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SPECIAL EDITION · CHILLVENTA 2026

Energy Efficiency in Refrigeration



Welcome to the 11th issue of our magazine!

This Special Edition is built around energy efficiency in refrigeration, and it arrives just before Chillventa 2026. Our preview reads the exhibitor material as a single body of evidence: six shifts stand out, from packaged CO_2 units reaching sites that never had a machine room, to heat pumps supplying at boiler temperatures. Alongside it we print every efficiency figure we could find in that material, together with what it was measured against and who measured it.

***Two calendars**. The Chillventa material is written against a European date: on 1 January 2027 the EU quota for HFCs placed on the market roughly halves, and GWP limits on equipment take effect the same day. North America is working to a different clock. On 21 May 2026 the EPA finalised its reconsideration of the 2023 Technology Transitions Rule, and in our interview David Bolaños of Heatcraft argues that the timing changed while the destination did not, and that the market is not converging on a single refrigerant at all. Read the two side by side and the contrast is not Europe ahead and America behind. It is two regulatory timetables producing different equipment choices, with the same constraint underneath both: the people who have to install and service what the regulation requires.*

***On the website.** Refindustry moved to a new platform in July. The first thing it brought is a For you view: signed-in readers get the news feed narrowed to the subjects they actually work with, and the feed follows those subjects from then on.*

***Topic hubs.** The newer addition is the topic hubs, one page per subject, gathering news, interviews, analysis and case studies in one place. Five are live now: CO_2, ammonia, commercial refrigeration, industrial refrigeration and data centres, with more to follow.*

If you would like to share feedback or contribute your own insights, write to us by email, or contact me directly on LinkedIn.

Warm regards,

Editor-in-Chief

Sergei Mukminov

The concept of the magazine

Instead of scrolling through feeds, one issue a quarter: the news, analysis and projects that mattered, selected and gathered in one place, to read in one sitting and keep.

The magazine is digital only, laid out in landscape for reading on screen. Links are live, both within the issue and to full articles on our website, and every news item can be found on the site by its title.

Case studies in this issue are paid placements.

Coming in 2027

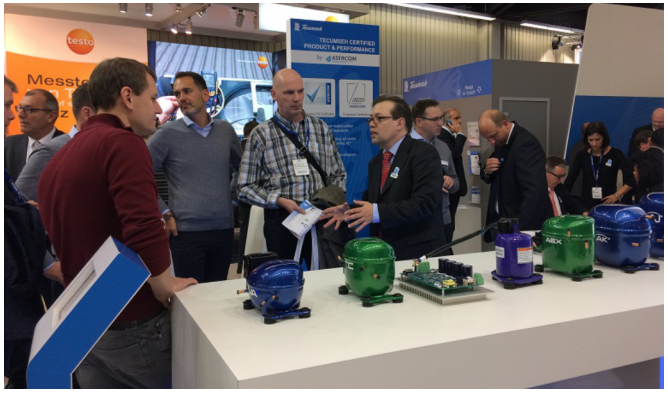
2027/1 · CO_2 Refrigeration · March

2027/2 · Skills and Careers · June

2027/3 · Heat Pumps · September

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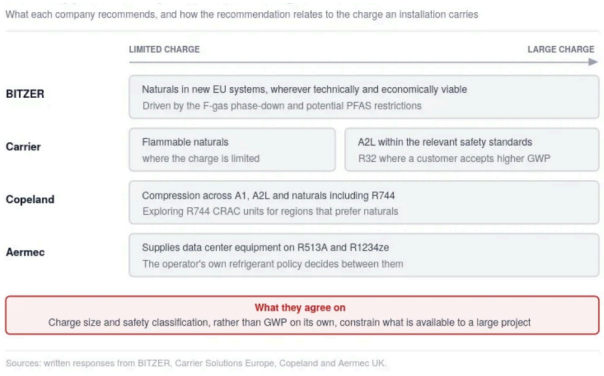
Case studies, advertising and partnership: see the formats and book at refindustry.com/advertise



Chillventa 2026 Preview



Case studies: Enex Technologies, SWEP



The site decides the system, the operator decides the refrigerant



A2Ls are not a bridge: Heatcraft on refrigerant choice in North America

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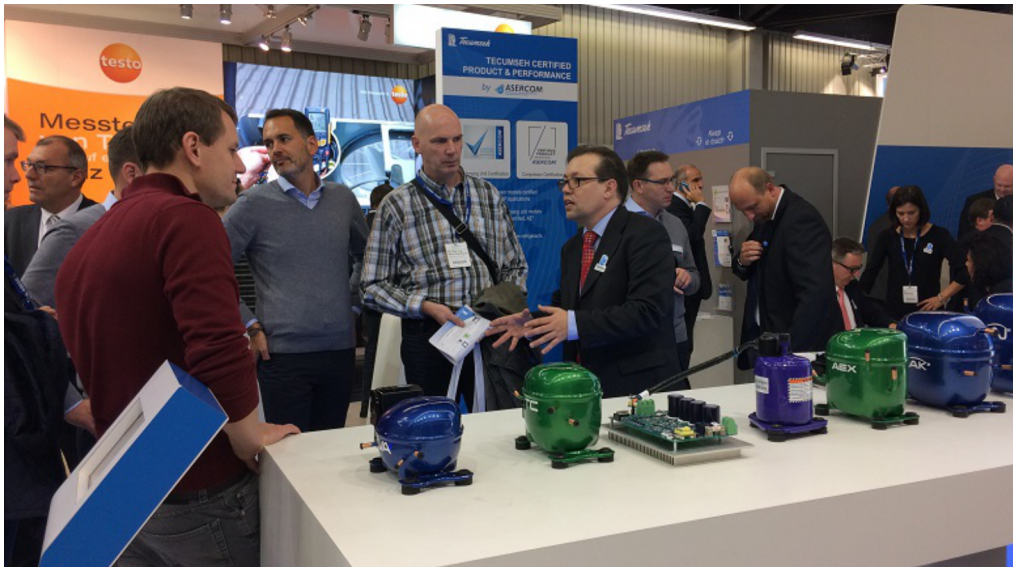
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An industry working to a deadline



Chillventa 2016. Photo: Refindustry

Trade fairs usually show what an industry would like to sell. This one shows what it has to build.

Read the material for Chillventa 2026 side by side, several dozen releases across the halls, and the same organising fact sits behind almost all of it. On 1 January 2027 the European quota for hydrofluorocarbons placed on the market roughly halves in a single step, and limits on the global warming potential of equipment take effect on the same date. The United Kingdom runs its own timetable, with its own cut in the same year.

Nothing in that calendar is new. It has been law since 2024. What is new is how close it now is, and how visibly the ranges heading to Nuremberg have been rebuilt around it.

The effect on the conversation is easy to state. Manufacturers are no longer arguing about whether to move to natural refrigerants. They are answering how fast the move can be made, and at what it costs. That is a different discussion, and a more useful one, because it can be answered with numbers.

Six shifts stand out.

CO_2 has left the supermarket

For fifteen years, transcritical CO_2 was a supermarket technology: a centralised rack, a machine room, a specialist contractor. The 2026 material shows it moving down and sideways, into bakeries, butcher shops, single display cases and small cold rooms, in packaged units that need none of those things.

TEKO's ROXSTAdiscpack is a compact unit aimed explicitly at sites a multi-compressor pack was never designed for. Arneg's PRISMA is a transcritical range for mini-markets and small stores, where floor area is the binding constraint. Frascold answers from the compressor side with a two-stage semi-hermetic piston range built

2027

EU HFC quota roughly halves on 1 January; GWP limits take effect the same day.

for single-compressor gas cooler units, and describes the shift plainly: the segment that once ran on medium and large transcritical or subcritical packs now runs mainly on mono-compressor units.

Three independent manufacturers, one direction. The reason is not that CO_2 became cheaper. It is that for these applications the alternatives are closing, and packaging the technology is the only way to reach sites that have no specialist engineering on hand.

This is also where the quota arithmetic bites hardest. Small commercial installations are numerous, dispersed and serviced by small contractors. They consume a disproportionate share of refrigerant relative to the cooling they deliver, and they are the hardest part of the market to convert. Packaged natural refrigerant units are the industry's answer to that problem, and 2026 is the year the answer arrives in volume.

Charge is counted in grams

The second shift follows from the first, and it hides inside product descriptions.

Arneg's TOWER RING, which lets one refrigeration unit serve several display cases in stores with no room for outdoor equipment, holds the propane charge below 150 grams per unit. KARYER's 5 mm heat exchanger coils for CO_2 cut size, weight and refrigerant charge together. Danfoss offers low-charge ammonia for industrial plant.

Grams and kilograms are now a design constraint alongside capacity and efficiency. Charge thresholds determine which safety regime an installation falls under, which determines who may install it and where it may be placed. A propane system that stays below a threshold is a different commercial product from one that does not, even when the thermodynamics are identical.



Chillventa 2018. Photo: Refindustry

Data centre cooling arrives in force

Two years ago this cluster barely existed at a refrigeration fair. For 2026, coolant distribution units, liquid cooling hardware and leak testing appear across the halls, including from makers of refrigeration components.

Siemens brings a stainless steel valve for coolant distribution units and differential pressure control in liquid-cooled server racks, built for the densities AI workloads impose. Danfoss covers the same ground from oil-free compressors to distribution units, and frames it as heat management rather than heat removal: recovery from the chiller down to chip level. CAREL offers control for architectures from CDUs to direct-to-chip and immersion. Sanhua carries its brazed plate exchangers across from heat pumps into high-density liquid cooling.

The framing matters more than the hardware. GEA uses its forum

slot to argue that data centre cooling should be treated as a heat supply business rather than a cooling cost. That is the same argument food retail has been making about CO_2 systems, transplanted into a sector with far more money in it. Server heat is low-grade, continuous and geographically fixed: exactly the load profile a heat network wants, if someone builds the connection.



Chillventa 2024. Photo: Refindustry

Heat pumps reach the megawatt class

The heat pump range on show runs from 3,000 kW of heat per rack, sized for a district heating network, down to reversible units for a shop or a restaurant.

At the top end the numbers are in boiler territory. GEA's ammonia heat pump supplies at up to 95°C, driven by a screw compressor rated to 95°C and 70 bar. Danfoss rates its compressors to support industrial heat pumps at up to 120°C. Fenagy's CO_2 range delivers 500 to 3,000 kW of heat per rack with supply temperatures to 85°C, aimed at district heating, industry and heat recovery.

What changed is not the physics but the addressable market. A heat pump that supplies at 95°C can replace a gas boiler in food processing, district heating and light industry without redesigning the heat distribution around it. That removes the largest obstacle to electrifying process heat, which was never the heat pump itself but everything downstream of it.

SWEP puts the design consequence on the record in its forum session: European F-gas requirements are pushing heat pump design from kilowatt low-charge systems to megawatt units, and that change breaks assumptions about refrigerant distribution and oil management that held at small scale. Scaling up is not the same engineering problem with bigger parts.

Efficiency moves from the component to the system

The most consistent engineering message of this cycle is that individual components have reached the point of diminishing returns, and the next gains sit in how the parts work together.

ebm-papst builds its entire stand on that thesis, presenting new fans inside a digital ecosystem of monitoring, reporting and predictive maintenance rather than as standalone products. Embraco makes the same argument almost literally, with a controller that coordinates up to 16 components, 12 of them variable speed, and an auto-tuning tool the company says brings commissioning parameters down from weeks to days. CAREL turns installed units into remotely managed assets. Eliwell automates the compliance reporting around them.

CO_2 BALL & CHECK VALVES

UP TO

150 BAR



CO_2 COPPER FITTINGS

RATED AT

130 BAR



NDL

CO_2 COMPONENTS AT BOOTH #4A-413 AT CHILLVENTA

RDM states the problem from the other end, beginning from the observation that most operators already collect the data they need and fail to turn it into decisions. Gradhoc shows what acting on that data looks like: a platform that starts in read-only mode on an existing installation and can progress to adjusting suction pressure, superheat and setpoints automatically, within limits the customer sets, on top of whatever controls are already in place.

ABB raises the consequence nobody else does. Once variable speed drives sit on every compressor, pump and fan, power quality becomes the next constraint, and harmonic distortion is the price of the efficiency everyone else is selling. That is the mark of a technology that has genuinely become the default: its side effects have become a product category.

The transition ships as components

The last shift is the least visible and the most practical. Converting the industry to natural refrigerants is not only a compressor problem. It is a valve, fitting, sensor, coil and heat exchanger problem, and a transcritical system does not ship without any of them.

NDL extends its CO_2 valve and fitting programme to 150 bar ball valves in stainless steel and UL-certified copper fittings to 2-5/8 inch. Siemens offers a magnetic expansion valve in a 90 bar version for CO_2, rated to 150°C fluid temperature. SWEP covers CO_2, propane and ammonia in brazed plate exchangers. Tecumseh rebuilds its compressor platforms around propane and A2Ls. Boyard does the same at the small commercial end, down to monoblocks ready to take a propane leak detector.

None of this makes headlines. All of it decides whether a project reaches commissioning.

What the calendar does next

The 2027 cut removes supply. It does not remove demand from the systems already installed, which will need servicing for another decade or more. That gap is where recovery and reclamation sit, and A-Gas brings exactly that proposition: recover used refrigerant, reclaim it to AHRI 700 standards, resell it, destroy what cannot be reused. Regulation treats reclaimed gas differently from virgin production, which turns the installed base into a supply source.

At the other end of the same trade, AFS Cooling exhibits as a quota and compliance desk: authorisations, statutory reporting and refrigerant sourcing for manufacturers and importers. When compliance trading takes a stand next to compressors, the regulatory calendar has become part of the industry's hardware.

The question the next eighteen months will answer is not whether the technology works. That is settled. It is whether the installed base can be converted fast enough, by a contractor workforce that has to learn transcritical CO_2, hydrocarbons and ammonia at the same time, against a deadline written into law.

That is a training and capacity problem, not an engineering one. It is also the one the industry has said least about.

The figures behind these shifts are on page 10; the exhibitors, grouped by theme, from page 12.

The figures, and what they were measured against

Every efficiency figure in the exhibitors' Chillventa 2026 material, with its baseline and who measured it.

THE FIGURE	WHAT IT WAS COMPARED AGAINST	WHO MEASURED IT, AND HOW
ENERGY SAVINGS		
Panasonic **−25.4% LT, −16.2% MT energy** **−67% total emissions**	Inverter-controlled R404A condensing units. The company notes R404A was the benchmark of its day and has not been permitted in new EU systems since 2020.	Tests by Panasonic engineers in Japan. The emissions figure covers refrigerant losses plus energy.
Gradhoc **−41% industrial NH_3 · −35% food retail** **−18% 24/7 frozen storage**	The same installation before and after the optimiser was deployed. Compressor demand down about 40% in the retail case.	Published project data, month before against month after. The company states the periods and warns against extrapolating to other sites.
Secop **up to −40% energy**	A fixed-speed R404A compressor.	Company figure for the NLV and SLVE variable-speed series.
Embraco **up to −30% energy**	**No basis of comparison published.**	Company figure for the Sync it All Pro ecosystem, with case studies shown at the stand.
ABB **−25 to −50% at part load**	**An industry range, not a project result.** Fixed-speed operation implied.	Cited in a Specialist Forum session on specifying variable speed control for compressors.
TECHNICAL CEILINGS		
95 °C supply, complete machine **120 °C, component level**	Boiler-range output from a heat pump.	GEA ammonia heat pump at 95 °C. Danfoss rates its PSG scroll and KH3 screw compressors to support industrial systems to 120 °C.
3,000 kW heat per rack **2,500 kW per adiabatic cooler**	District heating scale from a single unit.	Fenagy H-range, 500 to 3,000 kW. MITA PAD-XL W, configurable to 20 fans across 11.6 metres.
155 bar · 150 bar · 90 bar	Working pressures a transcritical CO_2 system imposes on every part of the circuit.	Frascold CO_2 Two-Stage discharge design pressure. NDL stainless steel ball valves. Siemens MVL702 for R744, rated to 150 °C fluid.
under 150 g R290 per unit	Charge thresholds that decide which safety regime applies.	Arneg TOWER RING, one unit serving several display cases.
−50 °C · −86 °C	The low end of commercial and laboratory duty.	Frascold CO_2 Two-Stage evaporation. Secop ultra-low temperature condensing unit.

A percentage without a baseline is not a measurement. Where a company gave none, we say so.

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Visit us at hall 9

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Booth 9-330

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Technologies by theme

What exhibitors are bringing to Nuremberg, 13–15 October, grouped by the themes of the preview.

CO_2 in small formats



Arneg PRISMA, transcritical CO_2 systems for mini-markets and small stores. TOWER RING, first seen at EuroShop 2026, serves several display cases from one unit while holding the R290 charge under 150 grams. Also the IMOLA promotional island, the GLOBO CO_2 system and an R290 HP chiller. Incold, the group's cold room company, brings POLAR panels and four rapid roll-up door models built for airtightness.

BITZER ECOLITE air-cooled CO_2 condensing units for medium and low temperature, plug-and-play with capacity control. PERFORMANCE, OPERATIONAL SAFETY and CONNECTIVITY kits extend the ECOLINE ranges into retrofit work.

Epta and **Hauser** The full store lifecycle on natural refrigerants led by CO_2, from plug-in cabinets to remote cases and packs, with Hauser adding light industrial applications.



Frascold CO_2 Two-Stage semi-hermetic pistons: 11 models in three sizes, first-stage displacement 1.5 to 12.6 m^3/h at 50 Hz, 155 bar discharge-side design pressure, evaporation to minus 50°C. Built for single-compressor gas cooler units.

Panasonic Fifteen years of CO_2 condensing units, and a measured comparison against inverter-controlled R404A: 25.4 per cent less energy at low temperature, 16.2 at medium, 67 per cent lower total emissions.

TEKO ROXSTAdiscpack, a compact CO_2 unit for small markets, butchers, bakeries and food service. ROXSTAcube mini pure develops the cube mini line.

Data centre cooling

CAREL Control for liquid cooling from CDUs to direct-to-chip and immersion architectures, with programmable controllers, sensors and edge connectivity for high thermal density.

Danfoss Turbocor TGS490 Active Cooling compressor, an oil-free cooling ecosystem, a CDU electrical panel sub-assembly and the Virtus differential pressure controller. The company frames the work as heat recovery from chiller to chip level.

Eliwell and **Schneider Electric** The electrical layer: PLCs, drives and technologies for data centre cooling and HVAC alongside Eliwell's refrigeration controls.

Magnotherm Magnetocaloric cooling with no refrigerant at all. The ECLIPSE platform entered retail with REWE Group this year. STELLAR, modular units of 125 kW and above on high-temperature superconducting magnets, is a development programme rather than a product.

Sanhua A brazed plate heat exchanger range that carries over from heat pumps to high-density liquid cooling, on both R290 and R744.

Siemens A stainless steel Intelligent Valve for coolant distribution units and differential pres-

sure control in liquid-cooled racks. The MVL702 magnetic expansion valve in a 90 bar version for R744, rated to 150°C fluid temperature. Climatix controllers with AI diagnostics.

Heat pumps in the megawatt class

Clivet SHEEN PRO, an air-cooled reversible R290 heat pump for the commercial and service sector, with the CVT9-Y VRF development and the TC3-7 touchscreen controller.

Danfoss PSG scroll compressors for R600a and R1234ze and the KH3 screw, rated to support industrial heat pumps at up to 120°C. For commercial duty, the VPN variable-speed R290 scroll with vapour injection.

Enex Technologies widens the choice rather than narrowing it: its portfolio now spans five natural refrigerants, with isobutane (R600a) added to CO_2, ammonia, propane and water.

Two of the new units are heat pumps: Everest, an air-to-water four-pipe machine on R290 in a modular three-unit configuration, and a water-to-water high-temperature booster on isobutane for process heat, waste heat recovery and domestic hot water.

Fenagy The H-range of CO_2 heat pumps delivers 500 to 3,000 kW of heat per rack, air or water sourced, with supply temperatures to 85°C.

GEA RedGenium ammonia heat pump supplies at up to 95 C on a Grasso L XHP screw compressor rated to 95°C and 70 bar. Also the CompaX semi-hermetic ammonia screw, a frame for the V reciprocating package that removes the need for a concrete foundation, and an outdoor enclosure for sites without a machine room.



SWEP Brazed plate heat exchangers for CO_2, propane and ammonia, including the FI190 for residential heat pumps and the B4TS for high temperature duty.

Efficiency as a system

ABB Ultra-low harmonic drives on active front end technology, because power quality is the cost of universal variable speed. The ACH580-01 range extends to 315 and 355 kW wall-mounted, with IP66 and UL Type 4X drives for installation next to the application.

ebm-papst AxiBlade.Perform fans inside the NEXAIRA ecosystem of monitoring, reporting and predictive maintenance. Two forum sessions: smart fan retrofit with guaranteed energy savings, and the first hundred days of ErP26.

Eliwell AIR, an app and cloud platform that automates HACCP reporting and flags anomalies remotely. IDNext controllers, the EWHT 600 for temperature and humidity, and the LK-DNext leak detector.



Embraco Sync it All Pro coordinates up to 16 components, 12 of them variable speed, under one operating logic, with an auto-tuning tool the company says brings parameter setting down from weeks to days. The Scroll range, 1.2 to 35 HP, carries the brand into heating and air conditioning.

Gradhoc A platform that starts read-only on an existing installation and can progress to adjusting suction pressure, superheat and setpoints automatically, within limits the customer sets, on top of existing BMS, PLC and SCADA systems.

RDM Argues efficiency from the data side: most operators already collect what they need and fail to turn it into decisions.

Components and heat transfer

Boyard Monoblocks from 0.5 to 3 HP in fixed and variable speed for R449/448, R454C and R290, ready to take an R290 leak detector. A2L-ready outdoor condensing units to 3 HP, a variable-speed outdoor range to 8 HP.



KARYER (Hall 8, stand 8-108) shows dry coolers with adiabatic pad, spray or hybrid support that can be run separately as capacity demands, 5 mm coils for CO2 that cut size, weight and refrigerant charge, fruit-storage evaporators optimised for low moisture loss, and a new stainless steel cabinet-type brine cooler working at a 3 K temperature difference.

MITA Cooling Technologies and Frigofluid The PAD-XL W adiabatic cooler, configurable to 20 fans and 2,500 kW across 11.6 metres, wets its adiabatic section only when necessary under PLC control and recovers water without chemical treatment. From 2026 the group runs its own climatic test chamber.

NDL Industries CO_2 ball valves to 150 bar in stainless steel and UL-certified CO_2 copper fittings to 2-5/8 inch.

Sanhua and **Reftronix** A stainless steel component line, REVO refrigeration controllers, and a standard controller for CO_2 condensing units developed jointly.

Secop Five application areas, from food service to medical cold chain. Up to 40 per cent energy



saving across the NLV and SLVE variable-speed series against a fixed-speed R404A compressor, R290 compressors for domestic hot water heat pumps, and an ultra-low temperature condensing unit reaching minus 86°C.

Tecumseh Four compressor platforms for R290 and A2Ls: Nexus, fixed speed 2 to 15 cc; Vector, variable speed 4 to 13 cc; Axion, 22 to 33 cc; and the Spirion scroll family to 13 HP. On the systems side, the Orion fractional platform, the A2L-ready Astra outdoor unit and the Silensys Scroll Inverter, 3 to 19 kW.

The 2027 clock

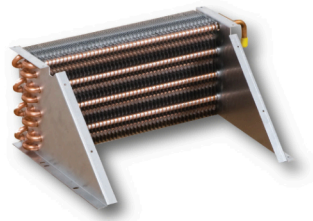
A-Gas Lifecycle refrigerant management: recovery, reclamation to AHRI 700 standards for resale, and UN-approved destruction of what cannot be reused. As new supply contracts, the installed base becomes a supply source.

AFS Cooling A quota and compliance desk: EU and GB quota authorisations, statutory reporting and refrigerant sourcing for manufacturers and importers.

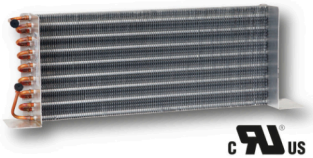
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KAR YER

www.karyergroup.com

Case study

Enex Technologies has the right refrigeration technology for every European climate

Comparing CO_2, ammonia and CO_2/NH_3 cascade systems for freezing applications

Freezing tunnels, blast freezers and similar low-temperature applications operate under demanding conditions. Choosing the right refrigeration system therefore requires more than comparing nominal COP values. Climate, capacity, electricity price, investment, maintenance, safety and operating requirements all influence the result.

To illustrate this interaction, Enex Technologies R&D team compared transcritical CO_2, pumped ammonia and CO_2/NH_3 cascade systems at 145, 300 and 600 kW across representative European locations. The annual COP maps show a clear climatic pattern. CO_2 is highly competitive in cooler regions, while ammonia and cascade systems progressively gain an efficiency advantage in milder and warmer climates. The trend is visible at every capacity. (See Figure 1)

Energy performance alone does not determine the best investment.

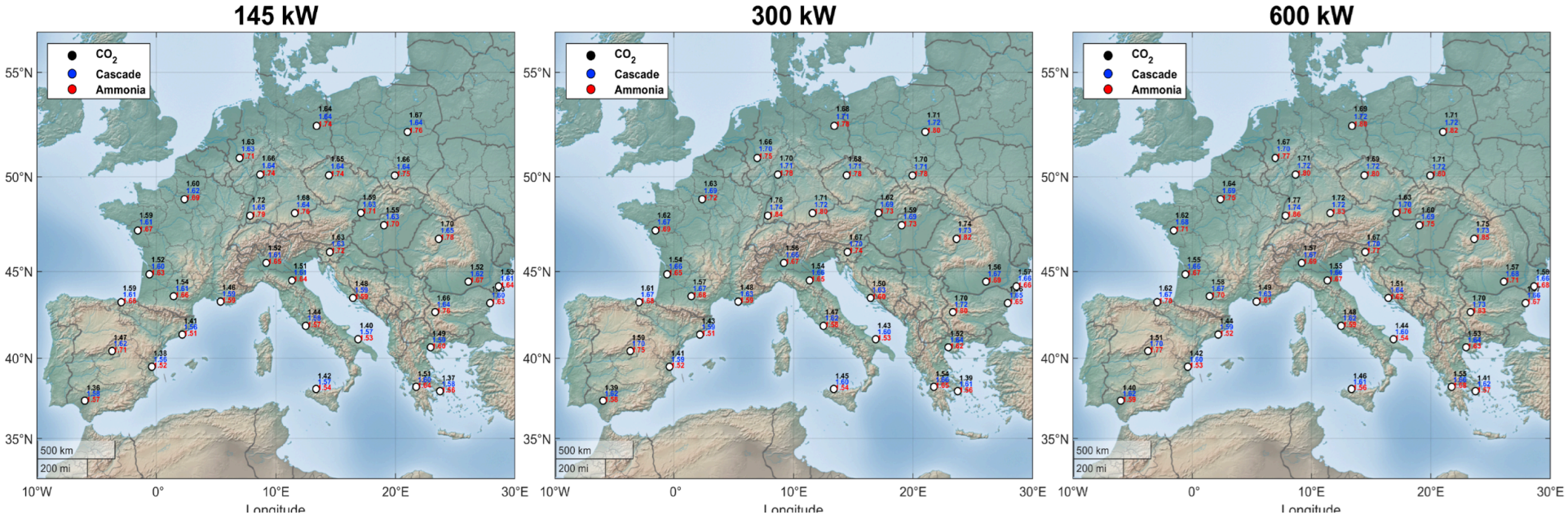


Figure 1. Annual COP for CO_2, CO_2/NH_3 cascade and pumped ammonia systems. Climate data: PVGIS Typical Meteorological Year.

The economic comparison uses CO_2 as the reference and country-specific industrial electricity prices. A higher annual COP can still produce a long payback when the additional initial cost is large. Warm climates and higher electricity prices instead increase the value of energy savings.

Capacity also affects the balance. Larger plants offer greater saving potential, but may require more expensive equipment. A favourable result at 145 kW cannot simply be scaled to 300 or 600 kW. This is why the payback maps differ from the COP maps. (See Figure 2)

The Enex Technologies analysis shows that CO_2/NH_3 cascade systems are the most attractive solution for large-capacity plants in hot, dry climates, such as Seville, whereas transcritical CO_2 is generally preferable for smaller plants in mild or cold climates, such as Berlin.

Enex Technologies can provide all three solutions—transcritical CO_2, ammonia and CO_2/NH_3 cascade—and is therefore able to evaluate each installation without favouring a predetermined technology. By combining climate, annual efficiency, energy prices, investment, service needs and application constraints, Enex Technologies can identify the solution that best fits each customer and location.

The customer receives a recommendation based on the complete technical and economic picture, not merely on the refrigerant or the highest nominal COP.

This research will be fully presented at Chillventa Forum on Wednesday October 14th. You can also visit Enex Technologies at Chillventa at hall 7 stand 7-210 and discover their full range of HVACR solutions with natural refrigerants.

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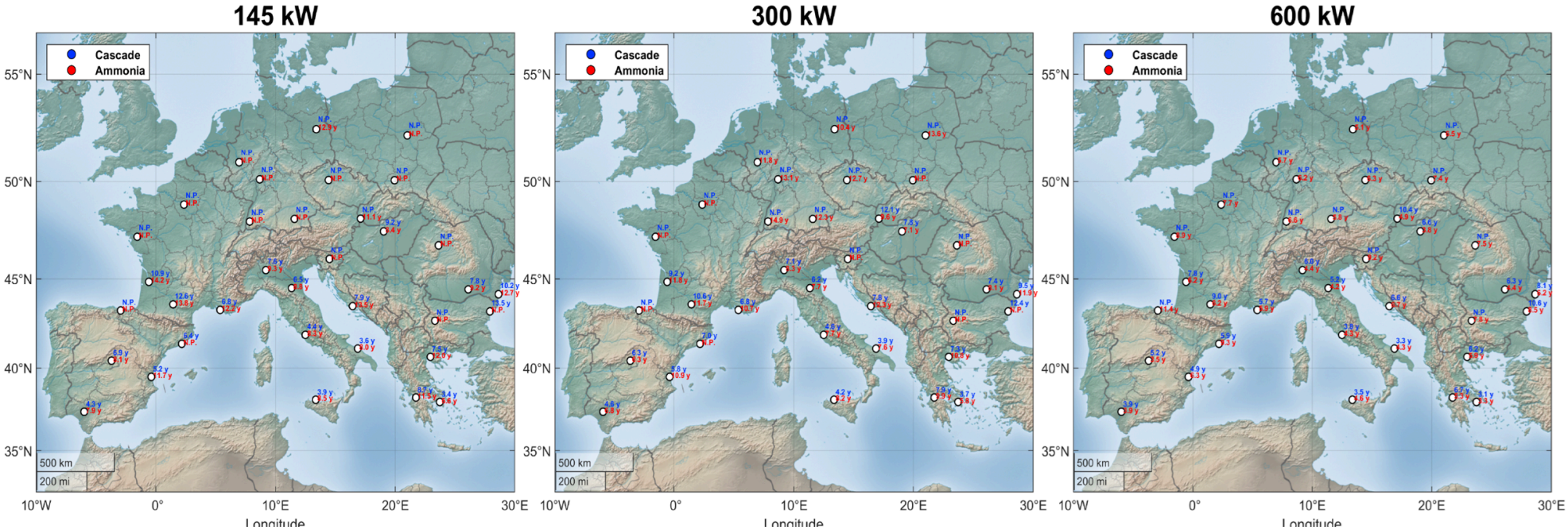


Figure 2. Simple payback of ammonia and cascade systems; N.P. indicates more than 15 years. Electricity prices: Eurostat non-household industrial band IC.

Case study

Breaking new ground in transcritical CO_2 systems





THE CUSTOMER

BITZER Australia, an industry leader in compressors, engineered refrigeration packages, pressure vessels, and air conditioning solutions.

THE CHALLENGE

Maintain critical temperature parameters for multiple loads, even when ambient temperatures reach 48°C.

THE SOLUTION

Create a new transcritical CO_2 system for a Woolworths grocery store in Sydney, Australia.

THE HEAT EXCHANGERS

The new system depends on SWEP B12, B200T and B18 brazed plate heat exchangers.

THE RESULTS

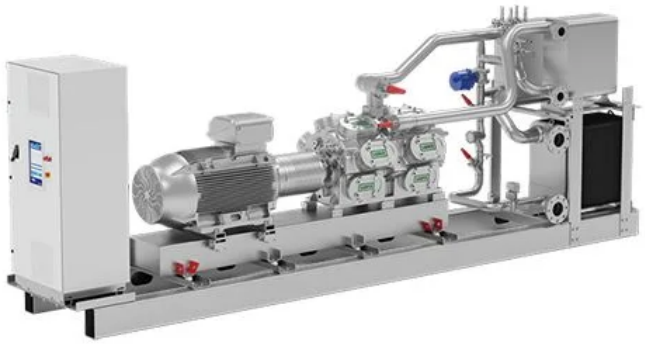
The system delivered exceptional temperature control to all connected loads – including a 34-kW frozen produce load, a 205-kW chilled produce load, 325 kW of space cooling and 12 kW of heating, even when peak temperatures reached 48°C.

swepgroup.com

New products

HEAT PUMPS AND WASTE HEAT

Johnson Controls launches high-temperature heat pumps for Europe



Johnson Controls has launched the Sabroe HitemHP range of industrial high-temperature heat pumps for European industries that need high-temperature process heat, built in Denmark around the Sabroe SMC single-stage reciprocating compressor and running on butane and iso-butane. Output reaches 122 °C and capacity turns down to 18 per cent. The company reports a COP up to 20 per cent higher at part load than at full capacity, and service intervals extended by nearly half. In one customer case, based on site-specific conditions, the system delivered up to three times the efficiency of electric boilers.

KIMM develops heat pump using 40°C waste heat for cooling

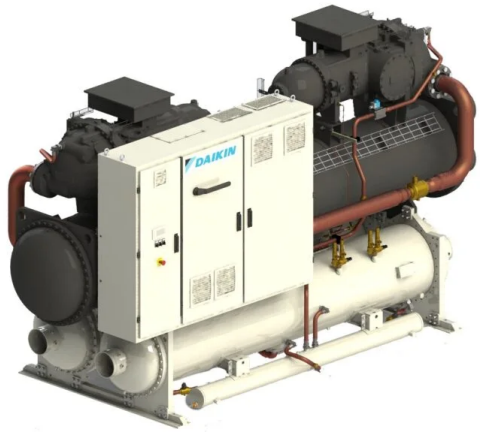
The Korea Institute of Machinery and Materials has demonstrated cooling from waste heat at about 40 °C, against the 70 °C and above that conventional adsorption systems require. The chemical adsorption heat pump uses ammonia and pairs with an electrochemical compressor developed at Chung-Ang University that has no mechanical moving parts. A redesigned adsorption bed reaches a specific cooling power of 346.5 W/kg. Samjung Tech built the 10 kW prototype now in demonstration testing.

COMPONENTS AND CONCEPTS

MHI develops N-Bleath ultra-low-temperature nitrogen brine chiller

Mitsubishi Heavy Industries Air-Conditioning and Refrigeration has developed N-Bleath, a brine chiller running an air refrigerant cycle on nitrogen, with sales from April 2027. It covers minus 40 °C to minus 100 °C for process cooling in pharmaceuticals, chemicals and semiconductors, and for environmental testing. A compact electric turbo with oil-free bearings removes lubricant changes. Nitrogen carries zero ODP and GWP and is PFAS-free, and the company says the unit is not subject to Japan's High Pressure Gas Safety Act.

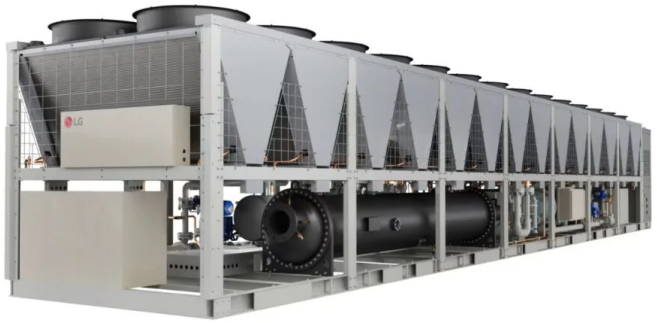
Daikin introduces DC-powered marine chiller concept at SMM 2026



Daikin is presenting a marine chiller concept at SMM 2026 that connects directly to onboard direct current distribution, using a dedicated DC/AC inverter and pre-charge architecture. On hybrid, electric and research vessels, fewer conversion stages between the energy source and the compressor drive can eliminate transformer losses and simplify power quality management. Units can be configured for onboard systems up to 1,050 VDC. Daikin reports more than 300 MW of installed marine cooling capacity, from 90 kW to 9 MW per unit.

DATA CENTRES

LG Electronics launches air-cooled centrifugal chiller for AI data centers



LG Electronics has launched an air-cooled centrifugal chiller for AI data centres, 480 to 600 refrigeration tons per unit, on an oil-free magnetic bearing compressor. Its free-cooling mode circulates refrigerant directly, without an intermediate heat exchanger or glycol, which by the company's internal simulation consumes about 30 per cent less energy a year than waterside free cooling. An integrated UPS stops the shaft safely during an outage, and cooling returns within three minutes.

Trane and Eaton integrate power and cooling for AI data centers

Trane Technologies and Eaton have published a joint reference design aligned with NVIDIA DSX platforms, combining thermal and electrical architecture for high-density AI sites. Against conventional low-voltage designs the companies report combined energy efficiency gains of up to 15 per cent, up to 80 per cent less copper and installation costs lower by up to 30 per cent. The design lets thermal and electrical systems exchange leading indicators from grid to chip.

RETAIL REFRIGERATION

FREOR Improves IDA QB Counter Energy Efficiency by Up to 45%



FREOR has reengineered its IDA QB self-service counter to deliver up to 45 per cent greater energy efficiency than previous models, moving it from energy class C to class B. The counter keeps its autonomous Plug & Cool system on R290. The gain comes from insulated glass units with a low-emissivity coating, held in a metal frame rather than drilled into the counter, XPS insulation under the base, and counter-specific glass lids that seal more tightly against cold air loss.

COMPONENTS AND CONCEPTS

Mitsubishi Electric develops plate heat exchanger with triple heat transfer

Mitsubishi Electric has developed a plate heat exchanger for heat pump equipment with roughly three times the heat transfer of its conventional grooved plates, which cuts the required refrigerant charge to about a third. Micro-offset fins between flat plates promote turbulence, and distribution channels at the inlets and outlets spread two-phase refrigerant evenly across the plates. The company links the smaller charge to flammable lower-GWP refrigerants such as R32.

TRANSPORT REFRIGERATION

GIZ Proklima showcases R290 reefer prototype at sustainability event

GIZ Proklima and Thermo King Global Marine displayed an R290 refrigerated container prototype at Hamburg Sustainability Week, replacing conventional fluorinated refrigerants with propane. Initial testing indicates energy savings of around 15 per cent against conventional reefer systems, alongside the removal of PFAS-containing fluids from the circuit. The project is moving from concept toward use in cold-chain logistics through the Greener Reefers Transition Alliance.

LABORATORY REFRIGERATION

Haier Biomedical Debuts Storage Systems at European and Japan Exhibitions



Haier Biomedical launched new low-temperature storage at Europe Biobank Week 2026 in Prague and Interphex Week Tokyo 2026. In Prague it showed the HAB80-60KA / HAB80-60KB automated storage system, holding samples at minus 80 °C in a modular layout for 50,000 to more than 200,000 samples. In Tokyo it unveiled the DWL368BPST ultra-low-temperature freezer, 670 mm wide, for laboratories with limited space. Against conventional models the company reports temperature uniformity of plus or minus 2 °C instead of 4 °C, 26 per cent lower energy consumption, 45 per cent faster temperature recovery and operating noise below 44 dB.

MOBILE AIR CONDITIONING

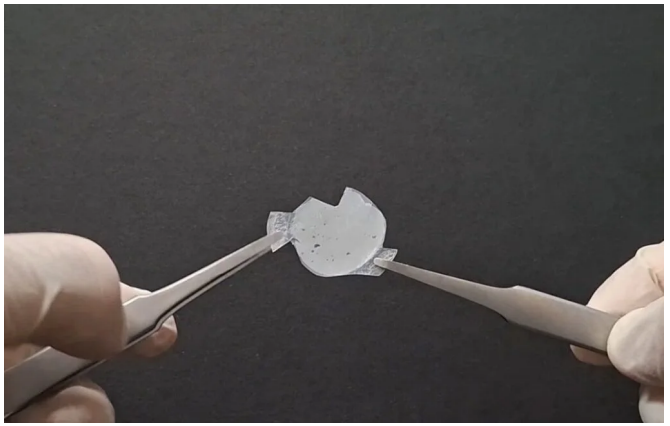
Solstice Introduces R-1234yf Retrofit for 100 Million R-134a Car Systems



Solstice Advanced Materials has introduced Direct-to-YF, a retrofit that converts car air conditioning from R-134a to R-1234yf without replacing components of the existing circuit. The procedure recovers the remaining charge and repairs the leak, fits snap-on adapters, then adds an oil additive before recharging. No new workshop equipment is needed. According to Solstice, the European aftermarket services more than 100 million R-134a systems. A commercial availability date has not been set.

RESEARCH

CSIC Develops Nanomaterial for Passive Cooling Without Electricity



Researchers at Spain's Institute of Micro and Nanotechnology have produced three-dimensional PVDF nanostructures that cool a surface under direct sun without electricity. The material reflects most solar radiation and emits heat through the atmospheric window between 8 and 13 micrometres. Outdoor tests in summer 2025 measured up to 12.9 °C below an uncoated reference sample in warm, dry conditions with high solar radiation. The work is published in Nanophotonics.

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Market news

DEALS

Madison Air to acquire ebm-papst in €5.1 billion deal



The owner families of ebm-papst have agreed to transfer their shares to the US company Madison Air, in a transaction valuing the fan and motor manufacturer at 5.1 billion euros. Closing is expected around the end of 2026. Mulfingen remains the headquarters and a site for research and manufacturing, and existing collective agreements are unaffected. ebm-papst employs more than 13,000 people, about 5,800 of them in Germany.

SLB agrees to acquire Germany's Kelvion for $4.1 billion

SLB has agreed to acquire the German thermal management manufacturer Kelvion for about 3.4 billion dollars in cash plus roughly 0.7 billion dollars of assumed debt. Kelvion is majority owned by Apollo-managed funds, with Triton holding a minority interest. Data centres are now Kelvion's largest and fastest-growing segment. SLB expects its data centre business to reach cumulative deliveries of more than 2 GW globally by year end. Closing is expected in the first half of 2027.

REGULATION

DEFRA delays tighter HFC phasedown in Great Britain

DEFRA will not alter Great Britain's HFC phasedown for 1 January 2027, saying further work is needed before a new proposal. The existing rules stand: quota falls from 31 to 24 per cent of the baseline, a 22.6 per cent cut in refrigerant availability, with a further reduction due in 2030. The consultation had proposed 16.2 per cent, equivalent to a 47.7 per cent cut. Northern Ireland continues to follow EU F-gas legislation.

US States and New York City Sue EPA Over Delayed HFC Phaseout



A coalition of 18 states, Washington DC and New York City filed suit on 21 July against the EPA rule that gives commercial refrigeration extra time to leave certain HFCs. According to the New York attorney general's office, the rule pushes compliance deadlines back by up to six years, and would let remote condensing systems in supermarkets, convenience stores and bakeries use refrigerants with more than nine times the previously permitted GWP until 2032.

REGULATION

EU plan calls for 4 million annual heat pump installations by 2030

The European Commission's Electrification Action Plan, published on 17 July 2026, calls for annual heat pump installations to rise from 2.4 million in 2025 to 4 million by 2030. It proposes capping national electricity-to-gas price ratios at 2.5 for households and 2.0 for industry, and states that electricity should not be taxed more heavily than gas. The plan also launches an EU Waste Heat Initiative, targeting 11 per cent of European heat demand from waste heat by 2050.

Australia proposes new GWP limits for HFCs and HFO management rules



Australia is consulting on GWP limits for new HFC imports and uses under its industrial chemicals standard. Split, ducted and light commercial air conditioning would need refrigerants below 750 GWP from 1 January 2028 and below 150 from 2036, while other stationary air conditioning, heat pumps and domestic and commercial cold-chain applications would face the 150 limit from 2028. Separate HFO handling rules would apply from 2027. Consultation closes on 23 October 2026.

Singapore NEA Tightens Refrigerant Rules for RAC Equipment

From 1 July 2027 new centralised commercial refrigeration systems in Singapore, the type used in supermarkets, must run on refrigerants with a GWP no higher than 150. The same limit applies to air conditioning in new passenger cars and light goods vehicles from July 2028. Existing equipment may run to the end of its service life. Companies dismantling covered equipment must register with the National Environment Agency from July 2027.

EU Tightens Fan Efficiency Rules from 2026

Stricter ErP requirements for fans apply from 24 July 2026. Axial fans must reach a fan efficiency grade of 50 per cent and backward-curved centrifugal fans 64 per cent, measured as total static efficiency at the best efficiency point, but the revised regulation also shifts assessment toward performance across the real operating range. Spare parts must stay available for up to ten years after discontinuation, and product information must be stored for up to twenty.

MANUFACTURING

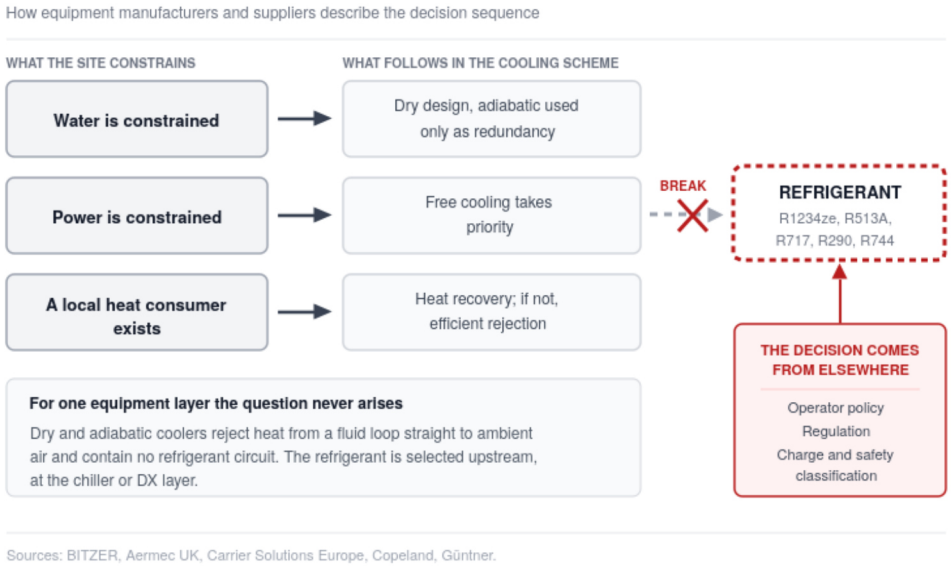
Samsung to establish HVAC production line in South Korea



Samsung Electronics is investing about 240 billion won, some 158 million dollars, in a FläktGroup production line at its Gwangju site in South Korea, due for completion by 2028. The 21,500 square metre plant will make HVAC products including cooling for AI data centres, and becomes FläktGroup's fifteenth manufacturing facility. Samsung acquired FläktGroup last year and is aiming the output at Korean industrial demand, data centres in particular.

Daily coverage: refindustry.com

The Site Decides the System, the Operator Decides the Refrigerant



In data center cooling the efficiency trade-offs are made at the site: dry against evaporative, water against energy, heat rejected against heat recovered. Six equipment suppliers explain where those decisions are taken, and why the refrigerant is rarely one of them.

The first part of this series, published on Refindustry, traced a chain of decisions from public data and disclosed projects: what a site can supply in power, water and demand for waste heat sets the cooling architecture, and the architecture narrows the refrigerant. This part puts that chain to six people who build and supply the equipment.

The first link holds. Suppliers describe resource availability as the starting point of the design, and in some locations a cooling scheme is ruled out by site conditions before any technical comparison begins.

The second link does not. Refrigerant selection turns out to be only loosely coupled to the site. It is set by the operator's corporate policy and by regulation, and for one entire equipment layer it does not arise at all.

Where the resource logic holds

Water is the constraint that shows up first, and it pushes designs dry.

"Where water is constrained, we lean dry and use adiabatic only as a form of redundancy, which often lets a site avoid on-site water storage entirely," said Alex Schafer, Director of Sales for Climate Solutions at Güntner in Chicago. He linked this to conditions across the United States, where much of the country is now abnormally dry or in drought, including locations not traditionally treated that way.

Going dry costs energy on site, and Schafer put a number on what it costs and what it returns. A well-optimised adiabatic system may only use on the order of 10 to 20 percent more energy per year on site than an evaporative solution, with a large reduction in water use. Counted net rather than on site alone, the comparison changes. Treating and distributing 1,000 gallons of water takes

10–20%

more site energy per year for a well-optimised adiabatic system than an evaporative one. Counted net, the gap closes.

roughly 3 to 5 kWh, and generating a kWh consumes 2 to 4 gallons, so once those off-site impacts are included the adiabatic system ends up using similar or slightly less total energy while cutting water consumption sharply. These are national averages, he noted, and vary considerably by location and generation mix.

Yan Evans, Managing Director of Güntner Data Center Solutions, described the same hierarchy. Where no water is available the solution has to be fully dry; where water is available but restricted, evaporative or adiabatic operation is used selectively at peak ambient conditions rather than as the default mode. His summary of the method: understand which resource is under pressure and design around that constraint from the beginning.

Power constraints push in the same direction. Evans framed it as an allocation problem, since every watt spent on cooling is a watt not available for compute. Michel Grabon, Data Center Vertical Engineering Director and Product Marketing Director at Carrier Solutions Europe in Montluel, France, described what Carrier commonly applies in Europe: primary-loop networks with air-cooled chillers and a hydronic free-cooling option, dry cooling where appropriate to limit water impact, and an option that caps chiller capacity where available power is restricted.

Waste heat behaves differently from the other two resources, because it depends on conditions outside the fence. Grabon said Carrier offers recovery equipment compatible with district heating and industrial temperature levels up to 85 or 90 °C, and attached three conditions to it: suitable heat demand, infrastructure, and commercial arrangements. Evans set the same threshold, distinguishing sites with a practical local heat consumer from sites without one, where the objective stays efficient rejection. Mike Oakley, Senior Director of Portfolio Marketing at Copeland, pointed to industrial heat pumps taking low-grade data center heat up to usable network temperatures for district heating.

Rising rack and chiller temperatures, Schafer said, are making fully air-cooled systems feasible in a way they were not previously, and Oakley described the same trend from the component side, with chip manufacturers developing parts that run hotter and require less cooling.

Where the chain breaks

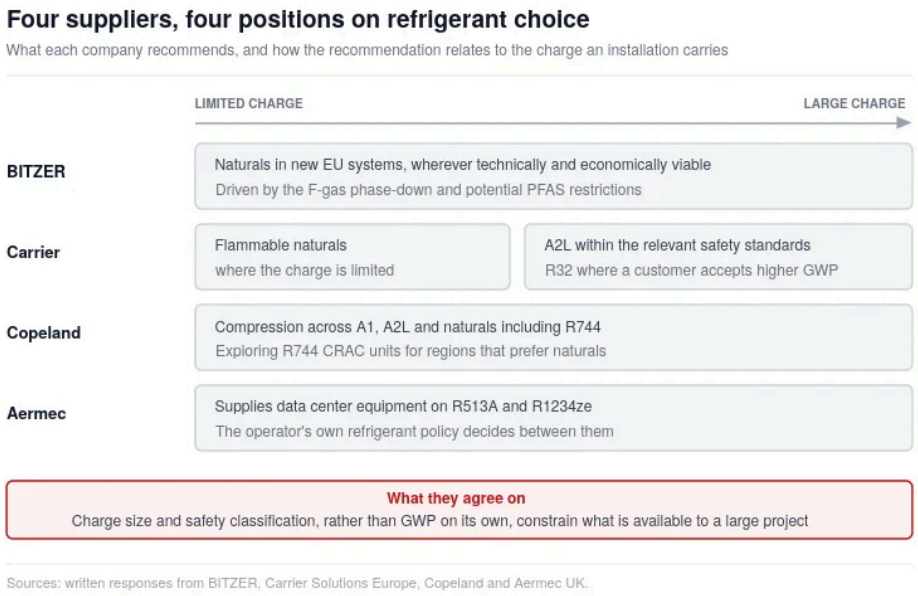
The proposition that site resources reach through to the refrigerant met direct resistance.

Andy Hawes, General Manager Technical Services at Aermec UK, said site resources are addressed upfront at system selection stage and heavily influence cooling strategy, but that the refrigerant choice "rarely if ever changes" as a result. Aermec supplies data center equipment on R513A and R1234ze, and described operator requirements as driven by net zero goals, operational risk and performance, with the customer's own strategy the deciding factor rather than manufacturer preference. Whichever fluid is chosen, the system is judged against the same criteria: he put European benchmark expectations for new facilities at annual PUE below 1.3, with some operators working toward 1.2 where site conditions allow.

> ***“Aermec follows the data centre operators’ own policy and does not directly choose the refrigerant.”***
>
> Andy Hawes, General Manager Technical Services, Aermec UK

Evans made a structural point that goes further. Dry and evaporative or adiabatic coolers reject heat from a fluid loop directly to ambient air and contain no refrigerant circuit at all. "That decision sits upstream, at the chiller or DX layer, and is made by the customer's engineering team and equipment suppliers," he said. For that layer of the system the refrigerant question does not arise; it is settled elsewhere in the architecture.

Four companies place refrigerant authority with the operator. What they would recommend if asked is another matter.



What actually forces the decision

What pushes a project away from the technically best option is rarely the technology. Schafer named capital cost first: a more efficient system can be designed by oversizing the heat rejection components, but it may be infeasible in terms of capex. Then speed of deployment in a booming construction market, skilled labour, and infrastructure, where some facilities have ample water available but no means to get water to the site and carry wastewater away. Oakley named unfamiliarity and a preference for familiar solutions. Evans named site selection and timing: energy and water availability increasingly determine where operators build, and a system that is technically sound when specified may be less suitable by the time the site is operational.

None of those constraints are refrigerant properties. Codes, insurance and fire load enter the picture, but as inputs priced into the specification at the start rather than as the reason a design changes late.

Schafer expects density to keep rising, with restrictions on power and water tightening and on-site generation becoming more common. Evans put the constraint in project planning: cooling architecture, redundancy strategy and operating assumptions are difficult to reverse once a site is designed. The sites that gain most, he said, treat cooling as a strategic design decision from the start rather than a late-stage equipment choice.

What emerges is a market where the site sets the architecture and the operator sets the refrigerant, and where the practical limits on both are capital, schedule and people rather than the technical merits of any fluid. The operators' own account of those decisions is the next piece of work.

The full version, with every supplier answer. Read it on Refindustry

Where this account comes from. All six contributors build or supply equipment; no data center operator or consulting engineer is among them, and operating data from live facilities stays with the operators. What operators decide, and why, is here the supply side’s reading of its customers. Written responses provided to Refindustry, July 2026.

A2Ls Are Not a Bridge: Heatcraft on Refrigerant Choice in North America



David Bolaños, Director of Marketing and Product Management, Heatcraft Refrigeration Products. Photo: Heatcraft

Sergei Mukminov, Editor-in-Chief of Refindustry.com, interviewed David Bolaños, Director of Marketing and Product Management at Heatcraft Refrigeration Products, about the direction of the North American commercial refrigeration market and the thinking behind the company's refrigerant strategy. The interview was conducted in writing in August 2026.

It comes at a point when the regulatory ground has shifted again. On 21 May 2026 the EPA finalized its reconsideration of the 2023 Technology Transitions Rule. New supermarket systems may use refrigerants up to 1,400 GWP from 1 January 2027, and new remote condensing units up to 1,400 and new cold storage equipment up to 700 from 60 days after publication in the Federal Register. In all three cases the original 150 and 300 limits return on 1 January 2032, a delay of five to six years against the schedule the industry had been planning around. That optionality arrived at the moment the market had finally moved from planning the transition to executing it.

The distance still to travel is considerable. In its 2025 market report, ATMOsphere puts CO_2 penetration in North American supermarkets at around 6 percent, against roughly a third in Europe, with about 5,120 stores in the region running transcritical systems, a quarter more than a year earlier. Whether that gap closes on a European trajectory, or on a different one entirely, is the question underneath most equipment decisions being made in the region today.

Bolaños argues that the timing changed but the destination did not, and that the market is not converging on a single refrigerant at all. He makes the case for A2Ls as a durable answer rather than a

transitional bridge, sets out where CO_2 does and does not fit in North America, explains how dual-listed A2L and A1 equipment is meant to let customers defer the refrigerant decision, and describes the technician shortage as a real constraint on how fast the transition can move.

The Chillventa preview earlier in this issue is written against the European quota cut of 1 January 2027. This conversation describes a market working to a different timetable.

North America is often described as several years behind Europe on low-GWP adoption, with CO_2 penetration in supermarkets still a fraction of the European level. Is that gap closing, or is it being shaped by different drivers entirely, and what is a realistic timeline for most new installations to move off high-GWP HFCs?

The gap is narrowing, but North America is not simply trailing Europe on a delayed timeline. The market is being shaped by different application, regulatory, infrastructure and cost drivers, which means adoption is happening at different rates across different segments. In areas like food retail, operators are already gaining real-world CO_2 experience and moving from evaluation to implementation. The transition away from high-GWP HFCs will continue, but is unlikely to follow a single deadline or a single refrigerant pathway. Instead, adoption will occur in stages as lower-GWP solutions become the right fit for specific applications and operating environments.

The industry is split on whether A2Ls are a durable long-term answer or a transitional bridge that will eventually face its own lifecycle and chemical-policy scrutiny. Where does Heatcraft place A2L in its refrigerant strategy, and how do you respond to those who see it as an interim step?

Heatcraft views A2Ls as a durable part of the North American transition, not a temporary bridge, particularly for small and medium commercial applications where system architecture, service practices and total installed cost matter. We do not see A2L and CO_2 as competing answers because they solve different problems. A2Ls are well suited for smaller systems, foodservice and walk-ins, while CO_2 is often a better fit for supermarkets, industrial refrigeration and larger centralized systems. That is why we believe A2Ls will remain an important lower-GWP solution alongside other refrigerant technologies, rather than a stage the market passes through.

Environmental scrutiny is widening beyond GWP toward lifecycle impacts and chemical-policy pressure, including PFAS and the TFA that HFO refrigerants break down into. For manufacturers whose transition path leans on A2Ls and HFOs, what is the real risk if that scrutiny tightens over the next five years, and how are you factoring it into your own refrigerant thinking?

Environmental policy, refrigerant technology, and sustainability expectations have continued to evolve throughout our industry's history, and we expect that evolution to continue. Rather than developing products around a single regulatory scenario, Heatcraft's roadmap focuses on customer applications and maintaining a

6% / 33%

CO_2 penetration in North American supermarkets against roughly a third in Europe. ATMOsphere 2025 market report.

broad portfolio of compliant low-GWP solutions.

Regulation in North America has become less linear, with the AIM Act, the EPA Technology Transitions Rule, state-level programs, and shifting timelines all in play at once. How do you plan a product roadmap and commit capital when you have to design for several regulatory scenarios simultaneously?

We plan by designing for flexibility rather than committing capital to a single regulatory outcome. Specific requirements may change, but the broader direction toward lower-GWP refrigerants, greater efficiency and more sophisticated controls remains clear. That allows us to invest with confidence while maintaining flexibility to adapt as regulations evolve.

Our A2L-convertible system platform is a good example. It gives customers options based on their application, timing, and local requirements rather than forcing a one-size-fits-all solution. A key feature of the new A2L equipment is its dual refrigerant class UL listing. This means the same newly designed equipment can be used with either legacy A1 HFC refrigerants or newer A2L refrigerants, giving contractors, distributors, and end users a more flexible path as the industry transitions from A1 to A2L refrigerants.

For new installations, customers can order a fully configured A2L system with the Refrigerant Detection System installed at our factory. For replacement applications, customers can order UL-listed A2L/A1 dual-class condensing units and/or A2L/A1 dual-class convertible unit coolers that can operate initially with A1 refrigerants and later be converted for A2L use with our proprietary field-installed Refrigerant Detection System kit.

The conversion option applies only to Heatcraft's newly designed A2L/A1 unit coolers, not older A1-designed equipment. This approach is intended to support a safer, simpler, and more flexible transition for the commercial refrigeration market while helping customers manage equipment replacement and future refrigerant requirements.

CO_2 is well established in European food retail but remains a minority architecture in North America. What specifically has to change, on installed cost, high-ambient efficiency, and service capacity, for CO_2 to become a default choice here rather than one option among several?

For CO_2 to move from a strong choice in select segments to a default, three things need to improve: installed cost, high-ambient performance and service capacity. Contractors need broader experience with the technology, customers need confidence in its performance across climates, and the industry needs deeper service and supply-chain support. That said, North America is unlikely to follow Europe's path exactly because our building stock, operating environments and customer requirements are different. We continue to invest in CO_2 solutions, training and application support, but our view is that CO_2 should be chosen when it is the best fit for the application, not simply because it offers the lowest GWP.

> ***"Heatcraft views A2Ls as a durable part of the North American transition, not a temporary bridge."***
>
> David Bolaños, Director of Marketing and Product Management, Heatcraft Refrigeration Products

The technician shortage is deepening just as A2L, CO_2, and controls-heavy systems raise the skill bar for installation and service. How is that shortage reshaping what the industry, and manufacturers specifically, are expected to provide, and is it becoming a real constraint on how fast the transition can actually move?

The technician shortage is absolutely a constraint on how quickly the transition can move because newer refrigerants, controls and connected systems require a higher level of skill to install, commission and service. Selling equipment is no longer enough. Customers need training, application expertise, controls support and practical field education to successfully adopt these technologies. Heatcraft views training as part of the solution itself, which is why we expanded our training programs and facility to help contractors and distributors build confidence with new refrigerants, controls and system architectures.

Equipment is only half of the refrigerant transition. The other half is the workforce, ensuring those installing and servicing this equipment are prepared for new refrigerants and the safety practices they require. In 2026, we trained 1,274 contractors. Certification takes it further, providing a credential that demonstrates field readiness. As of 1 August, 844 contractors nationwide are certified, up 91 this year. Training builds reach, certification builds depth, and together they ensure contractors are equipped to succeed in the field.

1,274 contractors trained by Heatcraft in 2026, as the company describes training as part of the transition itself.

Looking three to five years out, where do you see the growth in North American commercial refrigeration beyond traditional food retail, and what is the one shift most of the industry still underestimates?

Beyond traditional food retail, we see growth over the next three to five years in cold storage, food processing, industrial refrigeration, pharmaceutical storage, data center and other specialized cooling applications. But the shift most of the industry still underestimates is that refrigeration is becoming a systems-driven business rather than a product-driven one. Refrigerant choice is now only one part of a broader decision that includes compliance, safety, controls integration, energy performance, serviceability and lifecycle cost. As those decisions become more complex, customers increasingly need expertise and support in selecting the right solution for their application, not simply another piece of equipment.

Thank you, David, for sharing your insights!

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