01 · CHILLER CAPACITY

Water-cooled and air-cooled chillers reach 1.2 MW per unit

1.2 MW

PER UNIT · 341 TR



Both bars share one 0–1.2 MW axis.

SOURCE · SECON

What are some of the barriers preventing the wider adoption of commercial natural refrigerant chillers and heat pumps, and how can these be overcome?

JS: The primary barriers to a larger market share are strict safety codes for flammable refrigerants and a persistent knowledge gap among planners and installers. However, we address these challenges by leveraging our "safety by design" philosophy, which has been successfully proven in the field for over 15 years. Since our company's inception, we have refined a safety concept that makes even high-capacity hydrocarbon systems as reliable as traditional ones.

A key solution is our specialized safety consultation during the sales and planning phases. By providing deep technical expertise early on, we eliminate uncertainty and ensure that every project is built on a foundation of proven safety. This active knowledge transfer is essential to overcoming technical hesitation in the market.

One trend we've noticed is a growing demand for larger chillers/heat pumps from 500kW, up to and exceeding 1MW. What is Secon's approach to meeting this demand: modularity or building larger individual units?

JS: We address the growing demand for high-capacity systems through a versatile approach that combines high-performance individual units with modular scalability. While we are capable of building individual chillers and heat pumps with a capacity of over one MW, we also design these units to be easily combined into modular clusters. This allows us to deliver several megawatts of cooling or heating power for large-scale industrial projects and data centers.

What trend or new development related to natural refrigerant chillers and heat pumps in Europe is Secon watching closely?

JS: We are closely monitoring the rapid growth of the data center sector, where the demand for sustainable, high-capacity cooling is surging. At the same time, we see a massive shift toward high-temperature heat pumps for industrial decarbonization. Consequently, our strategy focuses on refining our booster technology for district heating and expanding our hydrocarbon portfolio to meet the extreme reliability and efficiency requirements of modern data centers.

The ongoing PFAS discussion further reinforces our mission and validates our 15-year commitment to chemical-free cooling. Our goal is to demonstrate that natural refrigerants are the superior choice for both high-temperature heating and critical cooling infrastructure, offering a future-proof alternative to synthetic substances in every high-capacity application.

What do you see as the next industry in Europe to be disrupted by natural refrigerant commercial chillers and heat pumps and why?

JS: The real disruption will not be limited to a single sector. We are witnessing a fundamental shift where natural refrigerants are rapidly gaining traction across all applications. The coming years will see natural refrigerants move from being a premium alternative to becoming the absolute dominant standard in the commercial HVAC sector.

This transition is inevitable because natural refrigerants are the only solution that simultaneously addresses all major market pressures. They are future-proof against tightening regulations, offer high thermodynamic performance and are entirely free of the environmental and health concerns associated with synthetic chemicals like PFAS. In the near future, we expect that any HVAC system not utilizing natural refrigerants will be seen as an outdated technology as the industry fully embraces a truly sustainable and chemical-free cooling and heating economy.

Key Takeaways

- Industrial process cooling is driving demand for hydrocarbon chillers, as are data centers.
- Regulatory certainty and ESG mandates are propelling the adoption of natural refrigerant-based chillers/heat pumps in the European commercial HVAC sector.
- Concerns about flammability can be mitigated through safety consultations designed to educate customers and communicate best practices of working with hydrocarbon chillers/heat pumps.

A rendering of the C1 office building in Berlin. Photo credit: Central One Midtown Offices

CASE STUDY

A Future-Proof HVAC System for a New Office Building in Berlin

Two air-cooled propane chillers from Secon's STRATOS VP series, featuring integrated heat recovery, were installed in a recently constructed office building located at the bustling and historic Alexanderplatz in Berlin. The system is operated by C1 (Central One Midtown Offices) and provides air-conditioning for the offices along with cooling for IT systems. Its total installed cooling capacity is 940kW (267TR), and it was commissioned in 2024 by Secon's field service team.

The goal of the project was to provide an efficient and sustainable cooling solution using natural refrigerants that could meet the operational and comfort cooling requirements of a modern office building while also providing server cooling. In addition, it had to be able to make use of waste heat to provide space heating during winter.

SYSTEM SPECS AT A GLANCE

COOLING CAPACITY	MAX WASTE HEAT REUSE	EER
470 kW 133 TR each · 2 chillers	**590** kW 167 TR	**4.74**

Keeping People and Servers Cool While Reusing Waste Heat

The system supplies chilled water at temperatures of 15°C/9°C (59°F/48°F). At the same time, the integrated heat recovery system uses waste heat from IT cooling at a temperature of 45°C/35°C (113°F/95°F) to support the building's space heating. The system is designed for typical Central European climatic conditions and operates reliably across varying seasonal load profiles.

The compressors in use operate in two independent refrigeration circuits per machine, ensuring high operational reliability. The installation features the Efficient Flow System developed by Secon, with one dedicated pump for each evaporator. This additional feature enhances part-load efficiency by preventing temperature mixing because fluid flows only through the active circuit. Each heat recovery plate heat exchanger also has a motorized shut-off valve to ensure high part-load efficiency.

Integrated remote monitoring via an LTE router ensures operating data can be viewed at any time from a laptop. This allows for diagnoses of malfunctions before a service team travels to the machine.

Lessons Learned

During implementation, particular emphasis was placed on integrating heat recovery into the overall system and on balancing cooling and heating requirements. Close collaboration between the installer and the operator proved to be crucial for smooth implementation and optimal system design.

The use of the natural refrigerant R290 helps ensure compliance with current and future requirements under the European F-gas Regulation. In addition, the system's high energy efficiency contributes to meeting modern building energy standards.

Secon's STRATOS VP series propane chillers installed on the roof of the C1 office building in Berlin. Photo credit: Secon

Key Technical Features

SERIES · COMMISSIONED

STRATOS VP series, two air-cooled chillers

One chiller is equipped with heat recovery

Commissioned 2024 by Secon's field service team

COOLING CAPACITY

470 kW

133TR for each of the two chillers

TOTAL INSTALLED CAPACITY

940 kW

267TR

MAX WASTE HEAT REUSE

590 kW

Up to 167TR · realistic heat use in winter 160kW (45.4TR)

REFRIGERANT

Propane

R290

EER

4.74

WATER TEMPERATURES

CHILLED WATER	15°C / 9°C	59°F / 48°F
HEAT RECOVERY	45°C / 35°C	113°F / 95°F
MAX AMBIENT	35°C	95°F

REFRIGERATION CIRCUITS

Two separate refrigerant circuits per chiller

CHARGE

16kg per circuit · 21kg per circuit for the chiller with heat recovery

PUMPS

Efficient Flow System developed by SECON

One dedicated pump for each evaporator

HEAT EXCHANGERS

Motorized shut-off valve on each heat recovery plate heat exchanger

MONITORING

Integrated remote monitoring via an LTE router

Deep Dive

systemair

DEEP DIVE

Systemair on Why Natural Refrigerants ‘Will Hit Hardest’ in Integrated HVAC Systems

BY MICHAEL HINES

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We think natural refrigerants will hit hardest in integrated HVAC systems.

IN CONVERSATION

Slobodan Rakulj
R&D Engineer, Systemair Slovenia

COMPANY PROFILE

Systemair was founded in Sweden in 1974 and was originally a manufacturer of circular in-line centrifugal duct fans. Today it offers a wide range of HVAC equipment for both residential and commercial applications, including air-handling units (AHU), ventilation systems, heat pumps and fans. Systemair acquired Menerga, a German manufacturer of AHUs, in 2013.

FOUNDED	SUBSIDIARY
1974 · Sweden	Menerga
REFRIGERANT	PLATFORM
CO_2 · R744	CO_2mpass

70°C

the water temperature the transcritical CO_2 process can reach, depending on the application, while

pulling heat out at different temperature levels

For this Deep Dive, ATMOsphere spoke with Slobodan Rakulj, R&D Engineer at Systemair Slovenia, about Menerga’s newest AHU, which features an integrated CO_2 (R744) heat pump, and the opportunity for natural refrigerants in integrated HVAC systems.

Can you briefly detail Systemair's natural refrigerant chiller and heat pump lineup?

Slobodan Rakulj: Menerga is currently developing HVAC systems around natural refrigerants, and CO_2 is the main one in our latest heat pump. The CO_2mpass platform puts an air-handling unit and an integrated CO_2 heat pump into one system, built for heating, cooling, ventilation and, depending on the job, dehumidification and heat recovery.

It's a good fit for swimming pools, wellness centers and other buildings that need heating and cooling at the same time. CO_2mpass isn't one fixed heat pump: It's a range covering different applications and capacities. A lot of the focus goes into making good use of the recovered heat at different temperature levels. In a pool application, for example, that recovered heat can go toward heating the air, the pool water and domestic hot water.

What is currently driving demand for Systemair's natural refrigerant chillers and heat pumps in Europe and why?

SR: Demand is coming mostly from applications that use a lot of energy and have a real need for heat recovery. Pools are the clearest example – they need constant ventilation and dehumidification, plus heating for the air, the pool water and domestic hot water, all at once. Beyond that we're seeing demand from hotels, wellness facilities, hospitals, commercial buildings and industrial sites.

Interest in natural refrigerants has grown noticeably over the last three to five years. Higher energy costs, decarbonization targets and the tightening f-gas rules in Europe are all pushing that. The retrofit side is picking up too: A lot of existing plant rooms and HVAC systems across Europe are getting old enough to need modernizing, and swapping older HFC equipment for a natural refrigerant system solves both the regulatory issue and the efficiency issue simultaneously.

What are the top drivers for the adoption of natural refrigerant commercial chillers and heat pumps in Europe?

SR: Regulation and efficiency are the two biggest ones right now. The f-gas rules are steadily cutting down what high-GWP refrigerants can be used for, so refrigerant choice is something you have to think about early at the design stage, not after.

Efficiency matters just as much. CO_2 works especially well where there's a demand for cooling and high-temperature heat at the same time. The transcritical CO_2 process can pull heat out at different temperature levels and, depending on the application, get water up to around 70°C [158°F]. On top of that, sustainability targets, running costs and how long the equipment needs to last are all pushing building owners to look harder at natural refrigerants.

The Menerga CO_2mpass, an air-handling unit with an integrated CO_2 heat pump, on display at ISH 2025. Photo credit: Systemair

What are some of the barriers preventing the wider adoption of commercial natural refrigerant chillers and heat pumps, and how can these be overcome?

SR: The big one is pressure – CO_2 systems run at much higher pressure than conventional HFC systems, which raises the bar on component selection, design, installation and commissioning. There's also a knowledge gap since a lot of designers and installers built their experience around conventional refrigerants over many years.

The fix is mostly technical education and hands-on experience. You can't just treat CO_2 as a drop-in replacement for an HFC. It has to be designed around it from the start. At Menerga we're closing that gap through our own product development, testing and commissioning work. Using our own production site to install the CO_2mpass 35.20 lets us get real operating experience and feed it straight back into product development.

One trend we've noticed is a growing demand for larger chillers/heat pumps from 500kW up to and exceeding 1MW. What is Systemair's approach to meeting this demand: modularity or building larger individual units?

SR: We treat both as relevant options. Which one makes sense depends on the application: available space, redundancy needs and how the heat pump has to tie into the rest of the HVAC system. We're not just chasing bigger nominal capacity on a single unit. The real focus is a scalable system concept that can flex to what the project needs. For Menerga, that means integrating with the air-handling system so the whole thing works as one energy system rather than treating the chiller or heat pump as something standalone bolted on.

What trend or new development related to natural refrigerant chillers and heat pumps in Europe is Systemair watching closely?

SR: Two things we're keeping a close eye on are refrigerant regulations continuing to tighten and the growth of the European retrofit market. The two are tied together. A lot of existing HVAC installations were built around refrigerants and technology that are getting harder to justify keeping over the equipment's lifetime.

That's creating demand for solutions that hold up not just today but years down the line from a refrigerant standpoint. Our development work is built around natural refrigerants, better system efficiency and flexible integration into existing HVAC setups. Retrofit capability is only going to matter more since Europe has a huge base of existing systems that will need modernizing in the coming years.

What do you see as the next industry in Europe to be disrupted by natural refrigerant commercial chillers and heat pumps and why?

SR: We think natural refrigerants will hit hardest in integrated HVAC systems – cases where heating, cooling and ventilation are currently handled by separate equipment. Pools already show what's possible since they need cooling/dehumidification and heating at the same time.

The next step is treating the heat pump as part of one integrated energy system where heat pulled out of one process gets recovered and reused elsewhere instead of just being thrown away. That can cut both energy use and the number of separate systems a building needs. We see a lot of room for this in hotels, wellness facilities, hospitals, industrial buildings and retrofit projects.

Key Takeaways

- Applications where there's a demand for simultaneous cooling and high-temperature heat – such as pools, hotels and hospitals – are driving demand for integrated CO_2-based HVAC solutions.

- The technical hurdles associated with CO_2 heat pumps, specifically the high operating pressures, can be addressed through technical education and hands-on experience.

- There is an opening for natural refrigerants in the commercial HVAC sector, specifically in applications where heating, cooling and ventilation are currently handled by separate equipment.

A Menerga CO_2mpass at the Maribor factory in Slovenia. Photo credit: Systemair

CASE STUDY

Walking the Walk – Two CO_2mpass Units Provide Ventilation, Heating and Cooling at a Menerga Factory

Menerga is currently commissioning two CO_2mpass 35.20 air-handling units at its production facility in Maribor, Slovenia. Each unit features an integrated CO_2 heat pump, and together the pair will handle ventilation, heating and cooling for the facility, which has 4,000m^2 (43,000ft^2) of production space and ceilings that reach 12m (39ft). Each CO_2mpass 35.20 moves 25,000 m^3/h.

HEATING & COOLING CAPACITY

HEATING 32.39kW

COOLING 87.43kW

(high load) and 43.86kW (low load)

HEATING COP

3.0

REFRIGERANT AND CHARGE

CO_2 33kg per unit

High Load and Low Load

HIGH LOAD

The high load cooling capacity is 87.43kW (24.86TR) at design conditions of 35°C (95°F) ambient and 40% relative humidity. Adiabatic cooling brings the air temperature down to 20.2°C (68.3°F), and it exits the evaporator at 16.3°C (61.3°F). The EER (energy efficiency ratio) at high load is 5.2.

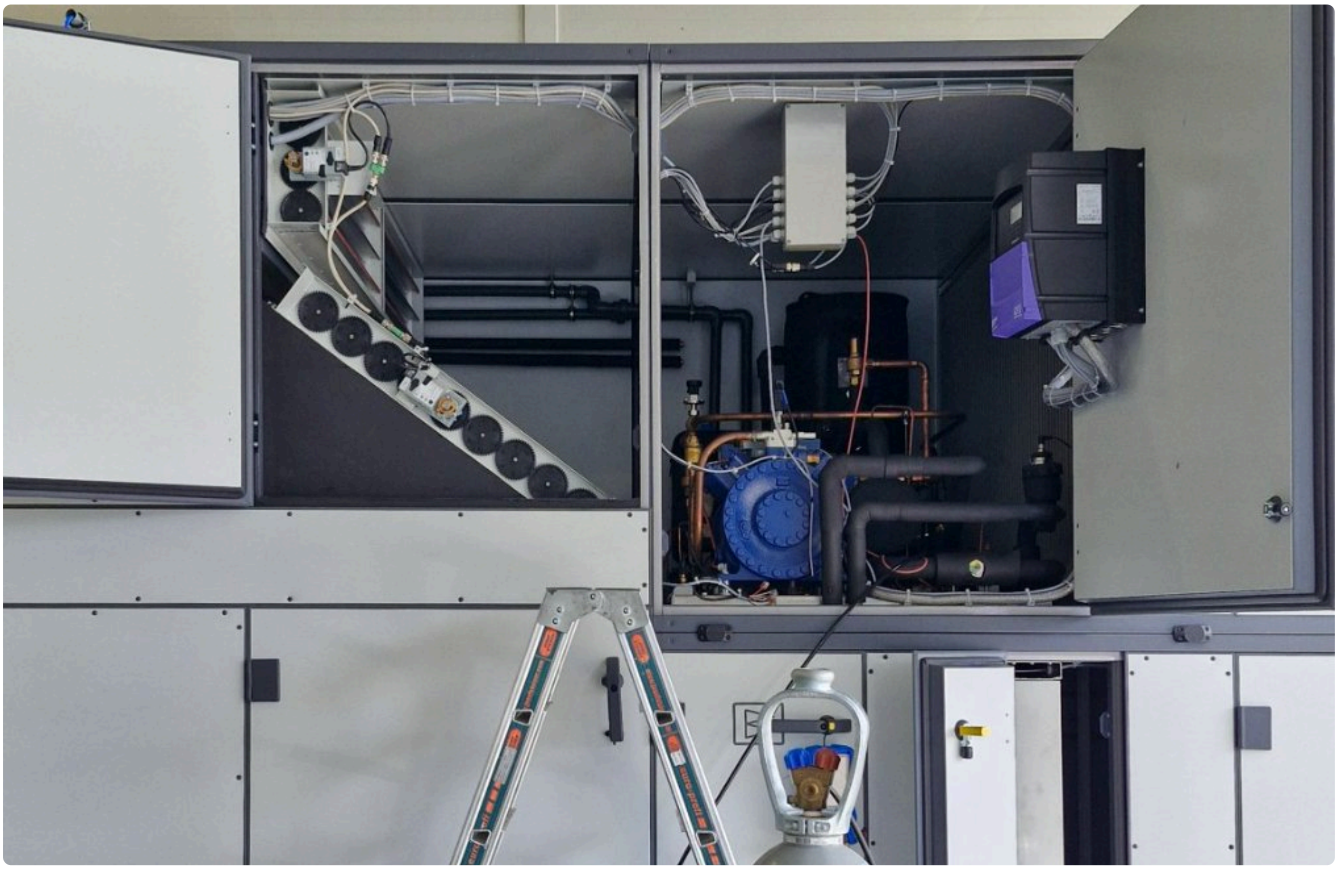
LOW LOAD

The low load cooling capacity is 43.86kW (12.47TR) at design conditions of 35°C (95°F) ambient and 40% relative humidity. Adiabatic cooling brings the air down to 22.7°C (72.8°F), and it exits the evaporator at 20.1°C (68.1°F). The EER is 6.9. Heating capacity is 32.39kW (9.20TR) with a COP of 3.0.

Drawing a Comparison

Before installing the CO_2mpass 35.20 units at Maribor, Menerga assessed the project's operational requirements and identified the CO_2mpass as the most suitable solution. Unique in the market, the unit delivers strong energy performance across different operating conditions, achieving an EER of 5.2 at high cooling load and 6.9 at low cooling load. This corresponds to electrical inputs of approximately 16.8kW and 6.4kW, respectively.

These numbers were modeled, and the real annual energy savings will depend on the production area's operating profile as well as the cooling load, outdoor conditions and running hours. The comparable system also used a digital-scroll compressor as opposed to a variable-frequency drive.



Inside the CO_2mpass during its commissioning at the Maribor factory. Photo credit: Systemair

Learning by Doing

In addition to energy efficiency, Menerga chose to install its own product to gather real-world performance data. The company's engineering, development, product management and production teams were all involved in the development and implementation of the project. This creates a feedback loop designed to enable the development team to evaluate the performance of the CO_2mpass in a real industrial environment. The system's energy consumption, part-load performance, compressor control and general operating behavior will all be checked against the original design assumptions, with the results used to optimize future systems.

While the Maribor project isn't a retrofit, Menerga sees a lot of potential for the CO_2mpass in that market. This is because there is a large base of old HVAC systems that will need replacement, and energy efficiency requirements and refrigerant regulations are creating an opportunity for natural refrigerants. In this way the Maribor project is one of the last steps before the wider roll out of the CO_2mpass across Europe.

Key Technical Features

REFRIGERANT AND CHARGE

CO_2

33 kg per unit

COOLING CAPACITY

87.43 kW

High load, at 35°C ambient and 40% relative humidity

43.86 kW

Low load, at 35°C ambient and 40% relative humidity

AIRFLOW VOLUME

25,000

m³/h per unit

COOLING EER

5.2

HIGH LOAD

6.9

LOW LOAD

HEATING CAPACITY AND COP

32.39 kW

HEATING CAPACITY

3.0

HEATING COP

SYSTEM TYPE

2x Menerga CO_2mpass 35.20 units

COMPRESSOR TYPE

Bock HGX34/170-4 SH CO_2T, 097G0085

Variable-frequency drive

Deep Dive

DEEP DIVE

TEKO Shares What's Behind the 'Significant and Consistent' Growth of CO_2 Chillers and Heat Pumps in Europe

BY MICHAEL HINES

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Once a CO_2 system is commissioned and operating, acceptance barriers diminish rapidly.

IN CONVERSATION

Roman Weingart
Manager, Heating and Cooling Business Unit, TEKO

COMPANY PROFILE

TEKO manufactures CO_2 (R744) racks, chillers and heat pumps. The company was founded in 1982 and is headquartered in Altenstadt, Germany. TEKO is part of the KKVB Group, which also includes the Canadian CO_2 heat pump manufacturer Vitalis and the Austrian industrial CO_2 refrigeration system manufacturer Frigopol.

FOUNDED **1982**	HEADQUARTERS **Altenstadt, DE**
GROUP **KKVB**	REFRIGERANT **CO_2 · R744**

100%

of TEKO's newly sold chillers and heat pumps in Europe are based on **natural refrigerants, primarily CO_2**

For this Deep Dive ATMOsphere spoke with Roman Weingart, Manager of the Heating and Cooling Business Unit at TEKO, about why demand for CO_2 chillers and heat pumps has grown in recent years along with the challenges that need to be addressed to unlock further growth.

Can you briefly detail TEKO's natural refrigerant chiller and heat pump lineup?

Roman Weingart: Our current lineup is marketed under the COOLSHIFT series and covers cooling capacities from approximately 50kW [14.2TR] up to 1.5MW [426TR] and heating capacities up to 3MW [853TR], depending on the configuration and application. These systems are designed for year-round operation and can provide simultaneous cooling and heat recovery where required.

In Europe, 100% of TEKO's newly sold chillers and heat pumps are based on natural refrigerants, primarily CO_2. This positioning is a deliberate strategic choice and not a transitional phase. CO_2 systems are not treated as an alternative but as the core technology across TEKO's development roadmap. The same applies to TEKO's broader refrigeration portfolio where the share of CO_2 systems has steadily increased over the past decade and now dominates new installations.

What is currently driving demand for TEKO's natural refrigerant chillers and heat pumps in Europe and why?

RW: Demand is primarily driven by food retail, logistics and cold storage, industrial process cooling and increasingly district energy and commercial building applications. End users typically require systems that deliver both high energy efficiency and long-term regulatory security, particularly as European f-gas restrictions continue to tighten. CO_2 technology allows these operators to combine cooling, heating and heat recovery within a single system architecture, which is especially attractive in applications with simultaneous thermal demands.

Over the past three to five years, demand for CO_2-based chillers and heat pumps has grown significantly and consistently. Initially, adoption was largely compliance-driven, particularly in food retail and industrial refrigeration. More recently, demand has broadened as customers increasingly recognize the economic and operational benefits of integrated cooling and heating solutions, including reduced energy costs and improved total cost of ownership. The rapid scale up of CO_2 installations across Europe, including megawatt-scale industrial projects, underlines this shift from niche adoption to mainstream acceptance.

What are the top drivers for the adoption of natural refrigerant commercial chillers and heat pumps in Europe?

RW: Regulation remains the primary initial driver, particularly the ongoing phase down of fluorinated gases under the EU F-gas Regulation. However, regulation alone does not explain the current pace of adoption. Customers are increasingly prioritizing energy efficiency, waste heat utilization and long-term investment security when selecting system technologies. CO_2 systems respond well to these requirements, especially in applications where heat recovery can be used for space heating, domestic hot water or industrial processes.

A second major driver is the growing alignment between corporate sustainability targets and system design decisions. Many European end users now translate ESG commitments into concrete technical specifications, favoring refrigerants with a GWP of 1 and transparent lifecycle performance. In this context, natural refrigerant chillers and heat pumps are no longer seen as experimental or "green premium" solutions but as robust, future-proof infrastructure. This shift is clearly reflected in TEKO's order intake and the expanding range of large-scale CO_2 HVAC projects.

What are some of the barriers preventing the wider adoption of commercial natural refrigerant chillers and heat pumps, and how can these be overcome?

RW: Despite strong momentum, several barriers still limit the wider adoption of natural refrigerant chillers and heat pumps. These include higher initial investment costs, a perceived complexity of CO_2 systems and in some regions a shortage of sufficiently trained planners and installers. In addition, legacy HVAC design standards and conservative procurement processes can slow down decision-making, particularly in commercial building projects.

These barriers are largely structural rather than technological. Effective solutions already exist and are increasingly being implemented. Standardization and modular system concepts help reduce engineering effort and installation complexity, while serial production improves cost competitiveness at scale. At the same time, targeted training programs and closer collaboration between manufacturers, system integrators and controls providers significantly lower the entry threshold for new customers. From TEKO's perspective, practical experience consistently shows that once a CO_2 system is commissioned and operating, acceptance barriers diminish rapidly.

One trend we've noticed is a growing demand for larger chillers/heat pumps from 500kW up to and exceeding 1MW. What is TEKO's approach to meeting this demand: modularity or building larger individual units?

RW: TEKO primarily addresses the growing demand for large-capacity systems through a modular architecture rather than by building single, oversized units. The COOLSHIFT L and XL platforms are designed to be combined into multi-module systems, allowing capacities well beyond 1MW [284TR] while maintaining redundancy, transportability and serviceability. This approach also ensures high part-load efficiency, which is critical for real-world operating profiles in commercial and industrial applications.

Modularity further enables customized system layouts without sacrificing standardization. For customers, this translates into shorter delivery times, predictable performance and easier system expansion over the lifecycle of the installation. TEKO applies this principle consistently across both cooling-dominant and heat-recovery-driven projects, including logistics centers and industrial sites.

What trend or new development related to natural refrigerant chillers and heat pumps in Europe is TEKO watching closely?

RW: TEKO is closely monitoring the convergence of refrigeration, heating and district energy systems in Europe. CO_2 technology increasingly acts as a link between traditionally separate energy domains, enabling integrated solutions that combine cooling, heating and grid-interactive operation. This trend is reinforced by rising energy costs and the political push toward sector coupling across the EU.

This development directly influences TEKO's product strategy, with a clear emphasis on heat pump functionality, higher supply temperatures and intelligent control systems. Rather than developing isolated appliances, TEKO focuses on system platforms that can be adapted to multiple use cases.

What do you see as the next industry in Europe to be disrupted by natural refrigerant commercial chillers and heat pumps and why?

RW: The next major disruption is likely to occur in commercial buildings that have traditionally relied on gas boilers or HFC-based chillers, such as office buildings, mixed-use developments and retail parks. As renovation cycles align with stricter climate targets, natural refrigerant heat pumps and chillers are increasingly positioned as drop-in infrastructure replacements rather than niche alternatives.

This is particularly true where simultaneous heating and cooling demands exist. In this segment, CO_2 systems are expected to gain traction because they offer high efficiency, regulatory certainty and the ability to integrate with existing heat distribution systems. From TEKO's point of view, the technological foundation is already in place: The remaining challenge lies in accelerating planning acceptance and market familiarity.

Key Takeaways

- The demand drivers for CO_2 chillers and heat pumps are shifting. While regulatory compliance is still the primary driver, end users are becoming increasingly interested in the economic and operational benefits of integrated CO_2-based heating and cooling systems.
- Modular architectures help reduce installation complexity, ensure high part-load efficiency and enable customized system layouts – all without sacrificing standardization in production.
- A combination of renovation cycles and stricter regulations makes offices and other large buildings the next major target for natural refrigerant-based chillers and heat pumps. Natural refrigerant systems are increasingly being positioned as the go-to drop-in replacements for HFC-based chillers and fossil boilers.

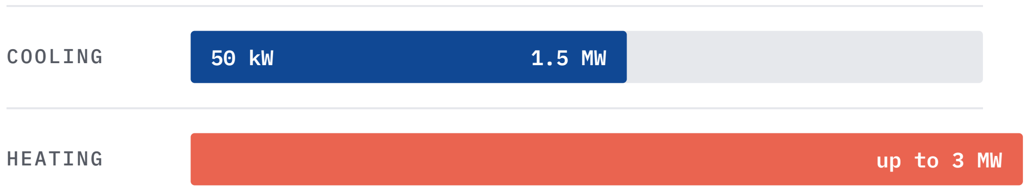
FIG. 01 — CAPACITY ENVELOPE

Heating capacity reaches twice the top of the cooling range

Chiller and heat pump duty across cooling and heating, configuration-dependent.

3 MW

MAXIMUM HEATING CAPACITY

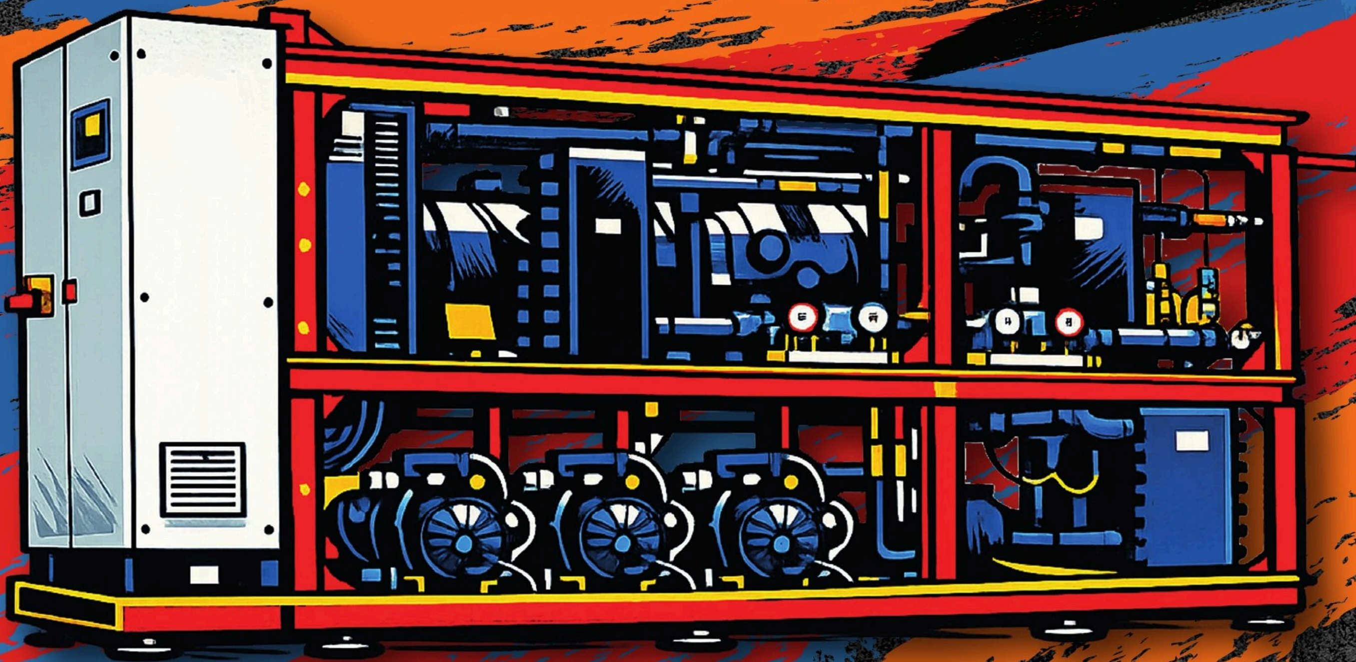


Both bars share one 0–3 MW scale. Coral marks the heating duty.

SOURCE · TEKO

Coolshift

CO_2 Chillers & Heat Pumps



Cooling. Heating. Air Conditioning.
Flexible and Future-proof.

FRIGOPOL EST. 1945

TEKO EST. 1982

VITALIS EST. 2016

www.teko-gmbh.com

The CO_2 chiller with integrated heat recovery TEKO built for an Italian winemaker. Photo credit: TEKO

CASE STUDY

A CO_2 Chiller with Heat Recovery for Process Cooling in the Food Industry

TEKO installed a CO_2-based chiller with integrated heat recovery for a wine producer in northern Italy. The system, engineered and manufactured by Frigopol, part of the TEKO Group, was commissioned in summer 2025 as part of the newly built production site. The objective was to provide reliable process cooling while simultaneously improving the overall energy efficiency of the facility by reusing waste heat.

SYSTEM SPECS AT A GLANCE

COOLING CAPACITY	HEAT RECOVERY	HOT WATER
350 kW	**200** kW	**60–70** °C
99 TR	56 TR	140–158 °F

System Description

The installation is based on a transcritical CO_2 system with low-lift ejector technology designed specifically for industrial process cooling applications.

Cooling is provided via a brine circuit supplying the required temperature levels for the production processes. Semi-flooded evaporators are used to enhance heat transfer and ensure stable operation under varying load conditions.

At the core of the system are four six-cylinder compressors providing flexible and reliable capacity control. The lead compressor is equipped with a frequency inverter, allowing continuous capacity modulation according to cooling demand. The remaining compressors operate with step capacity control at 33/66/100%.

To further improve efficiency, two ejectors are integrated into the system, enhancing performance particularly under transcritical operating conditions. One integrated system delivers both process cooling and useful heat, significantly reducing total energy demand.

Energy Efficiency and Sustainability

A key feature of the installation is the integrated heat recovery system with a capacity of up to 200kW (56TR), enabling the production of hot water at temperatures of up to 70°C (158°F). This recovered heat is used within the facility and reduces the demand for additional heating systems.

By combining process cooling with heat recovery, the system maximizes the use of available energy and significantly improves the overall efficiency of the installation.

The CO_2 chiller with integrated heat recovery TEKO built for an Italian winemaker. Photo credit: TEKO

Key Technical Features

SYSTEM TYPE

CO_2

Transcritical CO_2 using low-lift ejector technology

COOLING CAPACITY

350 kW (99TR)

At 5°C (41°F) return / −1°C (30°F) supply, brine circuit

DESIGN AMBIENT TEMPERATURE

38 °C / 100 °F

HEAT RECOVERY CAPACITY

Up to 200 kW (56TR)

For hot water production at 60–70°C (140–158°F)

EFFICIENCY

2.01	3.46
EER AT DESIGN	COMBINED COP

CAPACITY CONTROL

4 six-cylinder compressors

Lead compressor with frequency inverter; remaining compressors with step capacity control (33/66/100%)

CONTROL SYSTEM

Wurm hardware, TEKO software

EFFICIENCY FEATURES

Two ejectors for improved efficiency
Semi-flooded evaporators

ATMO Intelligence

2025 Edition