WORLD GUIDE TO TRANSCRITICAL CO_2 REFRIGERATION

PART II

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World Guide to
Transcritical CO_2 Refrigeration

THIS PROJECT WAS SUPPORTED BY

WELCOME MESSAGE BY LEAD AUTHOR

As the use of transcritical CO_2 refrigeration systems increase at an exponential rate around the world, it has become apparent that there is a great need for reliable information from a neutral source. As such, sheccoBase, the "brain" behind shecco, has undertaken an extensive market study to analyze the current state of the global industry and various trends.

When we first started collecting data in 2008, we only counted 140 transcritical CO_2 systems – all of which were in Europe. Today, this number is well beyond 30,000 globally as the accelerated phase down of harmful synthetics drives the search for a more climate-friendly alternative. Most notably we have found that this technology is no longer only used in commercial refrigeration installations. More and more we are seeing success stories in small convenience stores and even larger industrial installations.

The number of transcritical CO_2 installations keeps growing as industry finds innovative ways to realize the potential of CO_2, even in warmer ambient climates previously thought incompatible with transcritical systems. Ice rink applications in particular are also becoming ever-more popular globally.

Thanks to extensive market research and data collection by the inhouse sheccoBase Market Development team, we are proud to present this "World Guide to Transcritical CO_2 Refrigeration." Our hope is that it will serve as a resource to help drive the accelerated uptake of this highly sustainable and energy efficient HVAC&R technology. That is why it will be freely available, at no cost, as our contribution to help drive "clean cooling."

The Guide will be published in three separate parts after which the entire combined resource will be available for download online. Part 1 will look at CO_2 as a refrigerant, covering the history, policy measures and basic technical aspects related to this gas. It will also include a chapter on applications, showing case studies from around the world where transcritical CO_2 has been successfully deployed.

In Part 2, we will specifically look at convenience stores as well as commercial refrigeration installations, sharing market research and data regarding the number of installations worldwide and key market trends. Part 3 will cover industrial applications, as well as barriers and opportunities for the uptake of transcritical CO_2 systems, looking at the future market potential and trends.

Allow me a moment to thank our sponsors who have made this guide possible, many of whom have been key drivers of the uptake of natural refrigerants globally. Some of them will be sharing their expertise and experience by means of partner case studies and interviews, which will feature in Part 2 and 3 of the Guide.

Disclaimer: With technology moving so quickly, the numbers in this Guide might soon be out of date. Make sure to follow us online and on social media to get the latest updates on CO_2 and all other natural refrigerants too.

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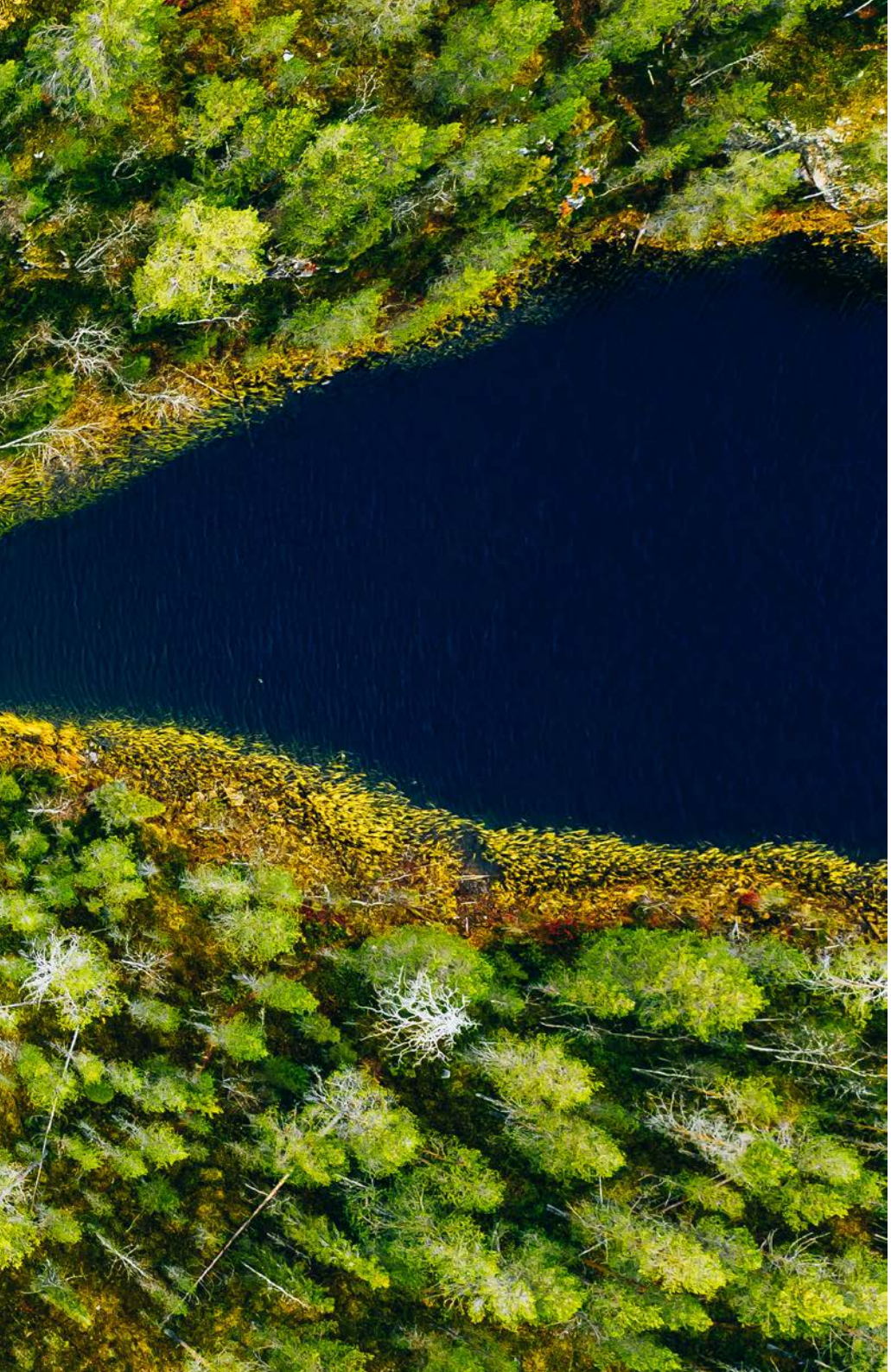
ABOUT THIS GUIDE



Introduction

The use of CO_2 as a refrigerant began in early industrial times and has been revived in the past few decades. Just like other natural refrigerants (ammonia, propane, isobutane etc), it neither contributes to ozone depletion nor to global warming, making it a preferred choice in terms of climate friendly cooling technologies.

CO_2 is often preferred over other natural alternatives as it has no flammability risk and no toxicity issues. This has allowed it to thrive without fear of policy or standard interventions that so often stifle the growth of alternatives such as ammonia and/or propane. The only potential concern is the high operating pressures of a CO_2 system, but much research and development has gone into designing the modern systems of today to ensure that this can easily be accommodated.

It's clear that CO_2 is the rising star of the commercial food retail industry – particularly since the refinement of transcritical systems. In Europe especially it's become almost a "no brainer" to select transcritical CO_2 systems for any commercial retail project – new or retrofit. Not only does this ensure the installation is future proof and protected from inevitable synthetic refrigerant phase downs, but it usually also offers impressive energy savings over other refrigerants – curbing indirect greenhouse gas GHG emissions as well as direct ones.

However, CO_2 is no longer confined to just commercial installations. Even smaller convenience store end users are seeing the benefit of going the transcritical CO_2 route and despite a widespread belief that industrial systems are more the domain of ammonia; there is a clear rise in industrial CO_2 applications around the world.

The global HVAC&R market is changing, and it is crucial to keep with the latest industry trends and technologies. As such, this guide will specifically look at the potential of transcritical CO_2 – today and in the future. By sharing case study examples, technical information, policy updates, challenges, opportunities, and even actual figures on the amount of installations completed globally, the aim is to help accelerate the uptake of this climate-neutral, sustainable refrigeration technology around the world.

A SHORT OVERVIEW

CHAPTER 1:
Introduction to CO_2 as a refrigerant

This chapter takes a look at the history of the use of CO_2 as refrigerant. It describes the key characteristics of CO_2, the types of available systems and the technical function of various components.

READ IN PART I

CHAPTER 2:
Applications of transcritical CO_2

This chapter shows examples of applications of transcritical CO2 around the world, from its beginnings in commercial supermarkets to new convenience store and industrial applications as well.

READ IN PART I

CHAPTER 3:
Transcritical CO_2 today

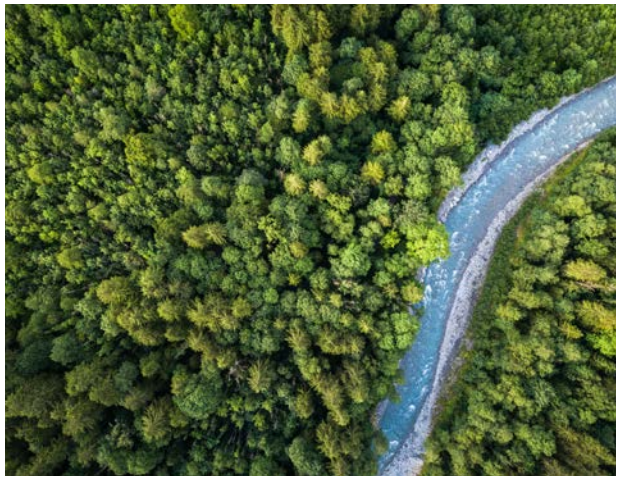
This chapter will give an introduction to our market research results and offer insight into the global transcritical CO_2 market today. It will look at the number of global installations and share general comments from our in-depth industry survey. It will also give an overview of policy and standards affecting the use of CO_2 as a refrigerant.

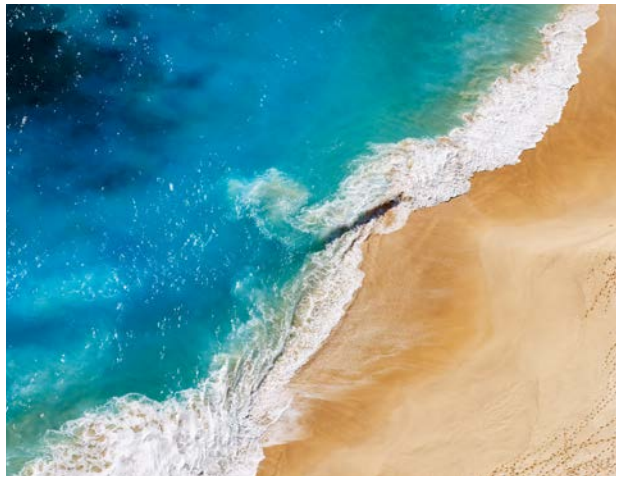
READ ON PAGE 10

CHAPTER 4:
Convenience store (small) applications

This chapter takes a closer look at the market for transcritical CO_2 in convenience stores today, including global market trends, partner case studies, and survey results. What is the potential of this technology for smaller systems?

READ ON PAGE 34





CHAPTER 5:
Commercial/supermarket applications

What does the market for transcritical CO_2 in supermarkets and commercial installations look like today? We take a look at global market trends, partner case studies and share survey results to get a better picture of this.

READ ON PAGE 60

CHAPTER 6:
Industrial applications

This chapter investigates the current market for transcritical CO_2 in industrial applications specifically with a look into global market trends, partner case studies and survey results relating to this.

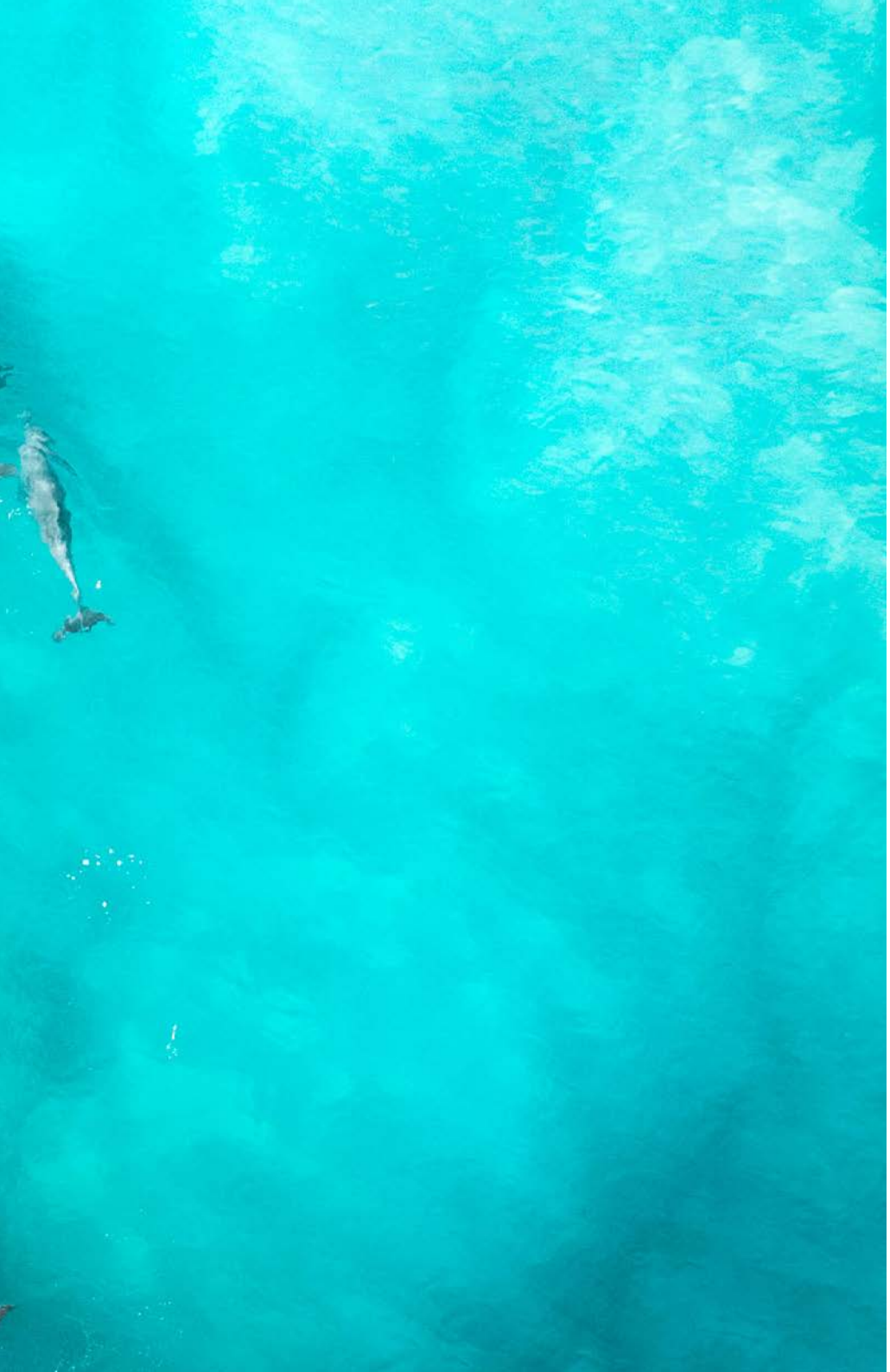
COMING SOON

CHAPTER 7:
The future of CO_2

Based on interviews, market research, and survey results, this chapter anticipates the global market potential for transcritical CO_2 technology, looking at its future uses and projected growth. It will also cover drivers and barriers for the uptake of this technology and include partner interviews on the topic.

COMING SOON


TRANSCRITICAL
CO_2 TODAY



An overview

This chapter provides a detailed look into the global transcritical CO_2 market today, including an overview of policy and standards affecting the use of CO_2 as a refrigerant.

By means of a rigorous data collection drive, as well as results from an in-depth industry survey, estimated figures for the global market share based on number of installations can be collated on an easy-to-read world map. The share per sector is also estimated for various key development regions.

Survey participants include representation from manufacturers, contractors and even end users to paint a well-balanced picture of the global transcritical CO_2 market and the most noticeable trends.

TRANSCRITICAL CO_2 AROUND THE WORLD

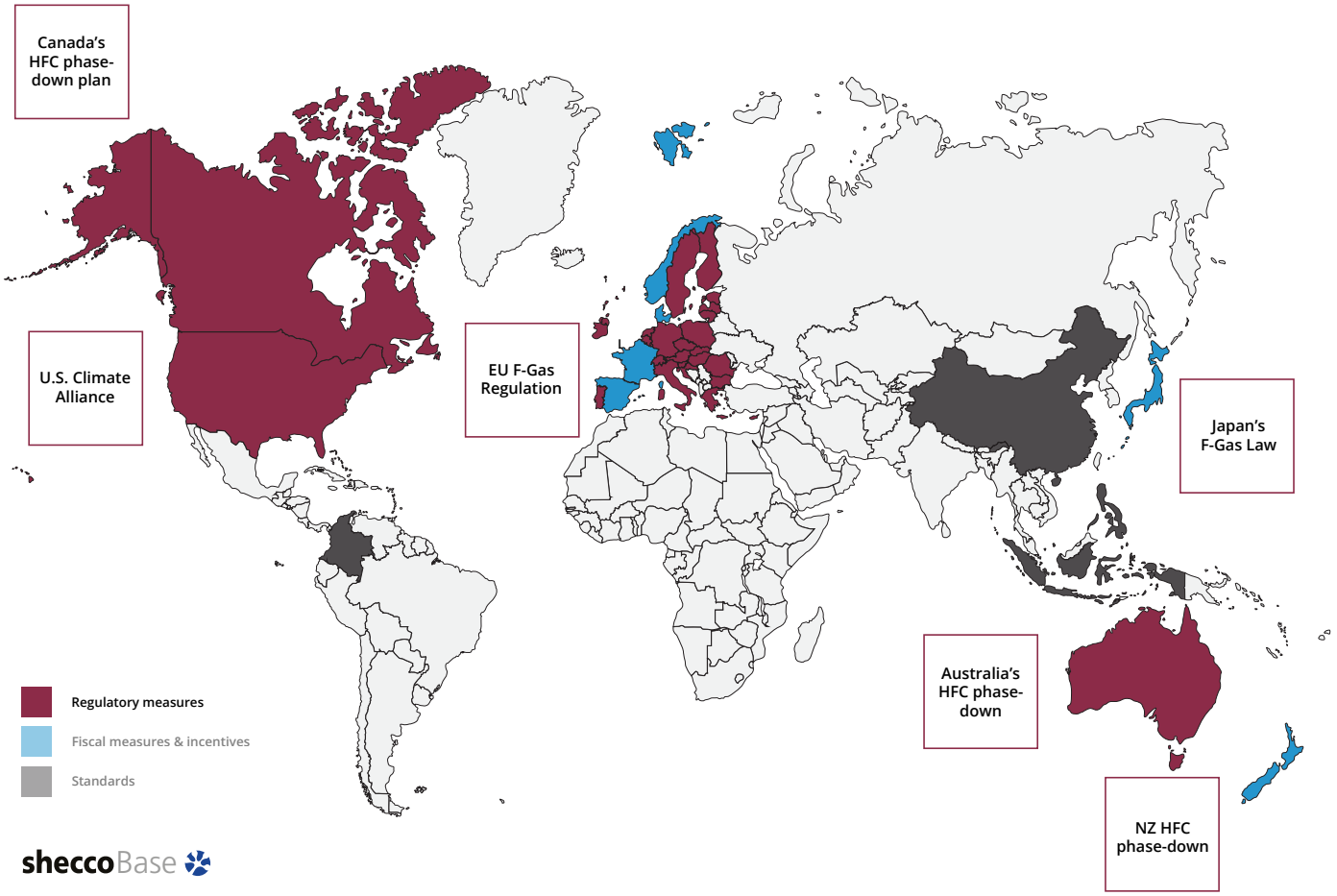
REGULATIONS AND STANDARDS

Globally, there are currently no legal uncertainties or restrictions concerning the use of CO_2 in refrigeration systems. This avoids costly replacements in the future.[1] However, there are safety requirements for working on-site and for the qualification and registration of technicians.

Under the Montreal Protocol on Substances that Deplete the Ozone Layer – an international treaty designed to protect the ozone layer – the world's economies agreed to phase out production and consumption of ozone depleting substances by 2030, with an earlier deadline of 2020 for developed countries.

The Kigali Amendment to the Montreal Protocol – which aims to phase down the use and production of HFCs globally and which entered into force on January 1, 2019 – is accelerating the uptake of natural refrigerants, including CO_2. Ninety-three (93) countries plus the EU have ratified it (as of June 2020). However, this number is every changing as more countries pledge their commitment to drastically scale down the use of HFCs.

In addition, energy efficiency in the HVAC&R sector is increasingly being scrutinized at a global level. Spurred by the Paris Agreement reached among nearly 200 countries at the 21st Conference of the Parties (COP21) to the United Nations Framework Convention on Climate Change (UNFCCC), the Parties committed to set climate and energy targets to keep the global temperature rise below 2°C [3.6°F], while pursuing efforts to limit it to 1.5°C [2.7°F] (compared to preindustrial levels) by 2100.



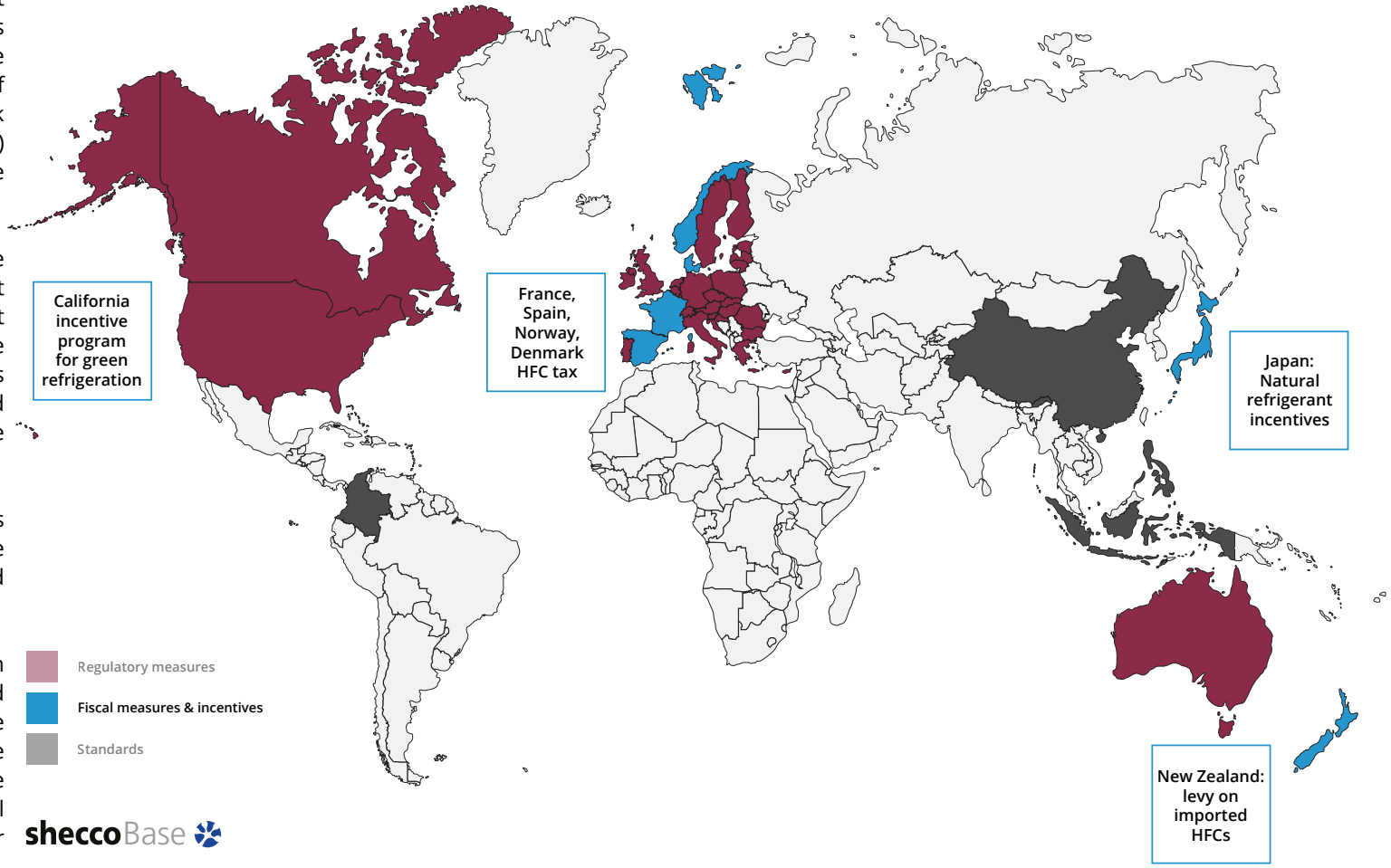
EU

The 2014 EU F-Gas Regulation (No. 517/2014) is set to phase down the use of HFCs, by 79% by 2030. It has a significant impact on users of HFC refrigerants and has led to a rapid growth in HFC prices. There are also various bans in place. For example, as of 2022, HFCs (GWP > 150) are prohibited in multipack centralized refrigeration systems (>40kW/11TR) (except in primary refrigeration circuit of cascade systems where GWP > 1,500 may be used).

The EU F-Gas Regulation also provides for leakage prevention during use and refrigerant collection at disposal. All technicians working on equipment that contains or is designed to contain f-gases require an f-gas handling training qualification. Activities under the scope include refrigerant recovery and decommissioning, as well as installation, leakage checking, and maintenance or servicing.

The regulation makes it very clear that the f-gases must be recovered or transferred to an appropriate greenhouse gas container when they are removed from the equipment.

Furthermore, there are additional restrictions in national legislation of some European countries; and some countries have introduced or will introduce an HFC tax. Countries with an HFC tax in Europe are Denmark, Norway and Spain. France's 2019 Finance Bill, published on December 30, 2018 in its official government journal, confirmed that HFC tax will enter into force as of January 1, 2021.[2]



U.S.

Section 608 of the U.S. Environmental Protection Agency (EPA)'s Clean Air Act establishes the National Recycling and Emission Reduction Program. The Clean Air Act (CAA) defines the EPA's responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer. Section 608 establishes the National Recycling and Emission Reduction Program. Section 608 prohibits individuals from intentionally venting ODS refrigerants (including CFCs and HCFCs) and their substitutes (such as HFCs), while maintaining, servicing, repairing, or disposing of air- conditioning or refrigeration equipment.[3]

On a federal level, the U.S. Senate has not yet ratified the Kigali Amendment, despite widespread industry support for ratification. It is still waiting for a referral from the Trump administration. Furthermore, the EPA has recently taken leakage-repair rules for HFCs from 2016 back.[4] However, states are taking their own initiatives and making their own regulations. The United States Climate Alliance is a bipartisan coalition of 25 governors committed to reducing greenhouse gas emissions consistent with the goals of the Paris Agreement.

The Alliance represents 55% of the U.S. population and an US$11.7 trillion economy – an economy larger than all countries but the United States and China. The climate and clean energy policies in Alliance states have attracted billions of dollars of new investment and helped create more than 1.7 million clean energy jobs, over half the U.S. total.[5]

The states that have passed legislation to adopt HFC use limits are: California, New Jersey, Washington, Colorado, Virginia and Vermont. States that are part of the U.S. Climate Alliance and that have committed to, or are in the process of, adopting HFC use limits are: Hawaii, Oregon, Connecticut, Delaware, Maryland, New York, Rhode Island, Massachusetts, Pennsylvania, and Maine.[6]

Other U.S. Climate Alliance States are Illinois, Michigan, Minnesota, Montana, Nevada, New Mexico, North Carolina, Wisconsin and Puerto Rico.[4]

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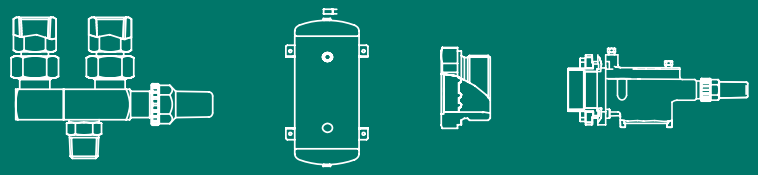

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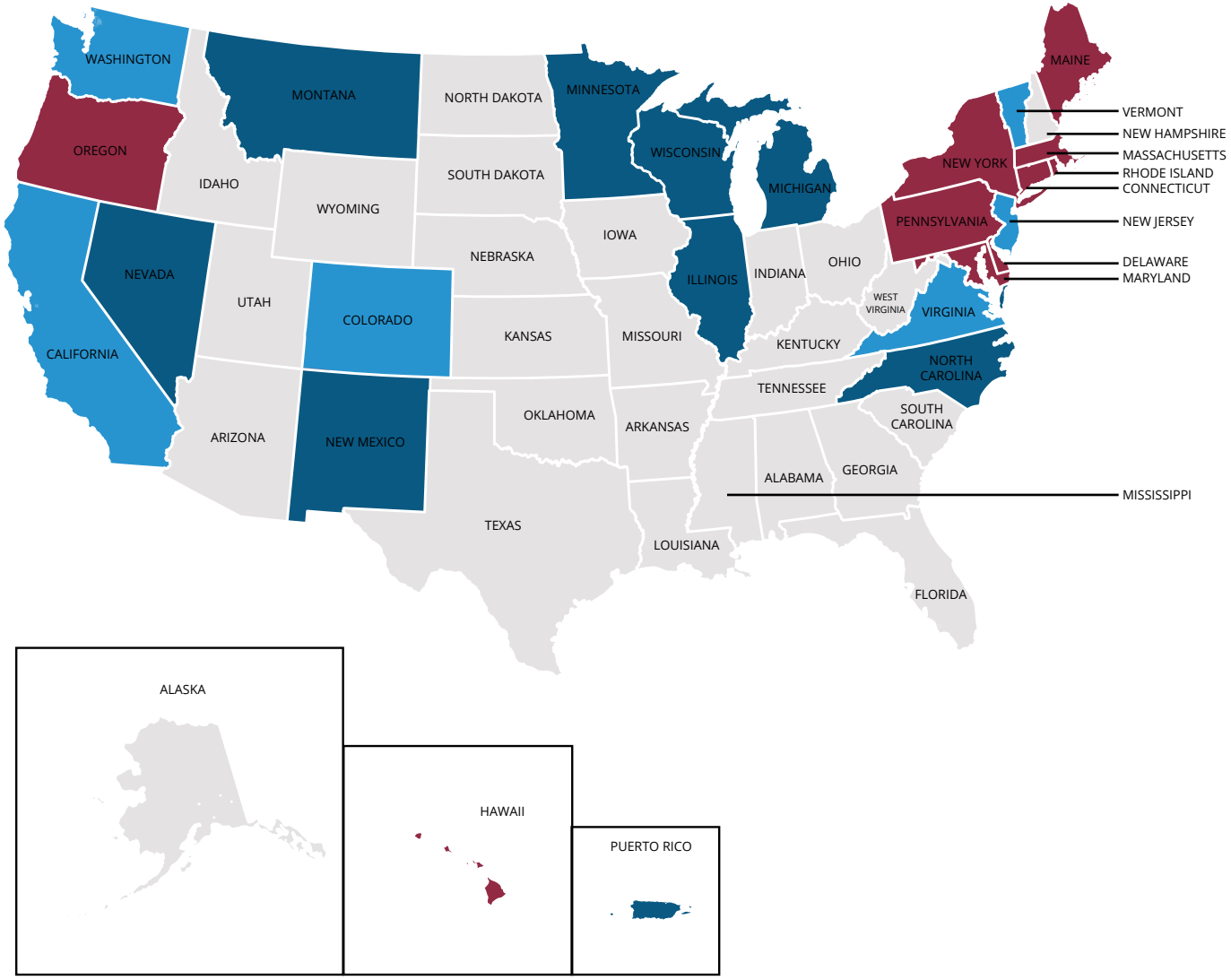
U.S. STATES ENACTING HFC-REDUCTION REGULATIONS



Group 1

U.S. Climate Alliance States that have passed legislation to adopt HFC use limits based on U.S. EPA SNAP rules 20 and 21: California, Colorado, New Jersey, Washington, Vermont, Virginia.

Group 2

U.S. Climate Alliance States that have committed to, or are in the process of, adopting HFC use limits based on U.S. EPA SNAP rules 20 and 21: Hawaii, Oregon, Connecticut, Delaware, Maryland, New York, Rhode Island, Massachusetts, Pennsylvania and Maine.

Group 3

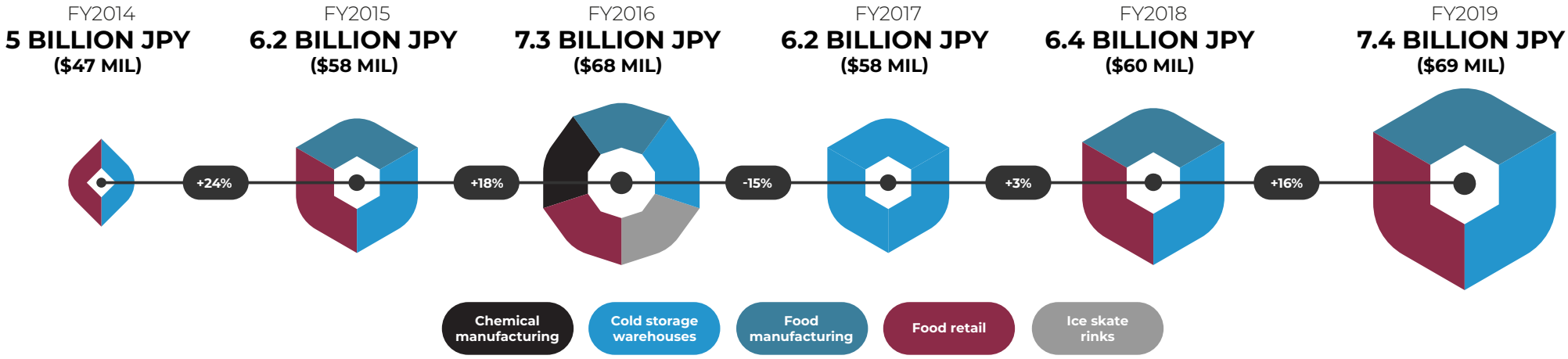
Other U.S. Climate Alliance States: Illinois, Michigan, Minnesota, Montana, Nevada, New Mexico, North Carolina, Wisconsin and Puerto Rico.

Note: The EPA abandoned SNAP Rules 20 and 21 following U.S. Court of Appeals rulings stating that the rules were not supported by federal law.

JAPAN

In Japan, government incentives play a big role in the growth of transcritical CO_2 in all applications. On July 25, 2017, the Japanese government eased restrictions on CO_2, opening the door to the wider adoption of large CO_2 systems in the Japanese market (update of High-Pressure Gas Safety Act). Before, this law had restricted the use of CO_2 in large refrigeration systems, subjecting manufacturers to heavy administrative burdens. This easing of regulations is creating new opportunities for overseas CO_2 system and component suppliers.[7]

A major growth factor for CO_2 stores and NH_3/CO_2 in industrial refrigeration is the renewed subsidy scheme for natural refrigerants running from 2018-2022. The five-year subsidy project helps end users reduce the capital cost of natural refrigerant technologies – including transcritical CO_2 installations. This scheme targets the food retail and food manufacturing sector as well as cold storage facilities. In the financial year 2018 (FY2018), the scheme operated with a budget of ¥6.4 billion [EUR47 million], while in FY2019 it increased to ¥7.4 billion [EUR58 million].



OCEANIA

Australia ratified the Kigali Amendment in 2017[8]; New Zealand ratified it in October 2019[9], thereby committing to start phasing down HFCs. The aim is to reduce HFC consumption by 85% by 2036 in line with obligations under the Amendment. This will be achieved by gradually reducing the maximum permitted amount of bulk HFC imports.

In November 2019, New Zealand also passed the Zero Carbon Bill, committing to reduce its carbon emissions to zero by 2050.[10]

On July 1, 2013 the Synthetic Greenhouse Gas (SSG) Levy for goods and vehicles was introduced in New Zealand. The SGG Levy rates vary depending on the gas used, type of equipment or cooling capacity.

These regulatory measures have been adding pressure in this region to switch to more climate-friendly alternatives such as transcritical CO_2.

OTHER: NATIONAL COOLING PLANS

Other big industrial nations such as China, India and Russia have not ratified the Kigali Amendment yet.[6] However, there are National Cooling Action Plans, such as in China and India. These have been a key driver of natural refrigerant solutions such as transcritical CO_2.

The China Cooling Action Plan sets forth targets for cooling-product energy efficiency improvement by 2022 and 2030. The Plan also describes key cooling-related priorities for China, including:

- Strengthening energy efficiency standards;
- Expanding the supply of green and high-efficiency cooling products, including through increased R&D on low-GWP and high-efficiency refrigerants;
- Promoting green and high-efficiency cooling product consumption, including through government and enterprise green procurement;
- Deepening international cooperation, including on HFC phase down pursuant to the Montreal Protocol and on the promotion of green and high-efficiency cooling for all, in both domestic and export markets, through mechanisms such as the Belt and Road Green Cooling Initiative.

The China Cooling Action Plan also calls for strengthened compliance accountability in the area of cooling energy efficiency, including through enforcement spot checks, and the release of compliance information through national credit information public disclosure platforms.

India's Cooling Action Plan was released on March 8, 2019 and sets goals of reducing by 2037-38:

- Overall cooling demand by 25%
- Cooling energy requirements by 25%
- Refrigerant demand by 30%

Furthermore, it seeks to certify 100,000 service sector technicians by 2023.

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INSTALLATIONS MAP

shecco conducted a data collection during the first quarter of 2020 with manufacturers of CO_2 refrigeration systems (original equipment manufacturers, OEM). The aim was to quantify the number of transcritical CO_2 installations worldwide. The companies were asked how many transcritical CO_2 installations they have completed to date. Furthermore, they were asked to differentiate between the applications convenience stores (<400m² [4306ft²]), supermarkets (>400m² [4306ft²]), industrial refrigeration installations; ice rinks; and data centers.

The results estimate that there are more than 35,500 transcritical CO_2 installations globally today. The use in supermarkets is still prevalent, with the share of convenience stores and industrial applications increasing steadily.

The number of transcritical CO_2 installations in the different world regions is shown below.

CO_2 transcritical installations in the world

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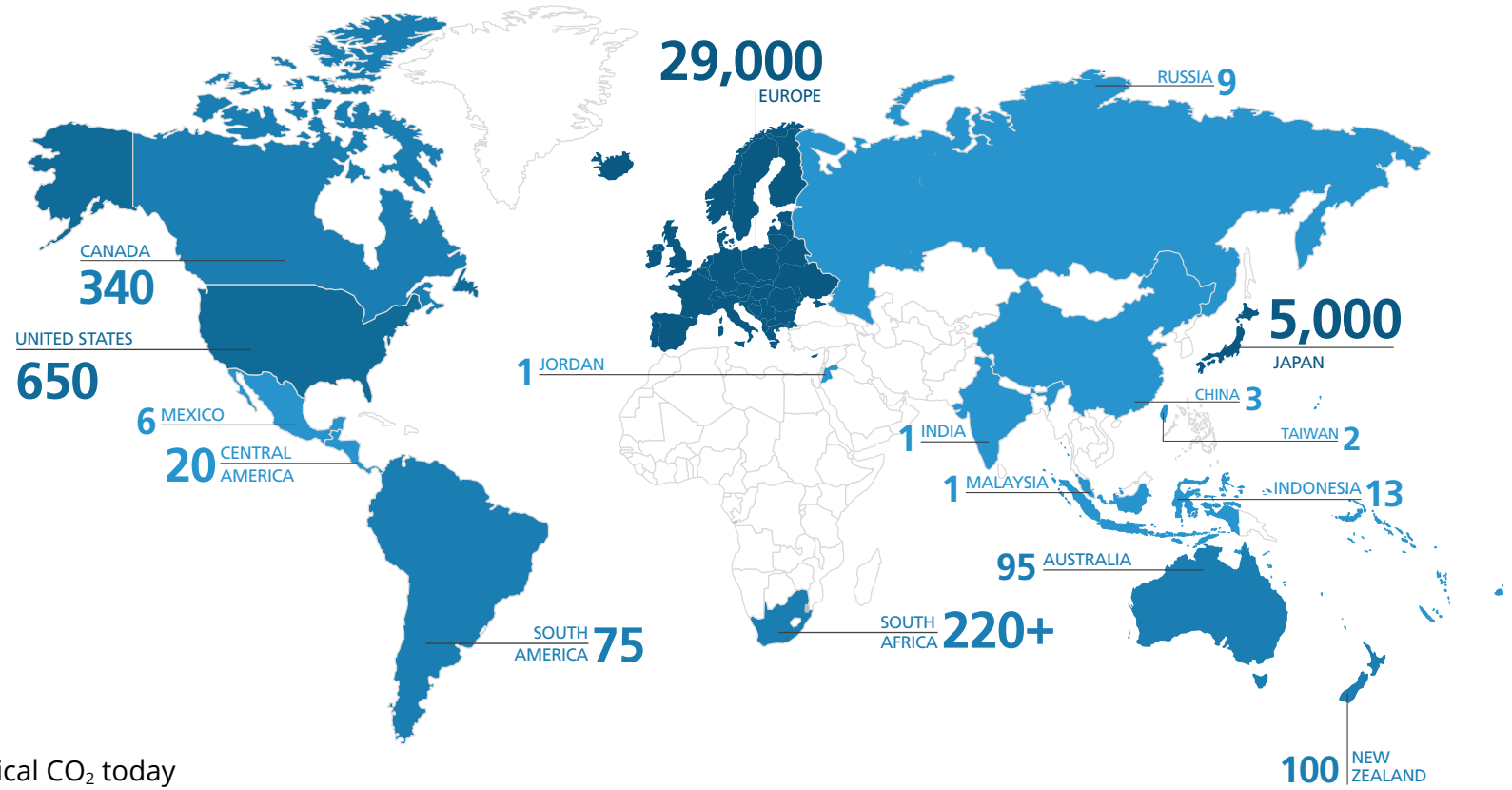


COMPARISON TO PREVIOUS YEARS

Looking at previous years (2008 and 2018), exponential growth can be observed within the transcritical CO_2 refrigeration sector. This is most noticeable within regions such as Europe, the U.S., Canada, Japan, Australia, New Zealand, and South Africa.

From a mere 140 installations in 2008 (all of which were in Europe), this technology has taken off rapidly across the world to reach an estimated total of 35,500 installations today globally – a number that is constantly climbing.

Region	Number of transcritical CO_2 installations in 2008	Number of transcritical CO_2 installations in 2018	Number of transcritical CO_2 installations in May 2020	Growth in % (from 2018 to 2020)
Europe	140	>16,000	29,000	81%
U.S.		>370	650	76%
Canada		>245	340	39%
Japan		>3,530	5,000	42%
Australia		>20	95	375%
New Zealand		>40	100	150%
South Africa		>110	>220	100%

MARKET DATA: SPLIT BY SECTORS

Globally, transcritical CO_2 systems are still used more in commercial supermarket applications than in any other sector. However, its use in convenience stores and even in industrial projects is gaining popularity.

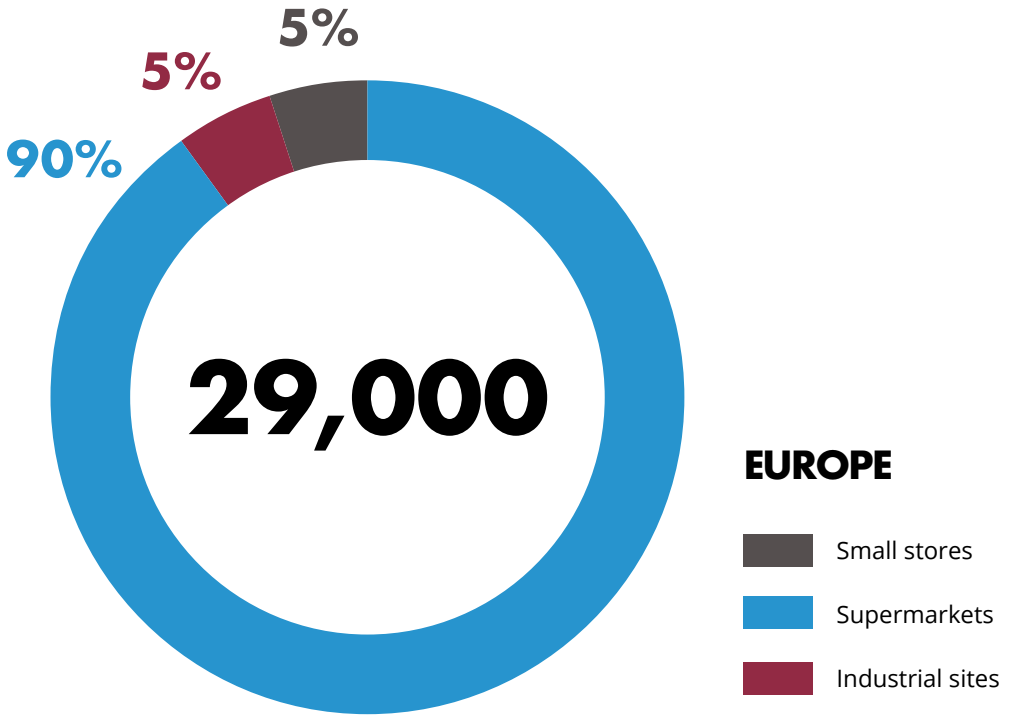
The current split by application for key regions, in relation to the transcritical CO_2 market as a whole, is reflected in the following infographics.

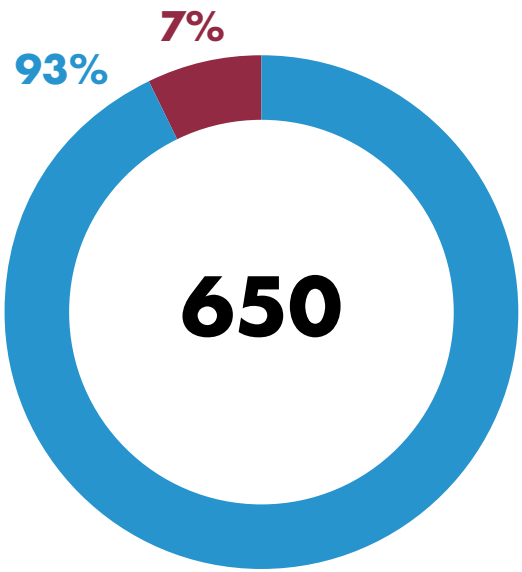
In Europe, there are an estimated 29,000 transcritical CO_2 installations in total today. On average, around 90% of all installations are in supermarkets. 5% are in convenience stores and 5% at industrial sites.

There are an estimated 650 transcritical CO_2 installations in the U.S. On average, 93% are in supermarkets and 7% at industrial sites. In Canada, there are an estimated 340 installations, including ice rinks and data centers.

In Japan, the use of transcritical CO_2 in small stores has traditionally been the most popular (compared to larger installations). However, in the past three years, there has been a noticeable shift towards using this solution in larger installations as well. This is predominantly thanks to eased government restrictions on the use of CO_2 in larger systems.

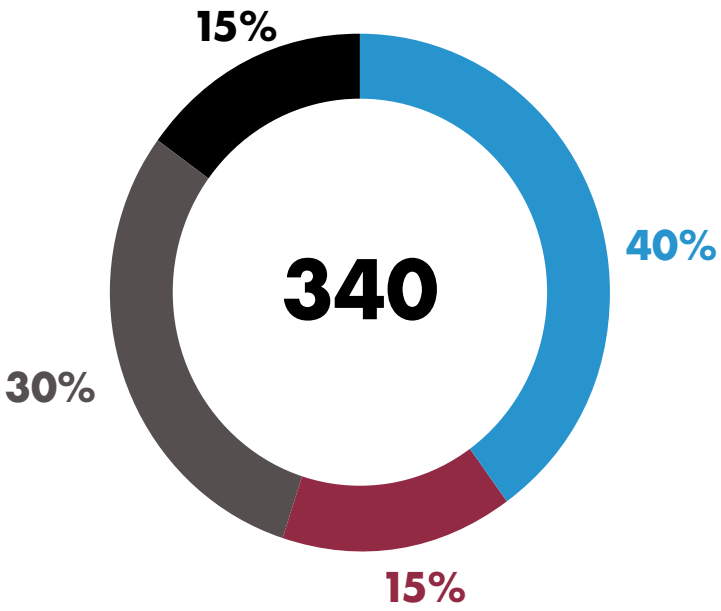
Government restrictions and incentives play a key role in the growth of transcritical CO_2 in all applications (refer to the section on “Regulations and standards”).





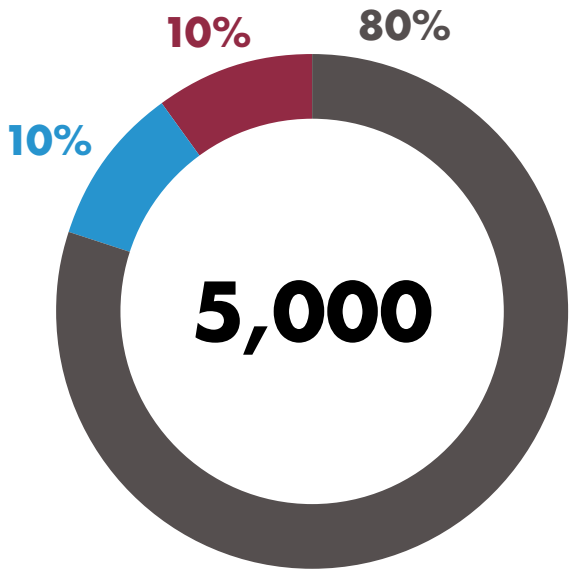
U.S.

- Supermarkets
- Industrial sites



CANADA

- Supermarkets
- Ice rinks
- Industrial sites
- Data centers



JAPAN

- Small stores
- Supermarkets
- Industrial sites

TRANSCRITICAL CO_2 AROUND THE WORLD TODAY – A SURVEY

During the first half of 2020, sheccoBase (part of the shecco group) conducted a global survey among 250 industry experts on the current use and future opportunities of transcritical CO_2.

The survey was addressed to all relevant stakeholders – both from industry and academia, including system and component manufacturers, refrigeration contractors, consultants, engineers, end users; and players from the education and training sector. It was addressed to all companies working with transcritical CO_2 refrigeration (whether presently or in the past), as well as companies considering working with it in future.

Key legend for survey infographics

All Participants

End Users

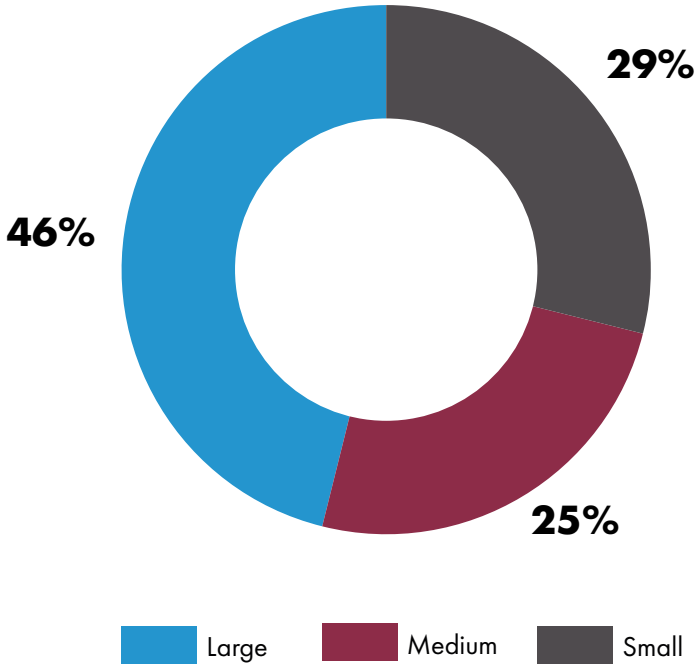
Component manufacturers, Original Equipment Manufacturers (OEM), refrigeration contractors, consultants/engineers, "Other"

All percentages are rounded values, except when stated otherwise.

The majority survey respondents are currently working with transcritical CO_2. 77% of manufacturers, contractors and consultants/engineers who responded are working with these systems, while 76% of the end users respondents currently have transcritical CO_2 installations.

LARGER COMPANIES MORE REPRESENTED

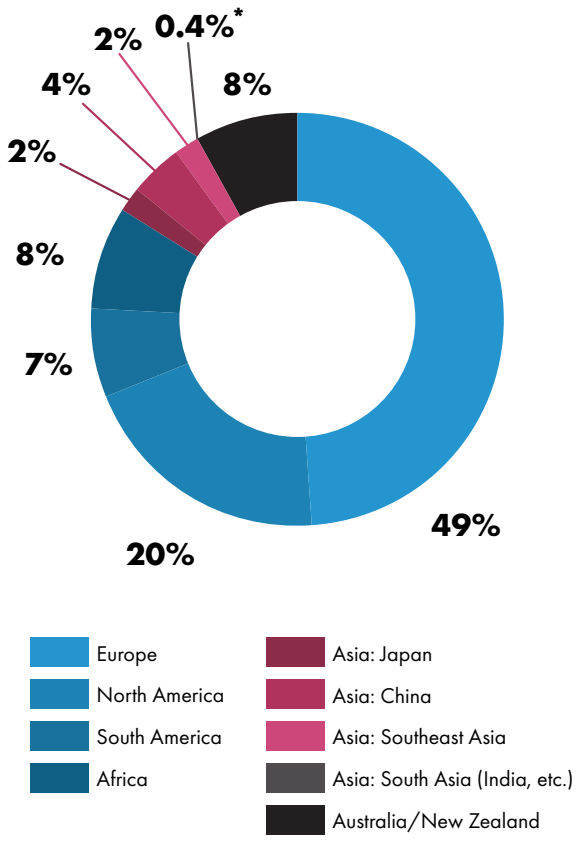
The survey collected responses from companies of all sizes, representing a good balance of respondents. The vast majority (nearly half) of the survey respondents were from organizations with more than 250 employees. The remainder of responses were nearly equally split between medium-sized companies (51-250 employees) and small companies (less than 50 employees).



Number of respondents: 239

MORE THAN HALF OF RESPONDENTS OUTSIDE OF EUROPE

The relative majority of survey respondents are based in Europe, representing 49% of all inputs. However, various other global regions were also represented, including North America (20%), Australia/ New Zealand (8%), Africa (8%), South America (7%) and Asia (8%).

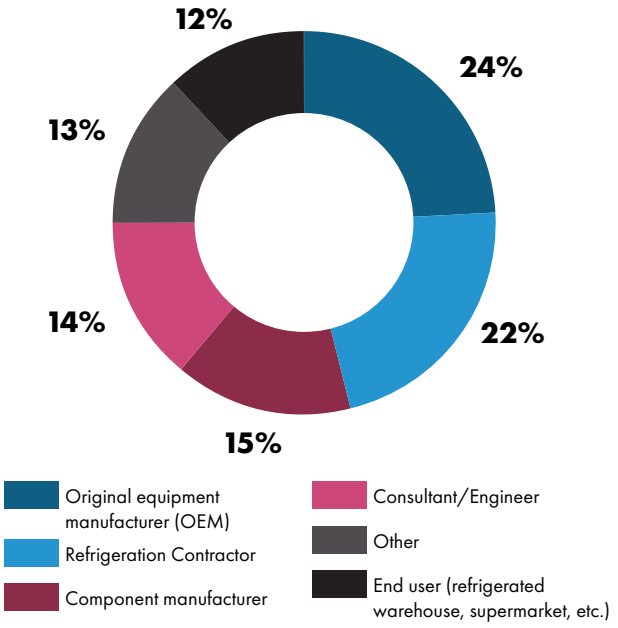


Number of respondents: 238

***** *Exact number*

MANUFACTURERS AND CONTRACTORS PREVAIL

In terms of type of business of the respondents, representation is relatively evenly distributed among the categories, with a slight majority of inputs by manufacturing (OEM with 24%; component manufacturer with 15%) and refrigeration contractor (22%). Responses were also collected from consultants/ engineer (14%) and 12% from end users (refrigerated warehouse, supermarket, etc.). 13% of respondents were from "other" categories, which could include sectors such as research and education.



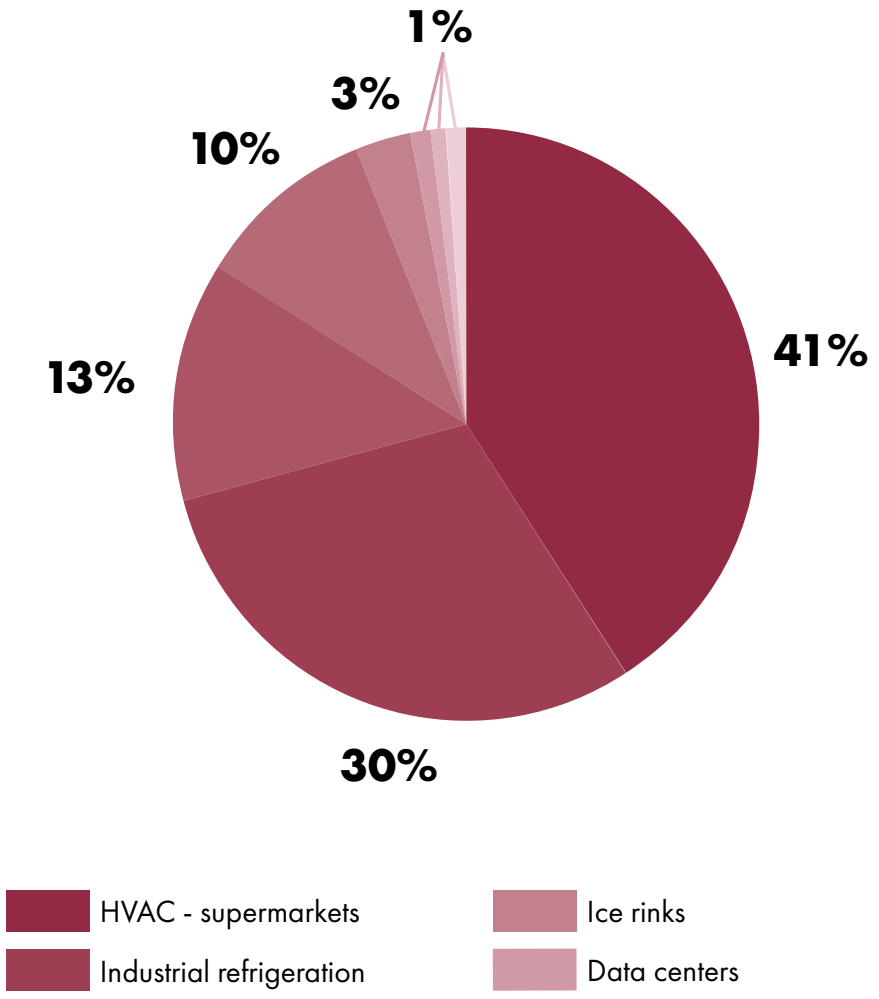
Number of respondents: 238

MANUFACTURERS AND CONTRACTORS: MAJORITY ACTIVE IN COMMERCIAL AND INDUSTRIAL REFRIGERATION

In the following section, questions were asked only to certain categories of relevant respondents, based on their main area of business/type of business. They are marked according to the color legend.

For this question, manufacturers, contractors, consultants/engineers and the unspecified "other" group were asked about their primary market sector. The data revealed that the majority of these respondents are active in the commercial HVAC&R supermarket sector (41%). A further 30% are active in the industrial HVAC&R sector which includes cold storage, food processing, pharmaceutical industry, chemical industry, etc. 10% are active in convenience stores while 13% of the respondents selected the unspecified "other" category.

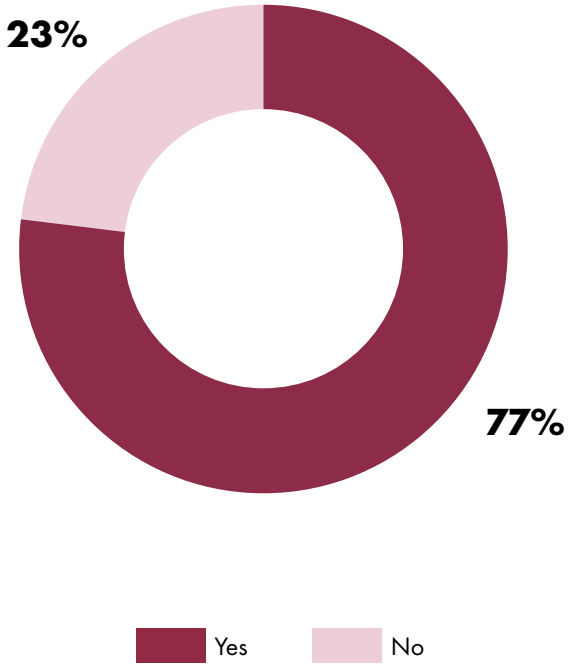
These answers show that although the greatest interest for transcritical CO_2 is still in commercial refrigeration as its traditional domain, it is also becoming an increasingly more viable option in industrial refrigeration and even convenience stores.



Number of respondents: 209

MANUFACTURERS AND CONTRACTORS: LARGE MAJORITY CURRENTLY WORKING WITH TRANSCRITICAL CO_2 SYSTEMS

A large majority of manufacturers and contractors who responded to the survey are working with transcritical CO_2 at the moment – more than three quarters.



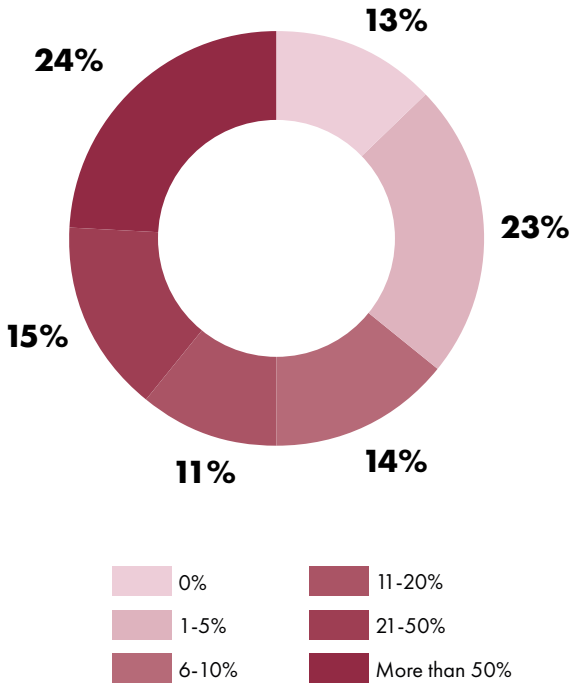
Number of respondents: 177

MANUFACTURERS: SHARE OF TRANSCRITICAL CO_2 IN PRODUCTS VARIED

The manufacturers (OEM and component manufacturers) were queried as to what percentage of their products were for the transcritical CO_2 market in 2019. The results were varied, with a tendency for a lower percentage of their total business.

24% of the respondents can be found in the highest category, with more than 50% of their products used for the transcritical CO_2 market in 2019. 15% are in the medium category (21-50%) and the other 61% combined are in the lower category (0-20%).

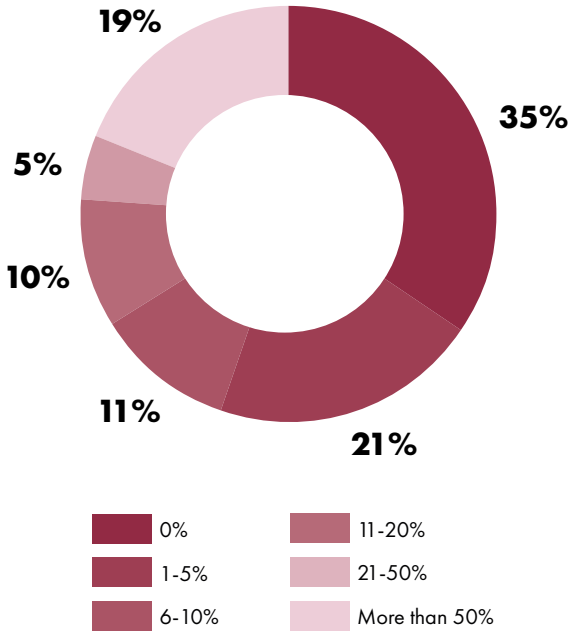
This indicates that the share of transcritical CO_2 among manufacturers' products is still quite low for the most part. However, encouragingly, there are a number of companies with a high focus on this market. This might indicate a growing specialization in transcritical CO_2 within companies that are focusing on this market.



Number of respondents: 92

CONTRACTORS AND OTHERS: TRANSCRITICAL CO_2 PROJECT SHARE STILL RELATIVELY LOW

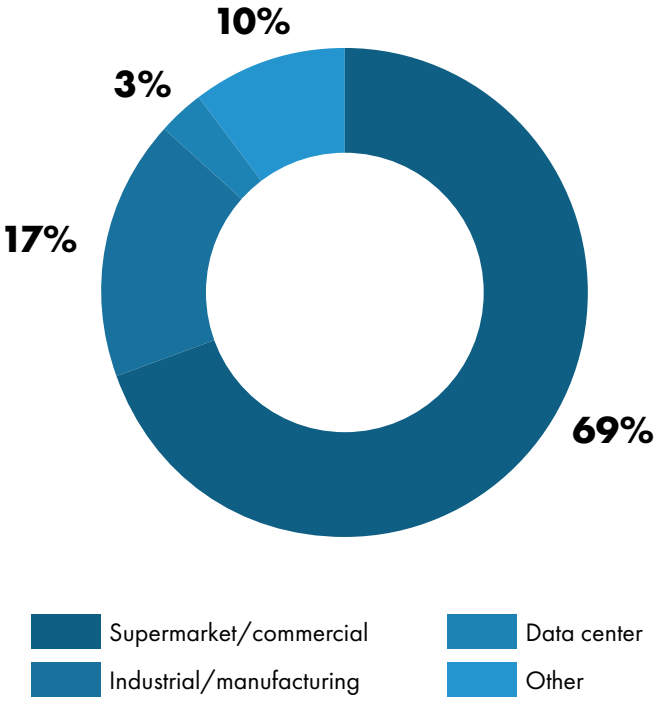
The contractors and those from the unspecified "other" category were also asked to indicate the share of transcritical CO_2 projects within their business. This share is shown to be relatively low, with only 19% of the respondents in the higher category (where more than 50% of the projects involved transcritical CO_2 in 2019) and 5% in the medium category (21-50%). A clear majority of respondents (77%) fall in the lower category range (0-20%).



Number of respondents: 84

END USERS: LARGE MAJORITY ACTIVE IN COMMERCIAL REFRIGERATION

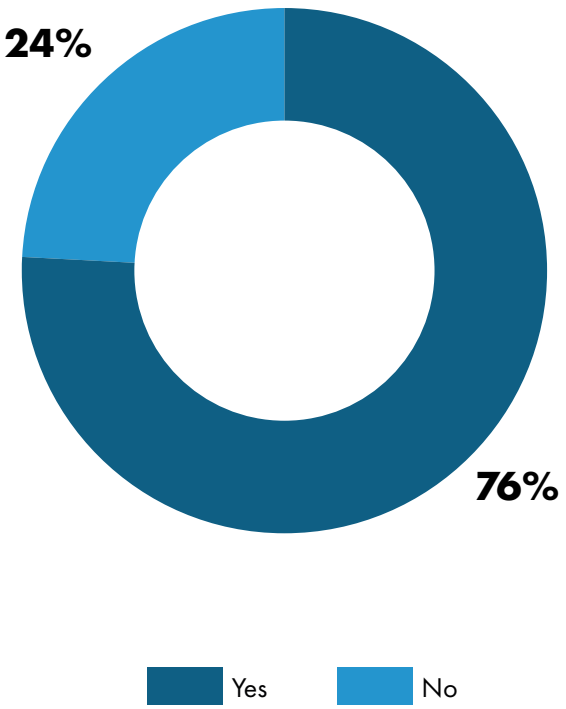
For a large majority of the end users (69%), the primary area of business is supermarkets/commercial refrigeration. This includes large supermarkets but excludes convenience stores. Commercial refrigeration is followed by industrial refrigeration (17%), "Other" (10%), and data centers (3%).



Number of respondents: 29

END USERS: LARGE MAJORITY ALREADY HAS TRANSCRITICAL CO_2 INSTALLATIONS

The large majority of the end users surveyed have transcritical CO_2 installations (three quarters) already, while the remaining quarter do not have any. Those who do not have any were later asked which factors would influence their purchasing decision. (Read more in Chapter 7, Drivers and barriers).



Number of respondents: 29

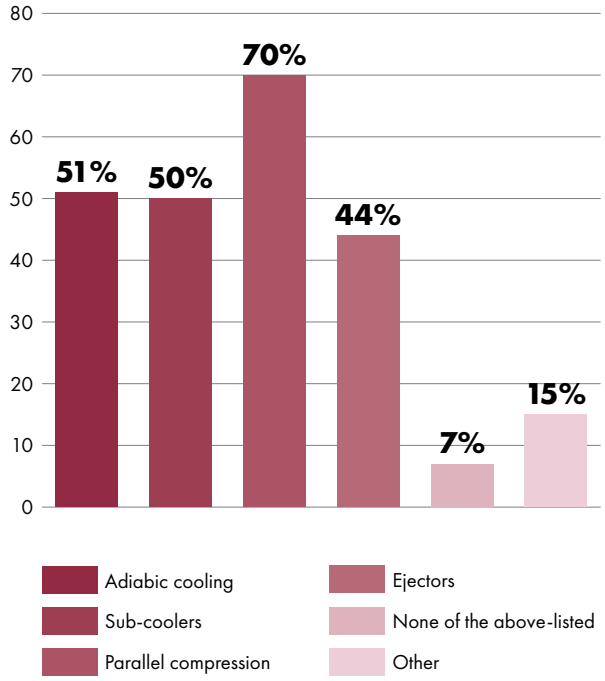
MANUFACTURERS AND CONTRACTORS: PARALLEL COMPRESSION MOST POPULAR EQUIPMENT

Manufacturers and contractors working with transcritical CO_2 were asked which equipment they currently work with. Respondents had the option of choosing adiabatic cooling, sub-coolers, parallel compression, ejectors, none of these, or other.

Multiple answers were possible. There were 325 answers in total, with 70% of respondents choosing parallel compression, 51% adiabatic cooling, 50% sub-coolers, and 44% ejectors. Only 7% do not work with any of these technologies.

This shows that parallel compression and related technologies are indeed very popular for increasing the energy efficiency of CO_2 systems. Some of these technologies are not only for transcritical/direct systems, but also for subcritical/indirect systems, like for example CO_2/NH_3 cascades; as indicated by some survey respondents.

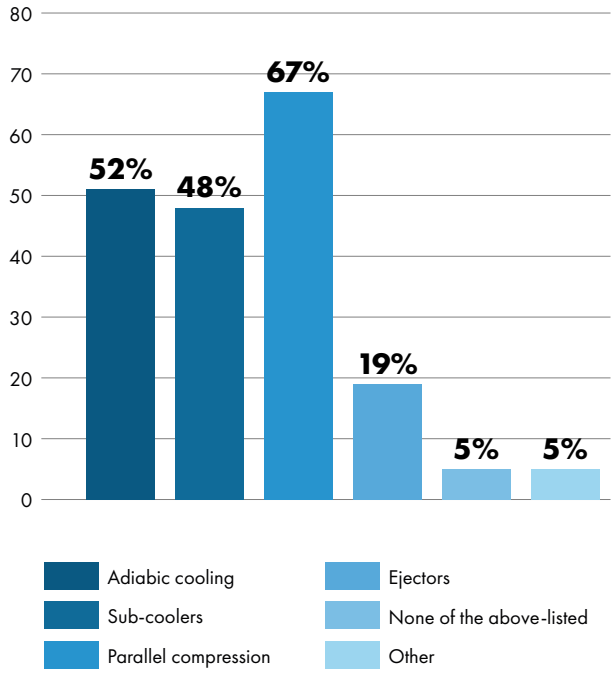
Survey participants also mentioned various other options (15%) for improving efficiencies of transcritical CO_2 systems. These include: booster systems, liquid injectors, and improved controls.



Number of responses: 325 [multiple answers possible]

END USERS: PARALLEL COMPRESSION ALSO POPULAR

End users were also asked which equipment they currently work with. Multiple answers were possible. Of the total 41 answers, 67% of responses went to parallel compression, 52% to adiabatic cooling, 48% to sub-coolers, and 19% to ejectors. Only 5% do not work with any of these technologies.

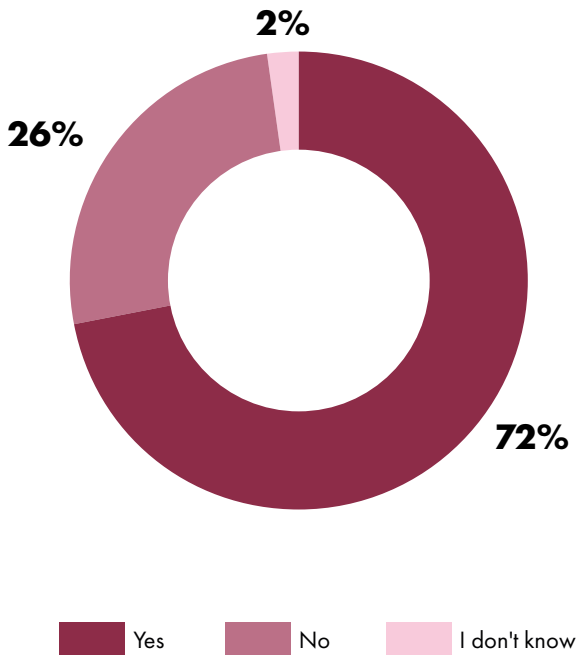


Number of responses: 41 [multiple answers possible]

MANUFACTURERS AND CONTRACTORS: ALL-IN-ONE INTEGRATED SYSTEMS VERY POPULAR

Transcritical CO_2 systems as part of all-in-one integrated systems (refrigeration, heating and air conditioning) are very popular among the manufacturers, contractors and consultants/engineers that currently work with transcritical CO_2. Nearly three quarters (72%) indicated that they work with transcritical CO_2 systems as part of all-in-one integrated systems.

Integrated HVAC&R systems are a clear way to improve energy efficiencies in transcritical CO_2 systems.



Number of respondents: 137

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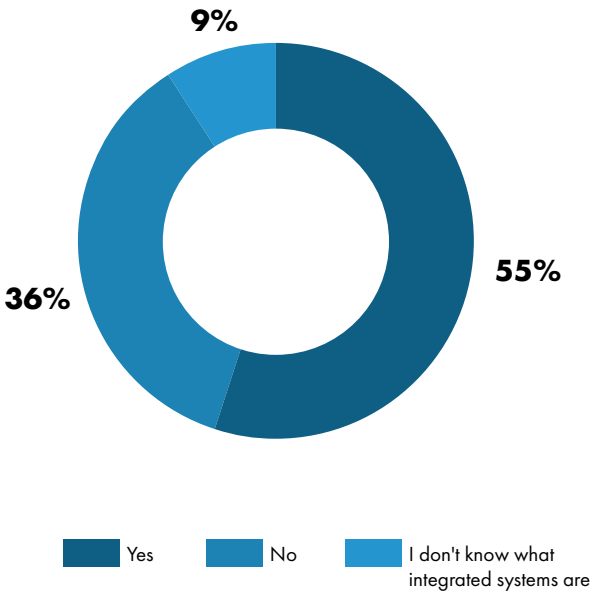
END USERS: MAJORITY ALREADY USE ALL-IN-ONE INTEGRATED SYSTEMS

All-in-one integrated systems are slightly less popular among end users than among manufacturers, contractors and consultants/engineers. However, the large majority (55%) of the end users that currently work with transcritical CO_2 answered this question affirmatively while 36% said "No," they do not use integrated systems. There were 9% of end user respondents that stated that they do not know what integrated systems are.

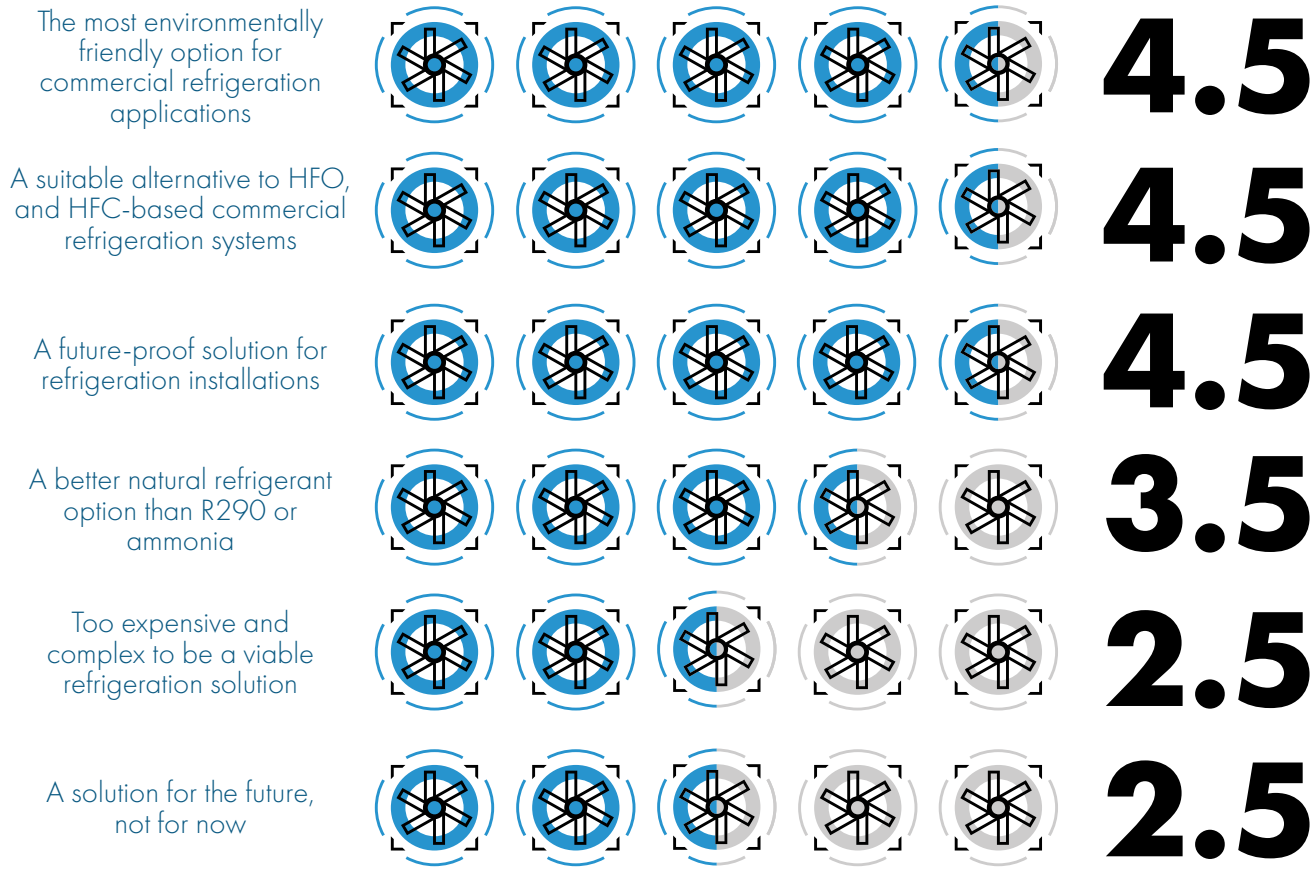


Number of respondents: 22

TRANSCRITICAL CO_2 PERCEIVED AS SUITABLE, FUTURE-PROOF ALTERNATIVE TO HFCS AND HFOS

Transcritical CO_2 technology is... (Ranking from 1 star for strongly disagree to 5 stars for strongly agree)

The survey shows that respondents view transcritical CO_2 as a suitable alternative to HFO and HFC-based commercial refrigeration systems; they also view it as the most environmentally friendly option for commercial refrigeration. This indicates that transcritical CO_2 is viewed as a future-proof solution for commercial refrigeration installations.



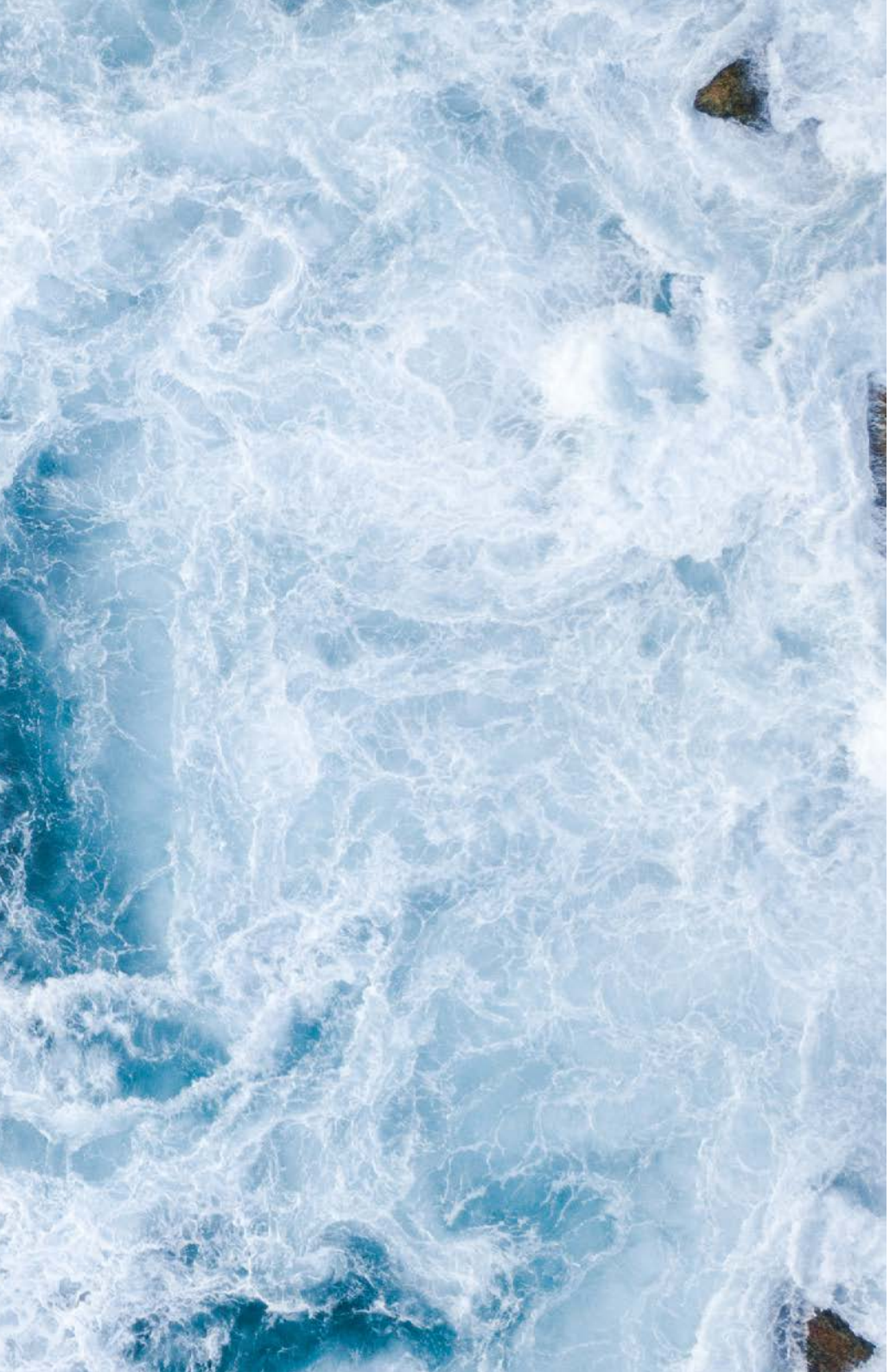
Number of respondents: 190

Summary

Overall, the survey provides a good representation of the transcritical CO_2 sector. The results indicate that although most of the survey respondents are active in transcritical CO_2 refrigeration, their profiles are quite diverse. This is shown by the variety within the main areas of business (i.e. manufacturers, contractors, end users etc.) as well as by the varied size of the share of transcritical CO_2 within their business.

As a whole, respondents evaluated transcritical CO_2 as a suitable alternative to HFCs and HFOs. It was also found that all-in-one integrated systems are popular with all participants and that equipment such as parallel compression and adiabatic cooling are considered essential for improving energy efficiencies.


CONVENIENCE
STORE (SMALL)
APPLICATIONS



An overview

With more and more OEMs offering small capacity solutions (see Euroshop trends article on page 64), there is a noticeable increase in transcritical CO_2 in convenience store applications around the world – not just in Japan where it was traditionally the most popular.

This chapter takes a closer look at the growing market for transcritical CO_2 in convenience stores today. The aim is to show the potential of transcritical CO_2 technology for smaller capacity systems as well (generally assumed <400m² [4306ft²] in this report).

It includes data from the global survey, as well as end user testimonials from around the world, sharing experiences and highlighting their reasons for using transcritical CO_2 in their convenience store.

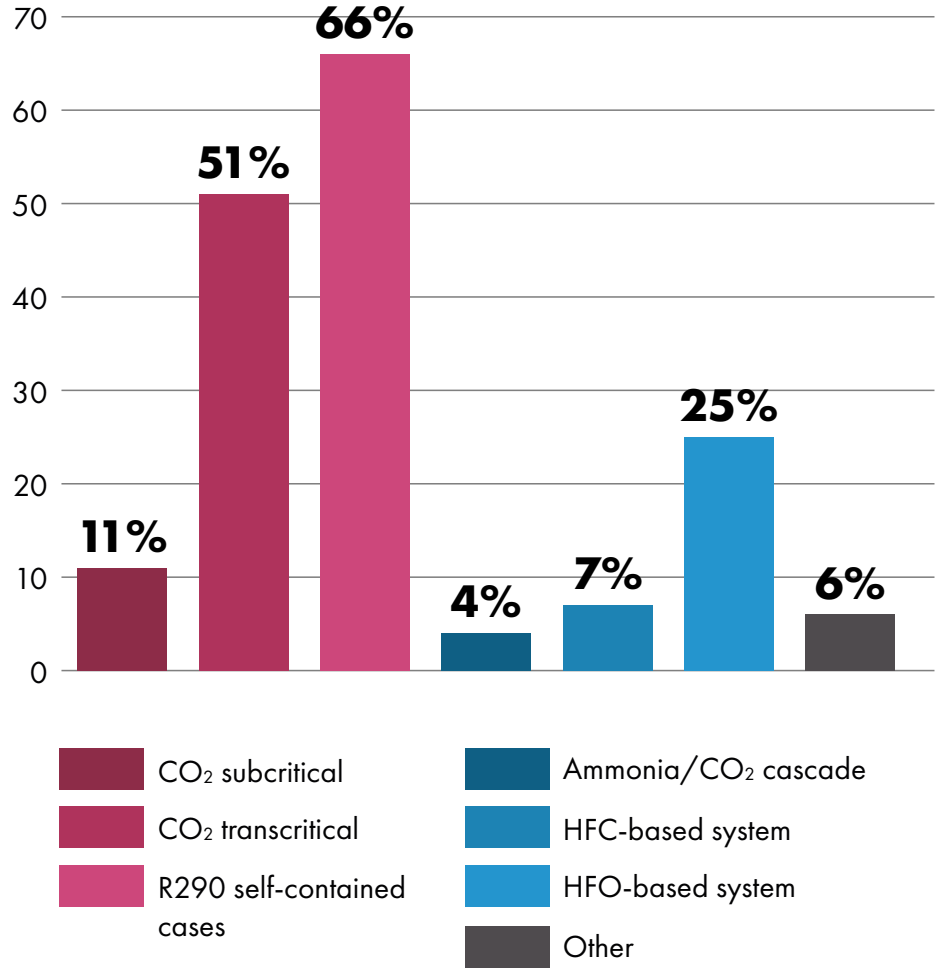
At the end of the chapter, various partner case studies show the application of transcritical CO_2 systems in real life – including an example for a small store. (More partner case studies to follow in later chapters.)

TRANSCRITICAL CO_2 IN CONVENIENCE STORES AROUND THE WORLD – A SURVEY

The global industry survey also looked specifically at convenience stores and available refrigeration equipment on the market to gauge the potential of transcritical CO_2 within this sector.

NATURAL REFRIGERANTS EXPECTED TO DOMINATE NEW CONVENIENCE/ SMALL STORE INSTALLATIONS

When asked as to what technology respondents expect to dominate the convenience/ small store market in future, respondents were clearly in favor of R290 self-contained cases (66%), followed by transcritical CO_2 solutions (51%). The lowest-ranking options were HFC-based systems (7%) and ammonia/CO_2 cascades (4%). In the category "Other"(6%), R290 water-loop systems were often mentioned as another suitable option.



Number of responses: 341 [multiple answers possible]

USING CO_2 IN CONVENIENCE STORES – END USERS SHARE CHALLENGES AND OPPORTUNITIES

Worldwide, sheccoBase estimates that there are around 5,500 convenience stores using transcritical CO_2 systems, most of which are in Japan.

There is a noticeable growing global trend for specifying transcritical CO_2 systems for convenience stores as well. Previously, this technology dominated the commercial (retail) space with larger installations (with exception of Japan where convenience stores have been installing CO_2 systems since 2001).

However, it is becoming more economically viable to consider CO_2 in convenience stores as well. This is largely thanks to impressive product innovation, the improvement of skills, and increasing commercial availability of suitable equipment – amongst others. (Read more in the upcoming Part 3 of the Guide for more about barriers and drivers.)

SOUTH AFRICA[1]

During ATMOsphere Cape Town in March 2020, three of the biggest food retailers presented on their journey with transcritical CO_2 and the challenges they've faced along the way. All three made mention of convenience store applications specifically.

Pick n Pay

Richard Taylor, General Manager of Store Design and Implementation of Cape Town-based food retailer Pick n Pay (PnP) explained that they are quickly moving over to transcritical CO_2 installations for their larger store formats. However, this is still a challenge for smaller stores.

PnP operates over 1,600 stores of various formats, of which 151 are express stores [300m²/ 3,229ft²]; and 467 liquor stores (of which 241 are corporate and 225 franchises). PnP aims to have 32 transcritical CO_2 stores by the end of 2020 – none of which are convenience.

Taylor explained that it's easier to motivate an investment in transcritical CO_2 for a large store or hypermarket, but it becomes much more difficult for a smaller store where there is a smaller budget to work with. The smaller stores are also sometimes situated in more rural areas where the specialized skills are not as easy to come by – driving up the price of opting for this technology.

Motivating for CO_2 over a conventional HFC system is especially difficult for the franchisees that are investing their own money. "It is very difficult to get the franchisees to invest more," said Taylor. "The economy is tight, there is a lot of competition in the market – it makes it difficult for small stores to select a system with a higher CAPEX. The CAPEX has to be reduced as far possible for them to get the funding to go ahead with the store…"

Woolworths

Alex Kuzma, Head of Engineering Services at Woolworths – the first retailer in South Africa to move to CO_2 – presented the benefits of this move.

Cape Town-based Woolworths operates over 200 full-line stores with food offerings and more than 400 stand-along food stores, with about 60 more in other African nations.

In November 2010, Woolworths switched on to transcritical CO_2 and today uses it at more than 100 stores.

According to Kuzma, in larger stores, transcritical CO_2 becomes almost cost neutral – but the challenge lies in smaller stores. "I want to make CO_2 the default for all formats but we are battling a bit with the smaller stores," he said.

Despite this, Woolworths is currently busy fitting out three convenience stores (300-400m²/ 3,229-4,306ft²) with transcritical CO_2. The installed refrigeration capacity is 26-40kW [7.4-11.4TR] for medium temperature and 7kW [2TR] for low temperature.

According to Kuzma, the price premium for transcritical CO_2 above an HFC refrigeration system, is about 16% at smaller stores. Things that cost more than an HFC system include compressors and components capable of withstanding higher pressures, while the piping itself is cheaper (less copper) as is the price of the gas (with less needed).

So, what are the solutions to higher cost? First, economies of scale, Kuzma said. He was encouraged by seeing the other retailers on stage talking about CO_2. "CO_2 and other natural refrigerants need to become more mainstream," he said. "We see it as a commodity."

SPAR

The third panelist was Wayne Derdekind, Group Development Manager of SPAR, which only recently started using transcritical CO_2 in retail stores in South Africa. SPAR, based in the Netherlands, operates more than 13,000 mostly franchised stores in 48 countries. In South Africa, there are more than 800 stores, with a relatively small footprint (1,164m^2/12,529ft^2).

Although transcritical CO_2 is nothing new for SPAR's European retail stores, South Africa has been slow to catch up, so far with only three transcritical installations, said Derdekind. This is because in South Africa, SPAR is a voluntary trading organization (similar to a franchise), he explained. Retailers pay a fee to belong to the brand, but SPAR doesn't dictate things such as what refrigeration system should be put in. Its retailers have a lot of freedom regarding what they use – and usually cost is a primary consideration.

Derdekind echoed the other retailers in saying that, traditionally, transcritical CO_2 didn't have potential for a great return on investment for retailers. This was predominantly because of South Africa's warm climate. As such, the only angle is the environmental benefit. "Our challenge comes with convincing these retailers to invest in something for a 'noble cause,'" said Derdekind.

That has been SPAR's biggest difficulty – until now. Fortunately, as technology and the industry evolved, the costs came down and efficiencies went up. Available expertise was a problem, as were availability and cost of components. But as South African retailers' demand for transcritical CO_2 grows, so does the local industry and expertise. "Transcritical CO_2 systems are getting more efficient and we're now seeing them match or even exceed efficiencies on R404A plants," he added. "It is becoming a great motivator for our retailers."

It's not a no-brainer yet, because the savings don't yet justify the premium. "It still involves a bit of sacrifice, but retailers are starting to see the long-term benefits," said Derdekind.

Trading on the successes of the other retailers, SPAR has since completed three transcritical CO_2 stores. The hope is to be able to show a significant improvement in energy savings, which will incentivize other stores to follow suit. "We hope there will be a knock-on effect," Derdekind said, mentioning that there are already another eight transcritical CO_2 stores in the pipeline for 2020.

EUROPE

Delhaize, Belgium[2]

A 250m² [2,691ft²] Delhaize 'Shop & Go' convenience store in Belgian capital Brussels uses CO_2 condensing units, installed in 2018 already. One of the Sanden units serves the medium-temperature cabinets, and the other serves the frozen food cabinets.

"In some store configurations, CO_2 condensing units are the preferred option to address the refrigeration needs, and also due to the limits of propane waterloop systems," said Benjamin Tissot, Sales Engineer at Sanden International Europe.

"We're always looking for opportunities to share our expertise (with CO_2 and natural refrigerants) with our franchise partners: with this project –developed by Delhaize engineers and Sanden – Delhaize is showing to its affiliates that CO_2 can also be a valid solution for smaller-sized stores," David Schalenbourg, Director of Department – Building Projects, Format and Maintenance at Delhaize Belgium.

"There is no stronger argument than a real live test," Schalenbourg said.

Tissot argued that condensing units are "a good option" for stores such as the Adolphe Max Shop & Go, which is fitted with remote multideck cabinets and has frozen as well as chilled produce.

Asked whether Delhaize would install more Sanden units in other stores, Schalenbourg said: "First we'll evaluate the performance of this installation. Looking forward, we confirm that we want to go forward in this direction."

"Recently we also built (with Panasonic) a cold room running on a small CO_2 unit (content 2kg/ 4.4lbs)," Schalenbourg said. "The engineering team is continuously scanning the market for solutions to improve energy efficiency and simultaneously decrease the environmental impact of our stores," he added.

Carrefour, France[3]

The European retailer opened its first full-CO_2 transcritical remote unit at a convenience store in Vannes, Brittany (France) in October 2017.

"The opening of the store is a very positive signal for all retailers who are waiting for natural refrigerants-based refrigeration solutions for small shops," Jean-Michel Fleury, Project Director at Carrefour, explained.

The store is located in the city center of Vannes and has a commercial trading area of 293m² [5,307ft²]. To save space for the refrigeration plant, Carrefour installed the refrigeration systems in the store's yard.

In addition, according to Carrefour, indirect emission, or in other words the energy consumption of the system, is considerably lowered as CO_2 transcritical technology is very energy efficient compared to traditional HFC-based systems.

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AUSTRALIA

Coles[4]

City Holdings has commissioned its fourth CO_2 transcritical project, fitting an SCM Frigo plant at a small-format Coles Local store in Melbourne, Victoria in December 2018. Italian multinational SCM Frigo, part of the Beijer Ref Group, provided the system.

"Coles Local gives the Surrey Hills community the convenience of a supermarket with the character of a specialty store," said Coles Chief Executive Steven Cain.

The Melbourne store is about half the size of the retailer's regular supermarkets. It sells local gourmet produce and specialty ranges, with exclusive Coles Local-branded.

The use of natural refrigerants corresponds to Coles' vision of environmentally friendly Coles Locals featuring 100% Australian-grown fresh fruit and vegetables and a zero-food waste policy.

Coles plans to extend the format to other parts of Australia, and will "listen carefully to customer feedback on the Surrey Hills store as we seek to roll out smaller format stores in coming years."

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JAPAN

Lawson[5]

Japanese convenience store chain Lawson installed its first CO_2 condensing unit at one of its stores in 2010. In Q1 2020, Lawson has confirmed 3,700 stores using CO_2 systems with projections of surpassing the 4,000 mark this year.

In general, the most common type of transcritical CO_2 system used in Lawson's convenience stores are outdoor condensing units. Typical systems consist of 2HP or 10 HP condensing units delivering medium to low temperatures in the range of -20°C to 8°C [-4°F to 46°F].

"We're taking a long-term perspective by proactively introducing natural refrigerants," said Shinichiro Uto, who heads Lawson's store Development Division in a presentation at an ATMOsphere networking event in Tokyo in 2013.

"As the CO_2 refrigeration market expands, we're endeavoring to advance the HVAC&R industry as a whole by field-testing products from a number of manufacturers," Uto said. "We're seeking to move towards a multi-supplier system by FY 2020, to establish a stable supply, improve cost-competitiveness, and hedge risks," he added.

Tokyo Department store[6]

In November 2019, Tokyo Department Store, a major Japanese chain, opened a new 47-story high-rise commercial complex called Shibuya Scramble Square.

The company installed several CO_2 plug-in display cases combined with a water loop system in the complex's basement food-shopping area. The combination of CO_2 plug-in equipment with a water loop system in a retail department store setting is relatively new in Japan, where CO_2 outdoor condensing units in convenience stores are dominant.

The innovation represents a new opportunity for end users such as department store retailers to employ natural refrigerant systems, especially those located in densely populated Tokyo neighborhoods, where space is always limited.

In the second-floor basement of the Shibuya Scramble Square high-rise tower, two food suppliers, Head Line (a rotating showcase of various food makers) and Sanwein (a vendor specializing in Taiwanese delicacies), use seven pieces of specially designed CO_2 water-cooled plug-in showcases.

While Tokyo Department Store aimed to use natural refrigerant equipment, the space restrictions and the underground location of the food sales area meant that the conventional CO_2 air-cooled condensing unit type system was not seen as a viable option.

Tokyo Department Store worked with Japanese OEM Panasonic and Japanese refrigeration installer Hama Refrigeration Industries to design and install CO_2 plug-in showcases that would be cooled by a water loop. The cooling tower is located outside on the 13th floor.

Tokyo Sato, Director of Hama Refrigeration Industries, said that in addition to preventing waste heat from being released on the sales floor, water- cooled systems are a good option for commercial facilities with limited space, and help businesses transition away from synthetic refrigerants.

"Several major department stores have called for water-cooled CO_2 showcases," said Sato. "Looking ahead, it is better to transition away from fluorocarbons now rather than half-way through with low-GWP refrigerants such as mixed fluorocarbons."

CHINA

Lawson[7]

Japanese convenience store chain Lawson has installed its first transcritical CO_2 and hydrocarbon-based cooling systems at one of its stores in China, a Shanghai outlet that opened on January 15, 2020.

While some large-format supermarkets have installed transcritical CO_2 rack systems in China in the past few years, this is thought to be the first transcritical CO_2 system deployed in a small-format food retail store in the country.

Lawson, which operates 14,000 convenience stores worldwide, is considered the world's leading adopter of small-format transcritical CO_2 outdoor condensing units. In China, Lawson operates close to 2,000 stores spread across Beijing, Dalian, Shanghai, Chongqing, Wuhan and Hefei. More than half of these stores are located in Shanghai.

The use of transcritical CO_2 and hydrocarbon equipment at the Shanghai store is driven by Lawson's "commitment to fulfilling its corporate responsibility towards the UN Sustainable Development Goals — specifically goal 7 (affordable and clean energy) and goal 13 (climate action)," said Masaaki Kanbe, Director of Construction Headquarters for Lawson (China) Holdings.

The new Shanghai store uses one Panasonic 2HP CO_2 outdoor condensing unit to supply cooling for one medium-temperature CO_2 display case inside the store. In addition, the store employs one propane-based plug-in ice cream cabinet. Kanbe said Lawson expects to see about 16% better energy performance, compared to conventional systems.

Installation went "smoothly and without any problems," said Kanbe, who credited prior and on-site technical guidance with making sure the installation of the CO_2 system went well. The challenge going forward, however, is "whether or not construction can be handled without technical guidance," he said.

While CO_2 systems have often been seen as less efficient in warm climates, Lawson has observed positive results at its Alfamidi stores in Indonesia. During last year's ATMOsphere China conference in April 2019, Kanbe described Lawson's efforts to adopt natural refrigerants at 12 Alfamidi stores in Indonesia in 2015 and 2016. "All 12 stores attained the target based on yearly total power consumption of existing Alfamidi stores (a reduction of 30%-49%)," according to Kanbe's presentation. The equipment used by a comparison store was not specified.

ACCELERATING THE USE OF CO_2 IN SMALLER STORES

Refrigerants, Naturally! for LIFE

The ongoing 'Refrigerants, Naturally! for LIFE' project aims to accelerate the uptake of climate-friendly Refrigeration, Air Conditioning and Heat Pump (RACHP) equipment in small-store food retail applications. This includes transcritical CO_2 equipment.

Funded under the EU-LIFE Programme, the project particularly addresses end users in the organic food retail sector. Many of these are individual retailers independent from larger supermarket chains, but they do have a strong potential to grow in urban settings. The second key target group is the servicing sector, providing store owners with the needed RACHP equipment, as well as commissioning, servicing and repair.

While many supermarket chains in Europe have started installing climate-friendly cooling over the last years to meet future regulatory requirements, this challenge has not been in the focus of the majority of smaller stores yet.

The project therefore prioritizes the building of capacities and raising of awareness among small store owners and the RACHP servicing sector by providing information and training needed to accelerate the shift to climate-friendly cooling.

The main objectives of the project are to:

- Raise awareness among end users and the distribution chain on climate friendly cooling and natural refrigerants.

- Increase the uptake of training and certification on climate-friendly alternatives.

- Accelerate the shift towards climate-friendly technologies and develop technical specifications for the use of non-fluorinated technologies using natural refrigerants.

- Support an effective and timely achievement of the EU 2030 climate targets (for small supermarkets up to 1,000m²/10,764ft2).

The project consortium consists of eight partners from across Europe, bringing together organic retail associations, experts and technicians of the refrigeration sector and market developers:

1. HEAT (project leader, Germany);

2. shecco (Belgium);

3. AgroBio – Associação Portuguesa de Agricultura Biológica (Portugal);

4. BNN – Bundesverband Naturkost Naturwaren (Germany);

5. SEAE – Sociedad Española de Agricultura Ecológica/ Agroecología (Spain);

6. BIV – Bundesinnungsverband des Deutschen Kälteanlagenbauerhandwerks (Germany);

7. KNVvK – Koninklijke Nederlandse Vereniging voor Koude (The Netherlands); and

8. STEK – Stichting Emissiepreventie Koudetechniek (the Netherlands).

Project activities started in June 2019 with a kick-off workshop in Germany and will continue until end of 2021. In its first phase, a market survey will give insight on the current as well as future situation and needs of RACHP end-users in the organic retail / small food retail sector. In a second step the project partners will develop a European stock model about RACHP technology and its related emissions.

Find out more about this project and how to get involved: https://www.refnat4life.eu/

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ARNEG ENTERS AFRICAN MARKET, OPENS FIRST TRANSCRITICAL CO_2 STORE

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ABOUT THE COMPANY

Based in Italy, the Arneg Group is an international leader in the design, manufacture and installation of complete equipment for the retail sector. Its leadership position in the commercial refrigeration sector finds its origins in the exploitation of synergies created between the various group companies spread all over the world.

The group's project is a high sustainability evolving hand in hand with intelligent technologies, interacting with the environment, society and its customers who then benefit from its activities. Continually improving quality of life is a fundamental part of this project, as well as CO_2 systems.

INTRODUCTION

When an existing retail store in Cape Town, South Africa was in need of revamping, it was replaced with a newly designed store, complete with a brand-new energy efficient CO_2 system. The new format also included more refrigerated cabinets than before. The new store offers a 2,200m^2 [23,681ft^2] shop floor with a variety of products – from fresh fish to hot foods.

The total cooling capacity required from the cabinets and cold rooms is 75kW [21.3TR] for medium temperature (MT) and 15kW [4.3TR] for low temperature (LT). The installed power for the refrigeration compressors rack is 91kW [26.0TR] for the MT and 25kW [7.1TR] for the LT.

- Summer design conditions: 34°C [93.2°F], 60% ambient condition
- Winter design conditions: 0°C [32°F], 90% ambient condition
- Refrigerant type: CO_2 (R744)
- LT evaporating temperature: -30°C [-25.6°F]
- MT evaporating temperature: -7°C [19.4°F]
- Gas cooler outlet temperature: 36°C [96.8°F]

THE SYSTEM

Considering Cape Town's ambient condition, Arneg decided to install its standard transcritical CO_2 system, complete with parallel compression. This technology is perfect for summertime and reduces the energy consumption. Parallel compressor takes the gas generated after the back-pressure valve and moves it directly to the gas cooler without passing through the whole circuit.

An Arneg booster rack was installed, including: three compressors for LT; three compressors for MT; one parallel compressor; inverter for all the pressure levels; and an easy to maintain filter.

THE RESULTS

The results show a minimum daily COP of 2.5 in January (traditionally one of the hottest months in Cape Town). This is a great result that can be compared to other similar plants running on different refrigerants – such as R404A, for example. The results are shown in the Figures below.

For **Figures 1-4**, orange dots show the energy consumption of the Cape Town system. The blue depicts a similar application in southern Italy with the same ambient temperature conditions.

The **Figure 1** graph shows the daily energy consumption [kWh/day] correlated to the external ambient conditions [C°]. **Figure 2** shows the relation between temperature and COP.

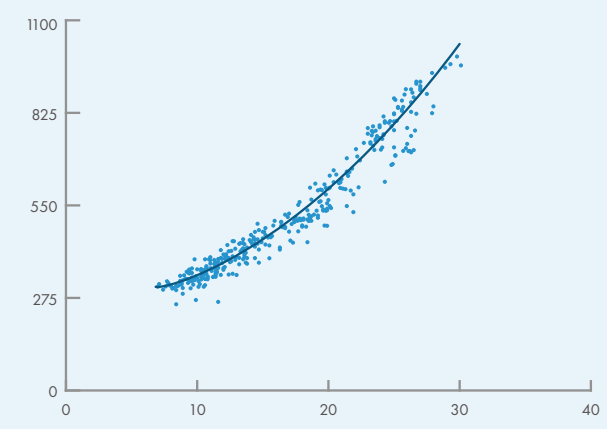

Figure 1: Power consumption vs ambient temperature.

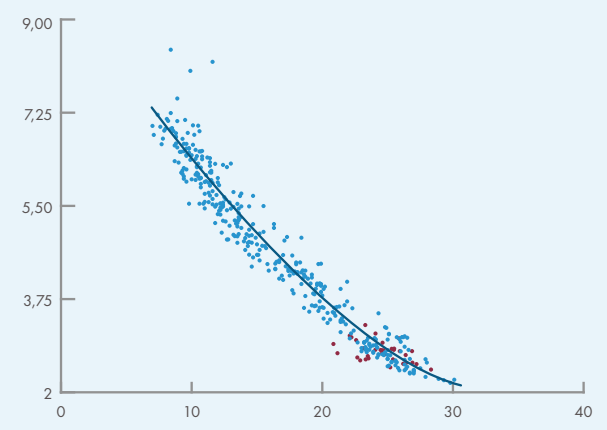

Figure 2: COP vs ambient condition.

In **Figure 3** and **Figure 4**, the grey shows an R404A application, measured in similar ambient conditions. The graph shows the daily energy consumption [kWh/day] with the external ambient condition [C°]. Summer season is shown in Figure 3 and winter in Figure 4. It is easy to see that R404A offers better performance compared to CO_2 when the ambient temperature is greater than 25°C [77°F], but for the most part of the year, the CO_2 performance (parallel compressor) is better than R404A.

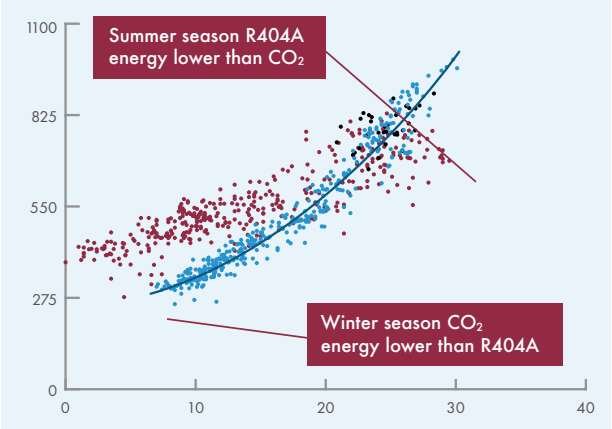

Figure 3.

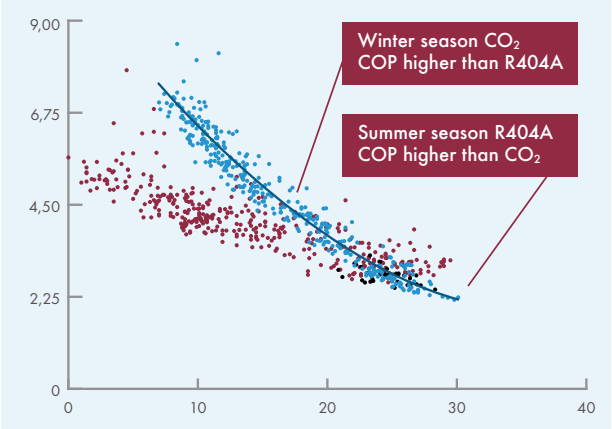

Figure 4.

Although the CO_2 maximum consumption is higher than R404A, when considering an entire year, CO_2 boasts an overall lower energy consumption (as can be seen in **Table 1**).

Technology	Min kWh/day	Max kWh/day	Average kWh/day	Total kWh/year
CO_2	256	992	513	187.215
R404A	277	830	554	202.432

Table 1

CONCLUSIONS

- Although the purchasing cost of CO_2 refrigerating systems is still higher than R404A technology, this is balanced by the extremely lower cost of gas.

- Using energy saving solutions such as parallel compressor makes transcritical CO_2 systems competitive against other systems – even in warm climates.

- Analysis of the entire lifetime cycle of a refrigeration system is mandatory to select the best solution. This shows that despite the initial higher investment, transcritical CO_2 systems have the lowest cost during a lifespan of six years.

FOOD RETAILER SPAR OPENS FIRST TRANSCRITIAL CO_2 STORE IN SOUTH AFRICA

Sphere.

CONTACT INFORMATION

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ABOUT THE COMPANY

For over 10 years now, the Sphere group of companies has equipped more than 150 stores with transcritical CO_2 refrigeration, helping its clients save over 150,000MWh [42,857RTh] of energy, over 3,500,000 metric tons of CO_2e, and over 320,000Mℓ [84,535 Mgal] of water.

The group includes Commercial Refrigeration Services (CRS), a Sphere company for over five years now, and celebrating 45 years of service to its customers. CRS has been a pioneer for developing CO_2 technology in Africa. Matador Refrigeration, founded in May 1958, also became part of the Sphere Group in 2017. Over the past 60 years, the company has grown into a national operation specializing in installation and servicing of supermarket refrigeration as well cold storage and industrial refrigeration.

ABOUT THE PROJECT

In a total refurbishment, SuperSPAR Wonderpark in Middelburg, South Africa not only completely rebuilt its premises from scratch, but replaced its existing R22/R404A refrigeration system with a transcritical CO_2 system built by Sphere's Matador Refrigeration contracting division. This is the first SPAR in South Africa to install a natural refrigeration system and the end user is very happy with the result.

The 3,700m^2 [39,827ft^2] SPAR Wonderpark project commenced late 2018 and was completed on time by September 25, 2019. The store belongs to the Patricio Group, who owns five SPAR stores across the Limpopo and Mpumalanga provinces in South Africa. It has worked with Matador Refrigeration before on various other projects and the two companies have a good working relationship. As such, upon deciding to go the CO_2 route, Matador was a natural choice for Patricio.

Matador then pitched the idea of a transcritical CO_2 system to the client, explaining the various benefits such as future-proofing the installation. "We were aware of the fast-growing increase in the price of synthetic refrigerants," explained Firmino Patricio, Owner of SuperSPAR Wonderpark. "And by installing a CO_2 system, it would help us negate this future problem."

ABOUT THE REFRIGERATION SYSTEM

Matador then supplied and installed a CO_2 booster system with parallel compression, including evaporator coils and expansion valves. Carel electronic controls and a monitoring system was also installed with dial-in facilities. It was designed to operate at 36°C [96.8°F] ambient conditions, 1,371m [4,498ft] above sea level.

The system's capacity is 265kW [75.35TR] at -6.5°C [20.3°F] on the medium temperature (MT) side with low temperature (LT) on: 23kW [6.54TR] at -35°C [95°F], which offers a greater capacity than the previous refrigeration system). It is used for the cooling of all cabinets, cold rooms, and freezer rooms. A custom biltong (local dried meat) drying room was also installed on site. There are 49 cabinets and 12 rooms operating on the MT side, with 18 cabinets and four LT rooms as well.

The system was designed complete with hot water reclaim, heating 500L [132 gal] of water from 20°C to 55°C [68°F to 131°F]. An Adiabatic gas cooler was also installed to maintain a 28°C [82.4°F] gas cooler outlet temperature for maximum energy savings. All cabinets are fitted with acrylic doors to further improve energy efficiency.

There were no challenges on this project and things ran according to plan. This was because of great planning and coordination between client and contractor, explained Maurice Robinson of Sphere Solutions. The client reported that they are happy with how the plant is running. "The installation and running of the plant have been seamless," according to Patricio.

Although it's too early to tell exactly how much the new refrigeration is saving SPAR, it is performing as it should. "Through careful commissioning and monitoring, it's apparent that the system is running optimally and efficiently," confirmed Robinson.

"We have been monitoring the development of CO_2 refrigeration systems for some time, however prior to transcritical systems, the South African climate had a significant impact on the efficiencies of these systems," Wayne Dedekind, Group Development Manager for SPAR South Africa stated. "With the advancements in transcritical CO_2 refrigeration, we were confident that our retailers would eventually be able to combat not only the environmental issues surrounding HFCs, but also be able to surpass the energy efficiencies of HFC plants."

Inside the machine room of SPAR Wonderpark.

Inside the shop.

"Mr. Patricio was the first of our independent retailers to acknowledge the inevitable future of refrigeration for The SPAR Group South Africa, and we have since opened a second CO_2 site, with the objective to open another 10 sites for 2020," said Dedekind.

DUTCH NET ZERO LIDL STORE: A PRIME EXAMPLE OF CO_2 IN CONVENIENCE STORES

TEKO Made in Germany.

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ABOUT THE COMPANY

Established in 1982, TEKO designs and manufactures industrial and commercial heating and cooling solutions using natural refrigerants CO_2 (R744), ammonia (NH_3, R717), and hydrocarbons (R290). TEKO offers tried-and-tested, tailored solutions for tens of thousands of applications in the areas of food retail; food production; commercial refrigeration; industrial refrigeration; medical refrigeration; transport refrigeration; warehouses.

The company is headquartered in Altenstadt, Germany. As an internationally active company, TEKO is represented by subsidiaries and affiliates in Europe and Asia, and also delivers to South America.

HOW NET ZERO COOLING WAS REALIZED

The upgraded Lidl Zero store in Woerden, the Netherlands, was a complete new build as the original building from 1972 was demolished. It opened less than a year after closing down in November 2018 – on September 4, 2019.

The HVAC&R system for this supermarket features a state-of-the-art smart design and combines multiple exciting features in this one building, including a special heat pump with thermal precast concrete piles in the ground, heat recovery to heat the store from the excess heat of the cooling system, and a smart, adaptable control system.

The basis for all this is a CO_2 ground source heat pump complete with special thermal precast concrete piles in the ground underneath the store and carports to create a thermal reservoir. Glycol is circulated via hollow tubes inside these precast concrete piles to transport the heat to and from the thermal reservoir, taking advantage of the natural ground temperatures during all seasons to complement the cooling and heating cycle in the building.

This heat can also be used to create a comfortable climate inside the store when the refrigeration system doesn't product enough excess heat in the heat recovery process (e.g. during the colder winter months). Additionally, the heat pump also serves as an air-conditioning system during summer by reversing its operation, i.e. to pump the cooler ground temperatures up into the store.

Another benefit of this system is that, as a result of pumping excess heat back into the thermal reservoir, the system's high-pressure CO_2 refrigerant is cooled, increasing the efficiency of the refrigeration system for store and warehouse, further reducing the energy needs of the whole building.

Lidl's Marcel Ganzeboom, Senior Manager in the Construction Department of Lidl Netherlands and the initiator of this project, confirms their satisfaction of the technical solutions: "It is a very closed chain of electricity generation and waste streams from cold and heat, which are used immediately or stored immediately. Very genius to see how it works," he explained.

THE COOLING POWER BEHIND NET-ZERO

Lidl Zero's refrigerated cabinets are cooled by an energy efficient transcritical CO_2 refrigeration system.

A total of 85m [279ft] of medium temperature cabinets in the sales area, plus two cold rooms, and one freezer room in the back-of-house areas are cooled with TEKO's ROXSTAsmart rack. The unit offers a capacity of 112kW (-8°C) [32TR/17.6°F] on the MT side and 4kW (-33°C) [1.2TR/-27.4°F] on the LT side. A chiller with a cooling capacity of 90kW (2°C) [25.6TR/36.5°F] and a heat pump (50kW/14.2TR) was also installed.

In addition to aiming for net zero, Lidl required that zero synthetic refrigerants were used. As such, local installer Frimex opted for a natural refrigerant CO_2 system that offers environmental advantages. "Most commonly used synthetic refrigerants have a very high Global Warming Potential (GWP), and thus contain a large amount of active greenhouse gasses," explains Hendrine Kalkman, Head Engineer at Frimex. "By using CO_2, even though it is a greenhouse gas as well, we designed a system with minimal impact on the environment." The GWP of CO_2 is only 1, making it one of the most sustainable refrigerants in existence.

The ROXSTAsmart system was installed in a separate plant room above the warehouse, taking up minimal space. It compactly only measured 2,614 x 1,904 x 984mm [8.6 x 6.2 x 32.3ft], including a sound enclosure, three MT compressors, and one LT compressor to cool the whole building of 2,057m^2 [22,141ft^2].

NO MORE ENERGY BILLS

An important requirement from Lidl for this zero-net store was to create an energy-neutral building, meaning that the power consumption of the whole building had to be fully self-sufficient and that no energy bills should be paid at any time during the year. All energy that is used in the store, such as for lighting, heating and cooling, the cashier tills and more, is in fact produced by the store itself from green energy sources.

Whilst Lidl confirms that the investment costs for this zero-net store were higher than an average supermarket, the expected pay-back time will be around five to 10 years – a perfectly acceptable period for an energy self-sufficient supermarket that never has to pay any energy bills.

Lidl goes even further and has put high emphasis on the fact that the supermarket customer should not be paying a premium for the sake of shopping in a sustainable store like this: "We do not charge sustainability to the customer; it is the other way around: it makes the shopping cheaper," said Ganzeboom.

**With inputs sourced by TEKO from RTL Nieuws, AD, and Indebuurt.*

INDUSTRIAL CO_2 SOLUTION FOR MAITRE PAUL'S DUTCH CHOCOLATE PLANT

A BEIJER REF Company

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ABOUT THE COMPANY

SCM Frigo (now part about the Beijer Ref Group) was established in 1979 in Padova (Italy, 30km from Venice). Since 2004, we have worked to develop technologies that use natural gases as refrigerants, thus becoming leaders in the production of CO_2 refrigeration systems.

SCM Frigo's goal is continuous innovation pursued through research, design and production of CO_2 refrigeration systems which are highly sustainable for the environment.

All this is made possible by a close-knit team of highly skilled professionals all working toward one end goal. We are natural born optimists, always striving to become better and better at doing what we believe in.

ABOUT THE PROJECT

Thanks to the good relationship that SCM Frigo has with many of its suppliers, it joined forces with Japanese Miyazawa in October 2019 to support the design of Maître Paul's chocolate plant in the Netherlands (head quartered in Japan). GEA Netherlands was selected as installer and design company for the refrigeration plant.

It was a challenging project due to the important dimensions and the short timeline for developing the entire project. The units had to be running by mid-February 2020 as not to lose Easter production.

Within five weeks, the project scope was defined and by mid-November 2019 SCM could start to develop and build the required refrigeration units. The first booster rack (DX) was supplied before Christmas and all the other units in week 3 of 2020.

The first part of the commissioning was done in week 8 of 2020 and SCM Frigo supported GEA to ensure a smooth operation of the compressor racks and the pumping stations.

There was a clear message from the Japanese HQ to develop a refrigeration system with a natural refrigerant solution and CO_2 was selected as the preferred choice.

SYSTEM REQUIREMENTS

The required cooling capacity was:

- 830kW [236TR] at -43°C [-45.4°F]
- 115kW [32.7TR] at -30°C [-22°F]

In November 2019, SCM started to work on the design of a CO_2 system that was to supply a total low temperature capacity of 945kW [268.7TR]. SCM Frigo designed and supplied four transcritical CO_2 booster racks (only low temp), three of which were connected to the two pump stations.

The system specifications were as follows:

- 2x transcritical CO_2 booster rack connect to a CO_2 pumping station of 3,500L [924.6gal] to supply 470kW/133.6TR at -43°C [-45.4°F].
- 1x transcritical CO_2 booster rack connect to a CO_2 pumping station of 2,300L [607.6gal] to supply 360kW [102.4TR] at -43°C [-45.4°F].
- 1x transcritical CO_2 booster rack standard direct expansion solution to supply 115kW [32.7TR] at -30°C [-22°F].

RESULTS

Thanks to the good collaboration between SCM Frigo, Miyazawa and GEA, it was possible to supply the entire solution on time and on schedule. At the end of February 2020, Maître Paul started the production as planned, without losing any days.

“We are very happy to have met customer expectation and collaborating with GEA, Miyazawa and Maître Paul to realize this successful installation,” said Alessandro Franchin, SCM Frigo Head of Sales. “We are also happy to once more show that CO_2 is a sustainable solution that can be applied in many applications.”

According to Maître Paul’s service manager, after more than two months of production, the installation is running fine.

CANADIAN TELECOMS COMPANY COOLS SERVER ROOMS WITH CO_2 SOLUTION

CARNOT REFRIGERATION

CONTACT INFORMATION

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ABOUT THE COMPANY

Carnot Refrigeration is a Canadian company headquartered in Quebec and established in 2008, with the goal of addressing the HVAC&R industry's failure to provide industrial and commercial clients with a thermodynamic option that would reduce environmental impact. Carnot Refrigeration makes a conscious effort to design refrigeration systems and heat pumps that cut down on the use of polluting refrigerants. It has taken the lead in its field by creating high-efficiency refrigeration systems designed by specialized engineers and manufactured in an environmentally controlled plant or at a constraint-free site. Carnot Refrigeration is experienced in meeting the needs of sports facilities, supermarkets, distribution centers and data centers.

INTRODUCTION

In 2012, Carnot Refrigeration designed and manufactured a CO_2 cooling unit for server rooms. Since then, the unit was tested extensively and installed for several communication companies in Canada. It was in 2018 that Telus launched a pilot project to test the Carnot Aquilon CO_2 air-conditioning unit in order to evaluate the feasibility of this product in larger deployments. The telecommunications company has ambitious energy and greenhouse gas reduction objectives, and the Aquilon unit could help achieve these goals.

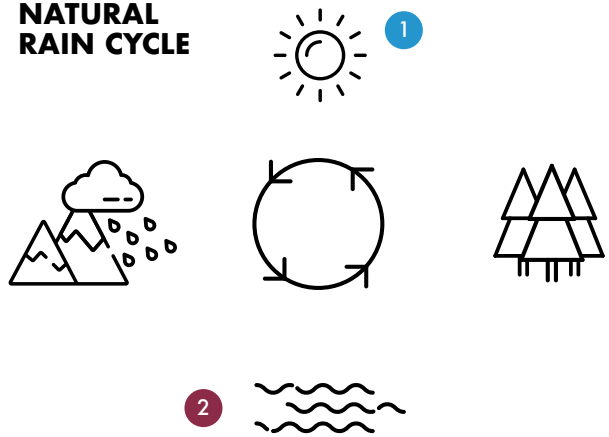
ABOUT THE PROJECT

The pilot project involved replacing an old R22 refrigeration system with a CO_2 system with a cooling capacity of 84kW [23.9TR] in a telecommunications facility of approximately 465m^2 [5,000ft^2] located in Matane, Quebec, Canada. With the environmental protection agency phasing out the ozone depleting refrigerant, Telus needed a greener solution to cool their centers, one that they knew would not be phased out and need to be changed in the years to come. The old cooling units contained around 91kg [200.6lbs] of R22, the equivalent of about 165,000kg [363,763lbs] of carbon dioxide. The Aquilon Computer Room Air Conditioning (CRAC) unit maintains the room at 23°C [73.4°F] year-round, using free cooling when outside temperatures permit it.

AVERAGE ENERGY CONSUMPTION USING RAIN CYCLE ™

CARNOT PATENTED RAIN CYCLE ™ FREE COOLING

STANDARD INSTALLATION



CONDENSATION EVAPORATION

The free cooling process, patented under the name Rain Cycle Free Cooling, allows the refrigerant to flow between the outside condenser and inside evaporator without the use of a pump or a compressor. This is in part due to the pressure differential between the two components. The process can be compared to the rain's natural cycle, where water evaporates on the ground and condenses in the clouds, falling back down in droplets to start the process again. In the Aquilon Unit, R744 evaporates in the evaporator, goes up to the condenser where it condenses to liquid form and drains by gravity back towards the evaporator, where the process starts again.

The 24T Aquilon Unit is equipped with an industrial type semi-hermetic compressor with a variable frequency drive, some electronic control valves, ECM motor fans and an integrated control system. In addition, the system integrates Rain Cycle technology, patented by Carnot Refrigeration, which allows for the continuation of refrigeration in the room without running using the compressor. The integrated controls system switches the unit from compression mode to free cooling mode without needing prompting from a technician. It is adaptive and self-learning, maximizing the free cooling hours as cooling load varies.

The unit is built with stainless steel piping and installed with bended tubing and orbital welding. The welding and advanced repairs require qualified contractors that were available in different cities across Canada. Some training was required for the Telus technicians.

RESULTS

No estimations on the reduction of greenhouse gases have been done, but no leaks have been experienced on the CO_2 unit. Telus estimates energy savings of 60% with the new unit during the first year of operation, this equated to around 14% decrease in the energy consumption of the entire building. This decrease is explained by the fact that cooling is a huge portion of the energy consumption of a data center.

The initial cost of the unit is around 40-50% more expensive than a standard unit. But given the energy saving Telus has seen within the first year of operation, the payback period for the Aquilon units run at around two years.

In summary, a suitable alternative to synthetic refrigerants in the data center industry is now available at a competitive price. The Aquilon Unit uses 100% natural refrigerant, is more energy efficient, greener, and cheaper to maintain. Telus has since the pilot project installed three more units in different locations across Canada.

BENEFITS:

- Elimination of any future phase-outs by using R744 (CO_2), a natural refrigerant.
- Significant decrease in the energy consumption related to the cooling.
- Improvement in reliability and efficiency
- Reduction of maintenance costs (due to its simplicity)
- Payback period of implementation around two years
- Greenhouse gas emission reduction due to low GWP of R744

FTE: FULL TRANSCRITICAL EFFICIENCY

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ABOUT THE COMPANY

Epta was founded in 2003 and has quickly become a leader in the commercial refrigeration industry. Family-owned and headquartered in Milan, Italy, Epta ensures efficient coverage of world markets through Group brands which include Costan, Bonnet Névé, Eurocryor, Misa, Iarp, and Kysor Warren. With the skills and specialization provided by each individual brand, Epta is able to offer innovative refrigeration solutions anywhere in the world. Epta Group has an extensive technical and sales force worldwide, comprised of over 40 direct branches and 11 production facilities in eight different countries. The company currently employs over 6,000 employees dedicated to providing the highest quality products and a customer experience that is second to none.

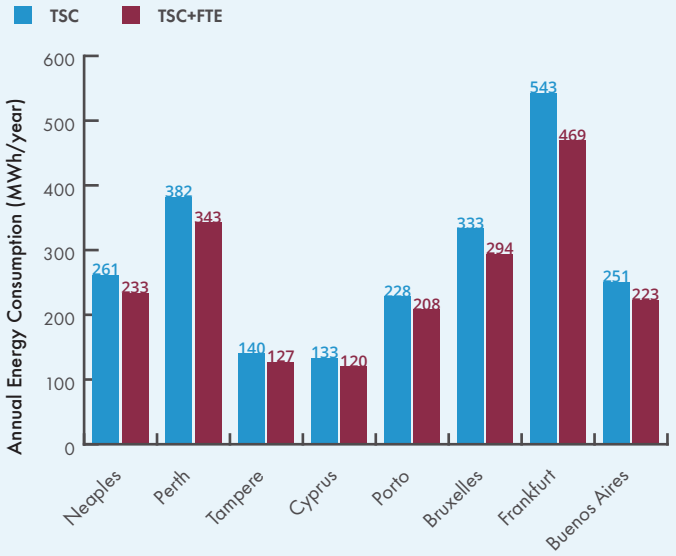
INTRODUCTION

Epta's Research and Development team is consistently pushing the envelope of cutting-edge technologies and designs in the rapidly developing area of CO_2 refrigeration systems. Being that CO_2 is non-flammable and non-toxic, it is an ideal refrigerant to aid in the advancement of natural refrigerant solutions around the globe; however, there are many factors that affect the adoption rate of new technologies. The three obstacles that were most prevalent amongst customers were defined as reduced efficiency in warmer climates, increased capital investment, and serviceability/ technical constraints. As a result, Epta developed the Full Transcritical Efficiency (FTE) system which minimizes the impact of these obstacles, making transcritical CO_2 systems a more attractive solution and ultimately increasing the adoption rate.

ABOUT THE PROJECT

The innovative design of the FTE system provides many benefits as compared to standard transcritical systems. FTE increases efficiency and reliability of CO_2 booster systems by flooding the medium temperature evaporators, without risking compressor flood-back. Flooding the medium temperature evaporators allows the suction temperature and pressure to increase,

FTE ENERGY SAVINGS IN MULTIPLE CLIMATE REGIONS

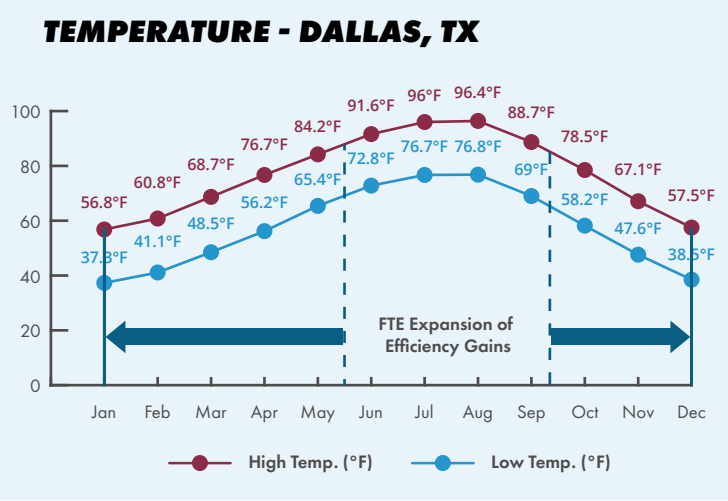


thus decreasing the compression ratio of the medium temp compressors. The effect of the lower compression ratio not only improves the efficiency of the system it also decreases the compressor discharge temperature. Lower discharge temperatures reduce the risk of overheating and degrading the quality of the oil, ultimately extending the compressor life cycle.

Since FTE is an enhancement implemented on the low-pressure side of the system, the efficiency benefits from flooding the medium temperature evaporators are recognized year-round, regardless of the ambient temperature. For this reason, FTE is the ideal solution for customers looking into options to reduce the need for expensive adiabatic or evaporative gas coolers which provide benefits only during the warmer seasons.

The simplicity and serviceability of the FTE system sets it apart from the competition. The technology requires only a few additional standard, easily-sourced components (tank/receiver, solenoid valves, check valves, and control boards) that service contractors use on a daily basis. Best in class training and support are available for installers and end users.

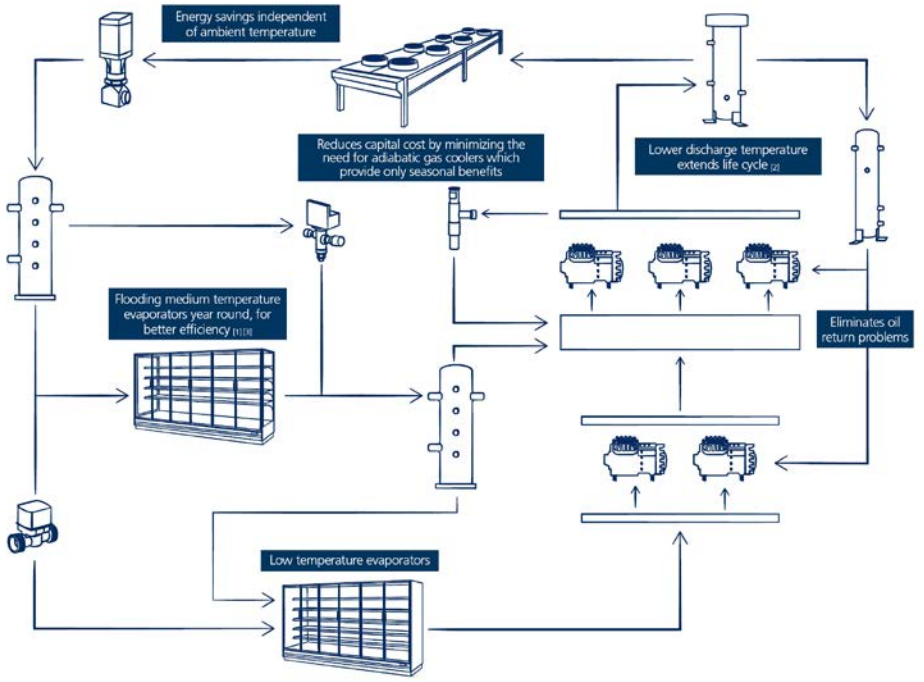
The importance and effectiveness of FTE is confirmed by the fact that it is at the heart of Life-C4R Carbon 4 Retail Refrigeration, the three-year Epta project co-financed by the European Union (under grant agreement n° LIFE 17 CCM/IT/000120). The project was conceived to accelerate the spread of highly efficient CO_2 refrigeration systems and is aimed at finding new technologies and standards for natural refrigeration in retail sector, highlighting Epta's commitment to research and development. It is part of the European program LIFE that includes a numerous array of projects to combat climate change.



FTE
FULL TRANSCRITICAL EFFICIENCY

Epta

SIMPLE. RELIABLE. EFFICIENT.



ECO-FRIENDLY R-744

Natural refrigerants that are both non flammable and non-toxic like CO_2, offer environmentally sound solutions for your refrigeration & sustainability goals

FIELD TEST DATA

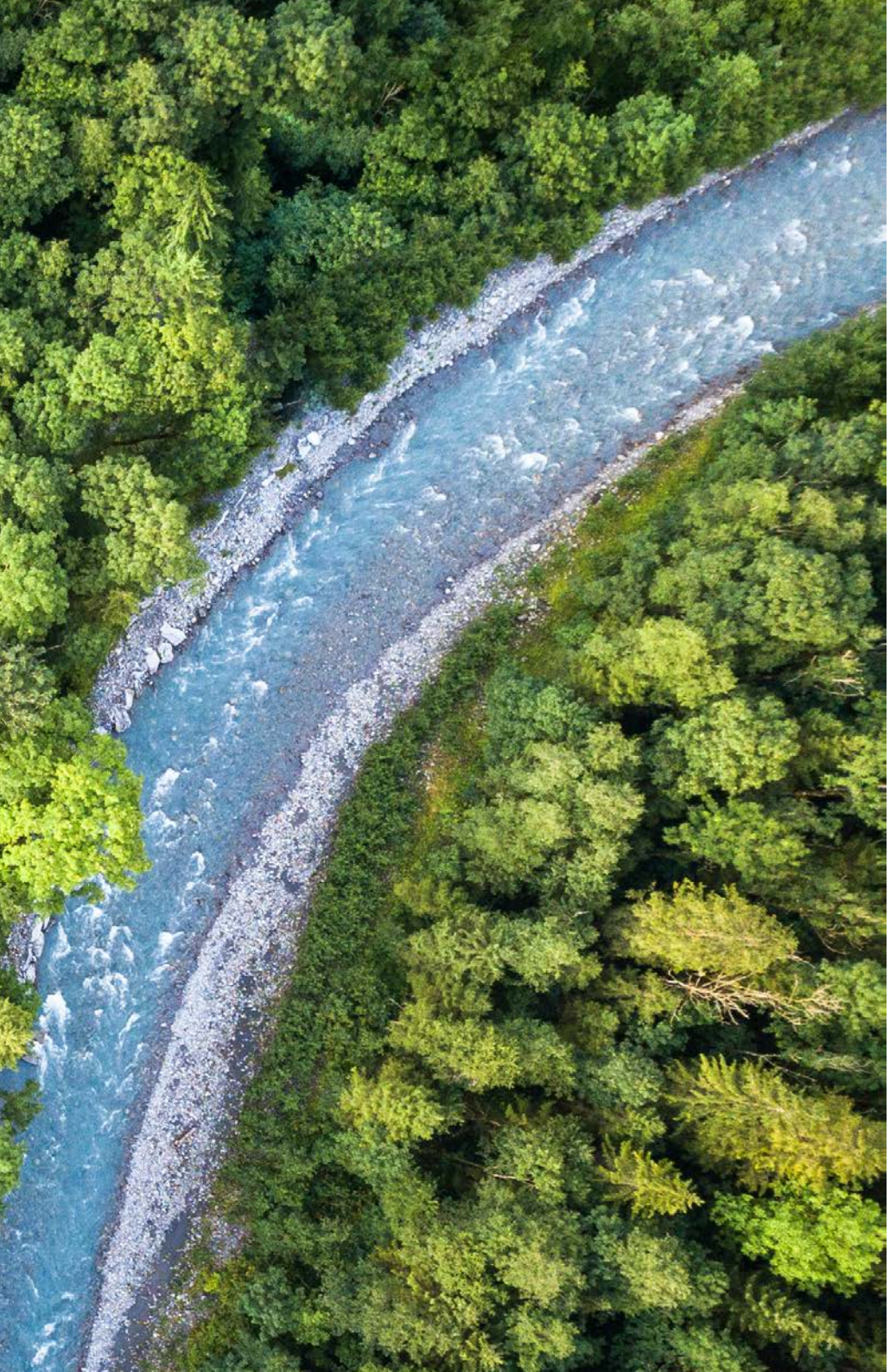
[1] 6-8°F ↑ MT Suction
[2] 16-18°F ↓ CDT*
[3] Efficiency ↑ > 10%
* CDT – compressor discharge temperature
**Test Data based on global FTE installations utilizing Epta display cases

Endorsed by Bitzer

RESULTS

With more than 300 FTE installations globally and five U.S. installations planned by end of 2020, Epta and Kysor Warren continue to see growth for this innovative design. The data collected from the global installations provide conclusive evidence of a 10% reduction in energy consumption. The data shows that flooding of the medium temperature evaporators allows the average suction temperature to increase by 6-8°F [by 3-4°C], while also maintaining product temperature and integrity. The discharge temperature of the medium temp compressors decreases by 16-18°F [by 9-10°C] which again reduces oil degradation and extends the compressor life cycle. Combining the simplicity, reliability, and energy efficiency of the FTE system make it the best option for customers interested in a future-proof, sustainable CO_2 refrigeration system.

COMMERCIAL/ SUPERMARKET APPLICATIONS



An overview

Commercial retail applications are where transcritical CO_2 refrigeration systems first found their niche in the early 2000s already and the total number of installations has been increasing globally at a rapid pace. With increasing pressures from global HFC-reducing policies and standards, specifying a transcritical CO_2 refrigeration system for commercial applications has become a standard way of future-proofing the installation.

As the demand for these climate-friendly systems grew, so did the number of players on the market and the availability of systems and specialized skills. Prices became more cost competitive, efficiencies went up – even in warmer climates previously considered unsuitable. (Read more on "drivers and barriers" in the upcoming Chapter 7.)

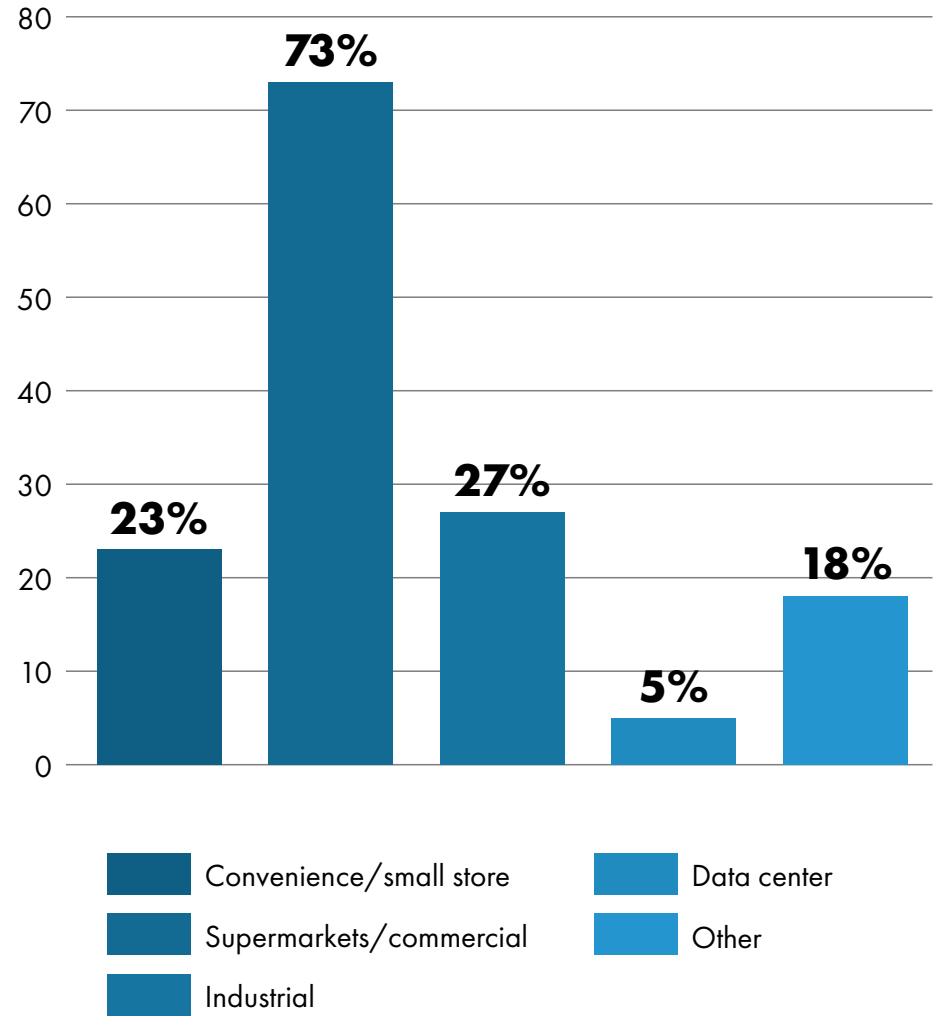
What does the market for transcritical CO_2 in supermarkets and commercial installations (>400m^2 [4306ft^2]) look like today?

This chapter investigates the global use of transcritical CO_2 in commercial applications – retail in particular. We take a look at global market trends, innovative technologies launched at EuroShop 2020, end user testimonials, and survey results to get a better picture of this.

TRANSCRITICAL CO_2 IN COMMERCIAL REFRIGERATION AROUND THE WORLD – A SURVEY

END USERS: LARGE MAJORITY ACTIVE IN COMMERCIAL REFRIGERATION/SUPERMARKETS

End users working with transcritical CO_2 systems were also asked where they use this technology predominantly. Multiple answers were possible. There were 32 responses in total and 73% indicated the commercial supermarket sector, while 27% selected industrial and 23% convenience/ small stores. Data centers received 5% of the answers with 18% unspecified as "Other". Examples of "Other" are dairy farms, hypermarkets, regional distribution centers and warehouses/depots.

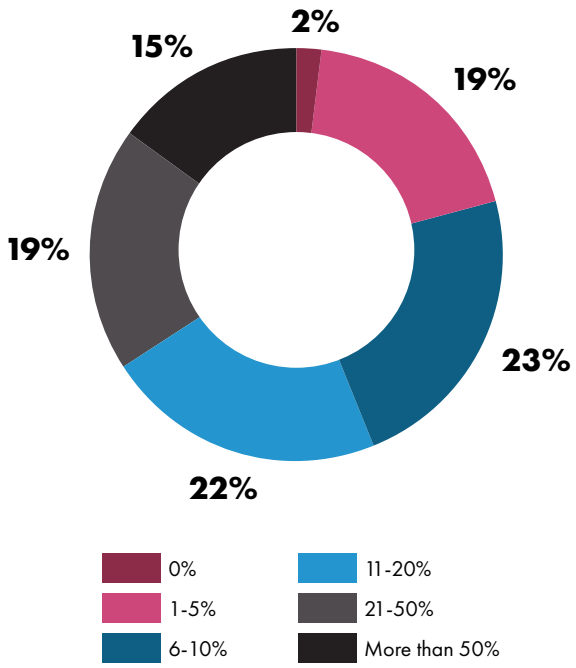


Number of responses: 32 [multiple answers possible]

MARKET SHARE ESTIMATES FOR TRANSCRITICAL CO_2 MODEST

The survey respondents were asked to estimate the market share of transcritical CO_2 in its traditional sector – commercial refrigeration. Responses were varied and only moderately ambitious. Results were rather evenly split between the possible ranges. The greatest exception was those (2% of the total respondents) who believed the market share to be 0%. More positively, 15% selected a market share of more than 50%.

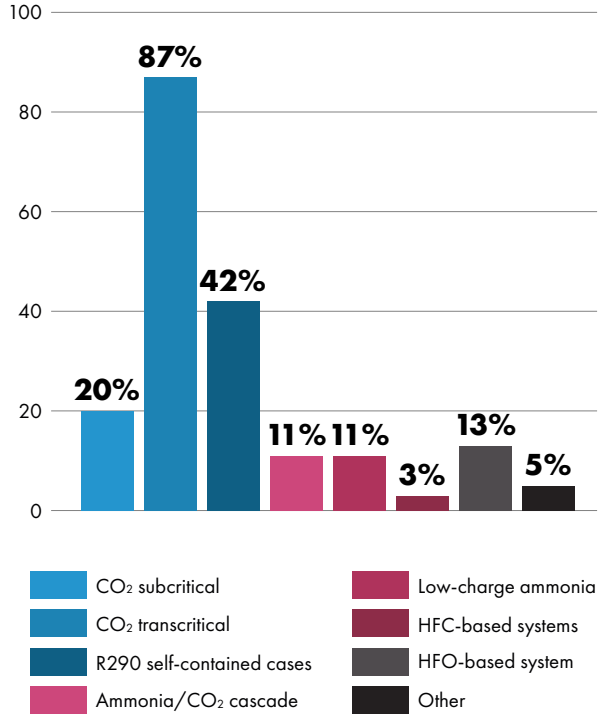
This shows that transcritical CO_2 has already penetrated the commercial refrigeration market to a considerable extent. However, there is still potential for even more growth in this market.



Number of respondents: 204

TRANSCRITICAL CO_2 EXPECTED TO DOMINATE COMMERCIAL REFRIGERATION IN SUPERMARKETS IN THE FUTURE

When respondents were asked what technology will dominate new supermarket installations in future, estimates were clearly in favor of transcritical CO_2 (an overwhelming 87%). R290 self-contained cases and subcritical CO_2 are also estimated to take a large share at 42% and 20% respectively. In the category "Other" (5%), R290 water-loop systems were often mentioned. Multiple answers were possible.



Number of responses: 394 [multiple answers possible]

GLOBAL TRANSCRITICAL CO_2 TRENDS IN RETAIL FROM EUROSHOP 2020

A first-hand look into the future of retail refrigeration shows an undeniable shift towards natural refrigerants – transcritical CO_2 in particular.

- by sheccoMedia

Every three years, the retail world converges in Düsseldorf, Germany, to attend EuroShop, which bills itself as "the World's No. 1 Retail Trade Fair." We take a look at the main trends from the February 2020 show to see where the global market is heading for transcritical CO_2 – for retail and beyond.

*[*Disclaimer: This is by no means a comprehensive report of all the exhibitors and innovations displayed at the 2020 show. This summary account is based on information gathered before, during, and after the show by various shecco team members.]*

More CO_2 solutions for small stores

EuroShop 2020 confirmed the expansion of CO_2 beyond mid-sized commercial retail applications – a noticeable trend that has been emerging worldwide. A number of companies displayed solutions for smaller convenience stores and large industrial projects.

CO_2, though primarily used in rack systems in larger stores, is increasingly being used in condensing units in small stores. For example, since introducing outdoor CO_2 condensing units in Europe in 2017, Japanese OEM Panasonic, has sold 600 units as of last October (2019),

according to Gaku Shimada, Overseas Sales Manager for Panasonic's Refrigeration System Sales Department. In marketing these units, Panasonic has targeted small-format stores, gas stations, fast-food chains and restaurants, said Shimada during a presentation at ATMOsphere Europe, in Warsaw, Poland, on October 16.

This year, **Panasonic Heating and Cooling Europe** introduced a 4HP [3.0kW; 0.9TR] CO_2 condensing unit for medium-temperature and low-temperature cases. With this new model, Panasonic's line-up (2HP/4HP/10HP [1.5kW; 0.4TR/ 3.0kW; 0.9TR/ 7.5kW; 2.1TR]) for medium- and low-temperature applications "can meet almost all the requirements for small stores," said Lena Ansorge, Communication Manager for Panasonic Appliances Air-Conditioning Europe.

In another example, **Area Cooling Solutions**, based in Barcelona, Spain, has developed an indoor CO_2 condensing unit, the iCool Max CO_2, for small urban stores. The system is designed for retail outlets such as supermarkets, grocery stores, markets, petrol stations and convenience stores of up to 200m^2 [2,153ft^2].

Even Danish OEM **Advansor**, which has installed more than 6,000 transcritical CO_2 racks, is catering to small stores now with its Minibooster and Tower units, which have a small footprint for stores where space is limited, said Jasmine Lange, marketing coordinator for Advansor.

German OEM **Teko** launched its ROXSTAmicro condensing unit for smaller convenience stores at EuroShop. The ROXSTAmicro is an air- or water-cooled unit for plug-and-play cabinets offering the same performance as similar propane (R290) units, but without the flammability risk, said Teko. It is suitable for applications up to 5kW [1.4TR] for medium-temperatures and as low as 500W [0.1TR] for low temperatures, thereby expanding Teko's overall range to include solutions from 500W [0.1TR] to 550kW [156.4TR]. The unit will be commercially available before the end of 2020.

Carrier presented its new Power CO_2OL solution, capable of delivering up to 550kW [156.4TR] low-temperature capacity, and up to 1,500kW [427TR] for medium temperature. The Power CO_2OL uses modulating vapor ejectors, allowing the compressors to operate at higher suction pressure.

Meanwhile, in December 2019, OEM **Daikin Europe** completed the installation of a prototype "Conveni-Pack" integrated refrigeration/air conditioning/ heating system for convenience stores, using CO_2 refrigerant, at a demonstration shop at its headquarters in Ostend, Belgium.

Co-funded by the European Union, this product was developed for Natural HVACR 4 LIFE, a sustainability focused research project exploring the use of CO_2 as a natural refrigerant.

This CO_2 version of the Conveni-Pack is based on an existing version that employs R410A as the refrigerant. (More about all-in-one integrated systems later on in this article.)

Daikin Europe will test the CO_2 prototype in a simulated convenience store, followed by demonstration and monitoring in stores in Germany and Spain, in average and warm climates, respectively. According to the European Commission, the project intends to install and monitor the system in 20 European stores. It will mainly monitor the energy efficiency and safety performance of the equipment "to provide a risk mitigation strategy as the basis for a large-scale application of CO_2 as a natural refrigerant."

Through Natural HVACR 4 LIFE, Daikin intends to remove market barriers by exploring the viability (in terms of energy and safety) of an integrated refrigeration, heating and comfort cooling system that uses CO_2 as a natural refrigerant, according to the website. The company will raise awareness among installers, engineers, customers and the general public on the potential benefits of using CO_2 as a natural refrigerant in convenience stores through exhibitions, conferences and online tools.

Improving rack efficiency for larger installations

Despite the inroads made by CO_2 condensing units in smaller stores, in medium- to-large supermarkets, CO_2 rack systems are still king.

CO_2 racks "have been growing a lot and fast in the past few years, not only in the commercial retail segment but also with growing interest from the industrial market, for example in food manufacturing such as bakeries and meat processing," said Lydia Matthäus-Wiltink, Business Development Manager for German OEM Teko, which had installed more than 4,000 CO_2 racks in the market by the end of 2019. "We expect this trend to continue and most likely to grow even further in 2020 and beyond."

The use of efficiency-enhancing technologies like ejectors and parallel compression in transcritical CO_2 systems continues to grow, enabling the systems to be used efficiently in high ambient climates. "The efficiency of transcritical CO_2 systems is improving year over year," said **Advansor's** Lange. "Ejectors are playing a role in warmer climates, and we believe very strongly in this technology. We are also introducing it on smaller systems now."

Last year, **Carel** supported the start-up of modern centralized transcritical CO_2 systems in China, South America, South Africa and Australia, some of which equipped with modulating ejectors, said Carel's Di Lena.

Enrico Zambotto, Refrigeration Director for Italian OEM **Arneg**, expects parallel compressors to become a "standard" feature in transcritical systems, while in warm climates, ejectors will increase in use.

Manufacturers are continuing to come up with new ways to improve efficiency of refrigeration systems. For example, Advansor is seeing "very good efficiency gains with permanent magnet motors in compressors," said Lange. With all efficiency measures taken into account, "there can be a difference of more than 25% seasonal energy performance ratio (SEPR) in warm climates between a standard solution that was top of the line five years ago and a high-end solution today."

Epta has developed its own energy-saving transcritical technology, the full transcritical efficiency (FTE) system. The company is promoting this technology through its participation in the Life-C4R (Carbon 4 Retail) project, which is co-funded by the EU and coordinated by Epta. There was a Networking Event organized by shecco around this project.

Francesco Mastrapasqua, Advocacy and Regulatory Affairs Manager at Epta, explains that "in a traditional system, superheating at evaporator is necessary to be certain of having only vapor at the outlet of the evaporator, since the presence of liquid sucked in by the compressors would irreparably damage them, but it also introduces a considerable waste of energy and greater compression work. With the evaporator flooding applied to the MT (medium temperature) loads the superheat is eliminated, so there is an improvement in the heat exchange as the entire surface of the evaporator is used in an optimal way obtaining a significant increase in evaporation temperature (up to 6 K), reducing energy consumption on MT compressors. Eliminating superheat by flooding the evaporators is the key to increasing efficiency in all the climates and during the whole year."

The FTE solution combines the efficiency of flooded evaporators with reliability and simplicity in any country with any external temperature, reducing the energy consumption of the refrigeration system all year round, without adding any significant cost or complexity compared to a basic CO_2 transcritical booster system. One of the main advantages is the simplicity, because it does not need complex control logic or any sophisticated components. Mechanically the FTE system operates with the same components as the basic CO_2 transcritical system, plus the FTE low-pressure liquid receiver and a solenoid valve (double for safety), able to stop the flow of liquid from the main liquid receiver to the LT cabinets.

Another solution by Epta to increase the energy efficiency in CO_2 refrigeration systems, especially in hot climates, is the Extreme Temperature Efficiency (ETE) System solution. This solution is an evolution of standard mechanical sub-cooler unit, integrating this system in a transcritical CO_2 system. With the Extreme Temperature Efficiency solution, the refrigerant flow coming out of gas cooler is sub-cooled by an integrated CO_2 unit, composed of a heat exchanger,

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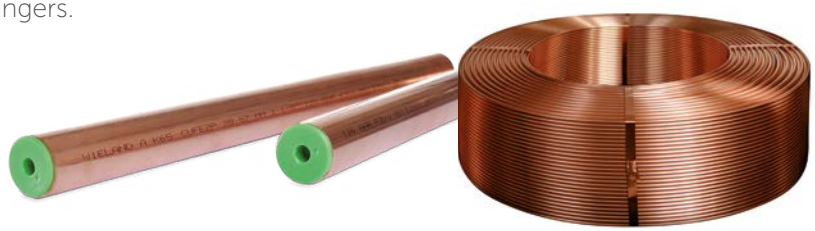

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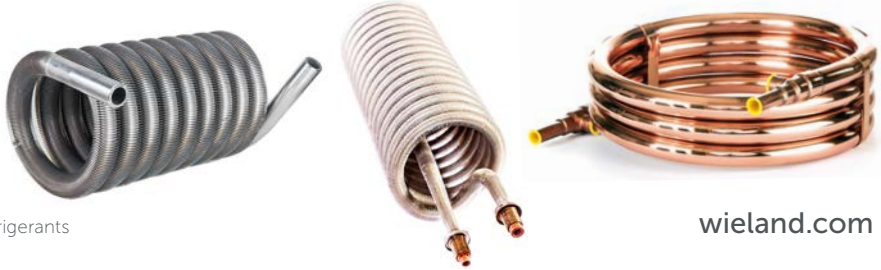

wieland.com/refrigerants

wieland.com

an electronic expansion valve (EEV) and a compressor. The sub-cooler is usually activated in transcritical conditions for energy saving, peak shaving and to address all the issues related to the high compressor discharging pressure and temperature. The ETE system ensures there is no performance loss in warm and hot climates, increases the total energy efficiency and can be used for both commercial and industrial applications. To be more precise, for ambient temperatures below 30°C [86°F], a standard transcritical CO_2 system is used, and ETE recommended. For ambient temperatures higher than 37°C [99°F], both FTE and ETE are recommended. Higher than 40°C [104°F], FTE is always included; and higher than 43°C [109°F], both FTE and ETE are always to be included.

Energy saving is key

An important reason for manufacturers to develop ever more energy saving products is the new EU Ecodesign and Energy Labeling Regulation, which will come into effect in March 2021, promising stricter energy efficiency requirements for the commercial refrigeration industry, and a shift in existing products in retail.

The European HVAC&R industry association **Eurovent**, with participation from the European Commission, hosted a seminar on February 17 at EuroShop to elaborate on the upcoming legislation. The aim was to offer the attending HVAC&R professionals an introduction to the new product requirements.

The new regulations "are game-changers for the commercial refrigeration sector," said Francesco Scuderi, Deputy Secretary General of industry group Eurovent. "They are expected to result in a phase out of certain products on the European market and increase the demand for the best market-available technologies."

CO_2 Moving Outdoors

Not all the CO_2 trends at EuroShop were about efficiency or size. Several companies also introduced products for outdoor installation.

One of them was **Danfoss**, which introduced its Optyma iCO_2, a plug-and-play stackable condensing unit for medium-temperature applications with a cooling capacity of 1.5-4.7kW [0.4 to 1.3TR]. The capacity is suitable for display-cabinet lineups of 1.5m-10m [5 to 33ft], but the unit can also be used to refrigerate cold rooms.

With the Optyma, Danfoss aims to bring CO_2 refrigeration to a new segment of convenience stores that have reduced indoor space. The unit will be commercially available later in 2020, and Danfoss is already planning a range extension, said John Broughton, Global Application Expert at Danfoss.

Another company with a new outdoor CO_2 offering is Swiss OEM **Biaggini Frigoriferi**. The company introduced TotalGreEnergy, an integrated transcritical CO_2 booster system that includes refrigeration, heating and air conditioning.

The TotalGreEnergy is a ready-to-install unit, aimed at supermarket applications and suitable for all climates. The system can save up to 30% in energy consumption, compared to traditional HFC systems and other CO_2 booster systems, according to Luca Rossi, Project Manager at Biaggini Frigoriferi. The saving is mainly due to an added subcooling section, and the "unique machine architecture," Rossi said.

The TotalGreEnergy system is customizable and available in refrigeration-and-HVAC-only versions. It is already commercially available in four size configurations. The smallest version with two fans has a chiller capacity of 15-35kW [4.3-10.0TR] while the largest, with five fans, offers 55-135kW [15.6-38.4TR].

The Growth of Integration

Another driver of efficiency in retail refrigeration is system integration: refrigeration, air conditioning and heating served by one rack system (as also seen by some of products mentioned already in this article). It is becoming ever more popular to use integrated functions to save energy, by for example using the waste heat from refrigeration for heating and/or hot water production.

Bitzer is expecting growing market share for integrated systems in stores greater than 1,000m^2 [10,764ft^2] in size, said Patrick Koops, Head of Public Relations for Bitzer.

Frascold sees "an incredible growing demand for compressors used in integrated systems, because stores are really focused on maximizing system efficiency," said Elisa Argenta, Marketing & Communications Manager for Frascold.

"System integration is something we've already been doing for some time in partnership with WURM Systems and GTM Gebäudetechnik Management," said **Teko's** Matthäus-Wiltink. The partnership "combines heating, cooling, lighting, controls, etc. all in one system, right from first design."

Integrating systems increases the overall store efficiency and reduces costs, noted Matthäus-Wiltink. "This makes total sense for supermarkets and others, and many successful installations we've been involved in are proof that this concept is the right way forward."

Advansor has been selling integrated transcritical systems for many years with its Sigma units, "and this is a standard for us now," said Lange.

Meanwhile **Danfoss** is participating in the MultiPACK project funded by the EU, which focuses on integrated systems in warmer climates, said Carina Brandt, Senior Director Marketing Communication Danfoss Cooling.

For many HVAC&R companies, the adoption of efficient natural refrigeration technology is a vital part of confronting the climate emergency. "We are living in an era of change and transformation towards a more environmentally friendly model," said **Epta's** Mastrapasqua. "We must support our clients who share our same vision in creating climate-neutral stores."

Omnipresent Digitalization

Digitalization (sometimes called Industry 4.0) was everywhere as manufacturers showed off new innovations in controls and data management, making products more intelligent than ever.

One example was the aforementioned Optyma iCO_2 from **Danfoss**, which can be connected with the company's ADAP-KOOL case controller solution to enable remote monitoring and management. The ADAP-KOOL is part of Danfoss' Smart Store Concept, which intends to save not only energy and heating costs, but also reduce service calls and overall carbon footprint.

Custom components

When German manufacturer **Wieland** displayed its K65 CO_2 copper-alloy piping solution – which contains 2% iron – 15 years ago, sales moved slowly, but now "everyone wants it," said Florian Diesch, Sales Manager of Wieland, during EuroShop.

The K65 piping is designed to be both lightweight and easy to weld, making it a great solution for CO_2 projects around the world, said Wieland. Because the pipe is mainly made of copper, it behaves like copper – except that it's much stronger and can withstand the high pressures of CO_2, explained Diesch. "This increases the strength of the copper without making the pipe heavier."

As copper in itself isn't strong enough to withstand the pressures of CO_2, stainless steel has often been the preferred choice for piping. However, stainless steel piping is heavy and requires a qualified welder. K65 piping, behaves the same as copper, so any plumber who can work with normal copper piping, can weld it, Wieland said. It is also much quicker to weld, reducing downtime for maintenance or repairs, the company added.

WHY USE (TRANSCRITICAL) CO_2 IN COMMERCIAL REFRIGERATION?

Today, many end users from around the world consider it a "no-brainer" to opt for transcritical CO_2 in commercial applications in particular – why?

- by sheccoBase and sheccoMedia

End users from around the world have been using transcritical CO_2 for their refrigeration needs since the early 2000s. In Europe, these systems have been the norm for many years and even eastern European companies are now getting on board. Globally, regions such as South Africa and Australia are also seeing a fast spike in number of installations. These are not the only warm climates opting for transcritical CO_2 – even Mexico and the Middle East now boast installations.

Examples of happy customers in the commercial space are plentiful... Why are end users switching to transcritical CO_2 at such a rapid pace?

SOUTH AFRICA

Woolworths[1]

During ATMOsphere Cape Town in March 2020, three of the biggest food retailers presented on their journey with transcritical CO_2.

Alex Kuzma, Head of Engineering Services at Woolworths said: "For us it's a no-brainer; CO_2 is business as usual now. We generally go for CO_2 wherever we can – because it works, and it works well."

"We found it reliable and simple – and of course, sustainable," Kuzma said about transcritical CO_2. He said that he had a lot of support from Woolworths' board as the company's strategy aligned with going "green." Transcritical CO_2 is also future proof, a major plus, he said. "This is Africa, I have enough to worry about already – I want to just put a system in and not worry about it again. Transcritical CO_2 allows for that."

SPAR[2]

Dutch food retailer SPAR opened its First Transcritial CO_2 Store in South Africa late 2019. The food retailer scrapped its existing premises and R22/R404A refrigeration system to invest in a more future-proof, energy efficient solution for its Middelburg store.

"We were aware of the fast-growing increase in the price of synthetic refrigerants," explained Firmino Patricio, Owner of SuperSPAR Wonderpark. "And by installing a CO_2 system, it would help us negate this future problem."

"We have been monitoring the development of CO_2 refrigeration systems for some time, however prior to transcritical systems, the South African climate had a significant impact on the efficiencies of these systems," Wayne Dedekind, Group Development Manager for SPAR South Africa stated. "With the advancements in transcritical CO_2 refrigeration, we were confident that our retailers would eventually be able to combat not only the environmental issues surrounding HFCs, but also be able to surpass the energy efficiencies of HFC plants."

"Mr. Patricio was the first of our independent retailers to acknowledge the inevitable future of refrigeration for The SPAR Group South Africa, and we have since opened a second CO_2 site, with the objective to open another 10 sites for 2020," said Dedekind.

Food Lovers Market[3]

In 2019, Food Lovers Market (FLM), a franchised supermarket and convenience store chain serving Southern Africa, installed its first transcritical CO_2 booster system in a new store in Ferndale, a suburb of Johannesburg.

"The system is quiet, manageable from a central point, and all data can be easily collated," said Arthur Woest, project manager for FLM. "Therefore, feedback collected can assist with preventing any potential liabilities that can result in stock loss."

U.S.

Seed to Table Market, Florida[4]

The 75,000ft^2 [6,968m^2] Seed to Table Market, a refurbished Albertsons store that opened in December, is located in North Naples, Florida, the most south-eastern state in the U.S. The system includes three rooftop adiabatic gas coolers which helps the system function efficiently in the balmy climes of southwest Florida.

The high ambient of North Naples, the energy consumption of the system as compared to that of a traditional DX system is "parity, probably using a little more," said Glenn Williams, sales manager, Supermarket Source, a Hialeah, Florida (U.S.)-based distributor of supermarket equipment, which arranged the purchase of the transcritical system for Seed to Table.

Williams suggested to Seed to Table's owner, Alfie Oakes, that he should use CO_2 refrigeration if he "wanted to go all natural," though it would cost more up front. "But he was happy that CO_2 was only 10% the cost of R448A refrigerant," Williams said.

Weis Markets, New Jersey[5]

"Remarkable," said Paul Burd, manager of refrigeration engineering for Weis Markets, a Mid-Atlantic chain of 204 grocery stores. He was referring to a chart comparing the energy usage of four refrigeration systems used by Weis stores between August 2018 and May 2019, as he stood before about 400 attendees of the ATMOsphere America conference in Atlanta, Ga., in June. All four systems are located in stores of similar size and refrigeration load.

What was remarkable to Burd was the energy savings demonstrated by Weis's transcritical CO_2 refrigeration system, installed at a 54,000ft^2 [5,017m^2] store in Randolph, N.J., in July 2018, the chain's first such system. Its energy usage during that period was 250,790 kWh [71,654RTh], substantially below the energy consumed by the other systems, all based on HFC or HFO refrigerants: 32% less than a 1.5-year-old secondary glycol/DX system, 39% less than a seven-year-old distributed rack system, and 86% below a 23-year-old centralized DX system.

The transcritical system, Burd said, "has really been a win for us."

AUSTRALIA

IGA, Cranbourne[6]

In 2018, the new Independent Grocers of Australia (IGA) supermarket at Clarinda Village in Cranbourne, Victoria opened boasting a transcritical CO_2 rack made in South Africa.

The client was very happy with their decision to try out this option. "When MB Refrigeration (the contractor) told me about the refrigerant changes and environmental impact of the new system along with long term cost of ownership with CO_2 gas, I could see that it was important to embrace the new system for my latest store," said Salam Rasool of IGA. "I am delighted with the result."

ALDI, Melbourne[7]

In September 2018, ALDI Australia began testing a CO_2 water-loop refrigeration system at a central Melbourne supermarket. The system is used in self-contained, plug-in cabinets, with heat withdrawn by the water loop.

After several months of operation, Marcus Meier, ALDI Australia's property director, revealed some conclusions from this test at ATMOsphere Australia 2019. The advantages of the system, Meier said, lay in three areas. First, the CO_2 plug-in units "provided excellent case temperature control," he said.

Second, the solution makes sense for sites with engine-room space constraints, which was one of the original motivations to trial the system. "It's a good solution if you are in a mixed-use development where you don't have a plant room or you don't have a lot of space," Meier said.

In this case, the system was installed as a refurbishment in a multi-story high-rise building in Melbourne's space-constrained central business district. Finally, the units are "ideal for sites with sensitive noise restrictions," he said.

Woolworths, NSW[8], Sydney[9]

Australian retailer Woolworths commissioned its first transcritical CO_2 system that fully integrates the store's HVAC&R systems on December 6, 2018. The store is located in Prestons, New South Wales.

Notably, the transcritical CO_2 system has been "completely locally designed, manufactured and installed for 45°C [113°F] ambient," according to Woolworths Sustainable Innovations Engineer Dario Ferlin.

The company states that, "by 2020 we will install ten natural systems employing technologies such as transcritical CO_2 or water loop," in its 'Corporate Responsibility Strategy 2020' report. This is a number that has since been exceeded.

Initially due for opening in March 2020, Eastern Creek is Woolworths' 13th store in Australia with a transcritical CO_2 system. The opening has been delayed however because of the COVID-19 pandemic. Ferlin said that, despite the current difficulties, the store is "an example of how transcritical CO_2 is quickly becoming the Woolworths norm."

EUROPE

Migros, Switzerland[10]

Swiss retailer Migros expects the vast majority of its supermarkets to use natural refrigerants by 2030 – and especially CO_2.

"In supermarket refrigeration, it's important to have efficient and reliable refrigeration production," says Urs Berger, who heads the Energy and Building Technology department at Migros Engineering Solutions (MES). "In our experience, CO_2 covers those two aspects very well," he adds.

In 2002, Migros opened its first supermarket to use CO_2, in a low-temperature subcritical system. It installed its first CO_2 transcritical system in 2005. "We decided in 2010 to make CO_2 our standard refrigerant," says Berger.

For supermarket refrigeration, all Migros's new and retrofitted installations use CO_2 transcritical systems as standard since that year.

"By 2030, the vast majority of our supermarkets will be with natural refrigerants – and especially CO_2 transcritical."

Of the 700 supermarkets in Migros's portfolio, 411 were equipped with CO_2 transcritical systems by the end of 2017 already.

Metro and Globus, Russia[11]

In 2019, German retailers Globus and Metro AG opened new trans-critical CO_2 stores in Russia.

As of January 2020, Metro AG has converted all of its R22 stores in Russia to CO_2 refrigeration, the final one located in Lipetsk, western Russia. Next on Metro's to-do list is the conversion of all of its R404A stores to CO_2.

"Talking about the large hypermarkets format, we don't see any other alternatives to CO_2 transcritical systems, as one of our top priorities is to increase the efficiency of refrigeration systems," said Vitaly Belozertsev, lead engineer for energy efficiency and refrigeration at Globus.

"In Russia we have now well performing installer partners, so that transcritical could be the standard. For us in Metro we will only install without exemptions transcritical systems, so far as technically possible," said Olaf Schulze, director – energy, facility and resource management, Metro AG.

"Natural refrigerants are a must for our climate, for our future as a wholesaler, and we will consequently follow this path," said Schulze, adding, "We are sure also the customers will recognize it."

Cementing the Group's reputation is its F-Gas Exit Program. A cornerstone of the firm's emissions reduction strategy, it will see Metro AG phase out f-gases by 2030, replacing them with natural refrigerants in all store locations worldwide – where it is technically feasible and economically reasonable to do so.

Mega Image (Ahold Delhaize), Romania[12]

As one of 22 local supermarket companies belonging to Ahold Delhaize, Mega Image SRL, the largest supermarket chain in Romania, shares its parent group's dedication to reducing the environmental footprint of its activities.

"Mega Image is part of the Ahold Delhaize group and all its actions are aligned to those of the group," said Vasile Casian, Technical Manager at Mega Image. "Our commitment is to have as little an impact on the environment as possible, and to make our actions more sustainable."

"Our targets refer to reaching a certain level of GWP and reducing our CO_2 emissions," he added. "To reach these targets, natural refrigerants are the best choice and the long-term solution."

MEXICO

Casa Ley, Culiacán[13]

In 2018, Casa Ley, a major food retailer in Northwest Mexico was the first supermarket operator in Mexico to install a climate-friendly transcritical CO_2 refrigeration system in one of its stores, a new 75,347 ft^2 [7,000m^2] supercenter in Culiacá.

"We were surprised to be the first," said Juan Manuel Ley-Bastidas, son of Ley and current CEO and chairman of Casa Ley. "But we're proud of that. It validates the work we're doing."

"We believe as a company we have to be very responsible to our communities and our customers and employees, said Ley-Bastidas, who became CEO of Casa Ley in 2008 and chairman this year. "And a big part of that is taking care of the environment."

"It's not just for publicity or for marketing," he added. "It's really caring about our kids and communities."

In addition, from their analysis of market and policy trends in Mexico and other countries around the world, Casa Ley executives could see that refrigeration technology was moving toward using "less polluting gases," he said. In selecting a transcritical system, "we wanted to get ahead of legislation and stay ahead of the curve."

CHINA

Metro, China[14]

Metro China's Chongqing store is located in the Nan'an district and originally opened in 2001. The store building area measures 15,536 m^2 [167,228 ft^2] and has a sales area of 8,597 m^2 [92,537 ft^2].

The store's transcritical CO_2 system replaced an existing R22 system. "Due to the high temperature of Chongqing in the summer, we chose to use the ejector system" – a first for China – "as a solution for this store," according to a statement from the company. Energy savings compared to the previous system is estimated to be 25%. Carbon emissions are expected to be reduced by around 917 metric tons [903 imperial tons] of CO_2e per year.

* This is by no means a comprehensive list of available end user case studies. For plenty more transcritical CO_2 success stories – within commercial refrigeration and beyond – visit www.r744.com.


It’s Our Future
For more than ten years, Beijer Ref has been offering the market refrigeration units and heat pumps based on CO_2, propane and ammonia.
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REFERENCES

Chapter three: 'Transcritical CO_2 today'

1. Banasiak, K. et al. (2019). CO2 units for supermarkets and efficient integration. sheccoBase Webinar- Zero Net Energy Supermarkets: Towards a Sustainable Future. February 22, 2019. Available online at: http://www.sheccobasewebinar.com/previous

2. (in French) Journal Officiel de la République Française (30 Décembre 2018), LOI n° 2018-1317 du 28 Décembre 2018 de finances pour 2019 (1). Accessed online at: https://www.cjoint.com/doc/19_01/IAdmafVwQ0h_loidefinances2019.pdf

3. United States Environmental Protection Agency (EPA) (2015). Section 608 of the Clean Air Act: Stationary Refrigeration and Air Conditioning. Accessed online at: https://www.epa.gov/sites/production/files/2015-08/documents/section_608_of_the_clean_air_act.pdf

4. Garry, M. (2020). U.S. EPA Rescinds Obama-Era Leak Repair Rules for HFCs. Available online at: http://r744.com/articles/9405/u_s_epa_rescinds_obama_era_leak_repair_rules_for_hfcs

5. http://www.usclimatealliance.org/us-climate-alliance-fact-sheet

6. Garry, M. (2020). Colorado, Virginia Enact HFC Regulations, Following Other U.S. States. Available online at: https://accelerate24.news/refrigerant/colorado-virginia-enact-hfc-regulations-following-other-u-s-states/2020/

7. McLaughlin, C. (2017). Key Japan CO2 regulation lifted. Available online at: http://r744.com/articles/7751/key_japan_co2_regulation_lifted_after_several_years_of_discussion

8. United Nations Treaty Collection (2020). 2. f Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer. Available online at: https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-2-f&chapter=27&clang=_en

9. New Zealand Ministry for the Environment (2019). Kigali Amendment to the Montreal Protocol. Available online at: https://www.mfe.govt.nz/more/international-agreements-kigali-amendment

10. New Zealand Ministry for the Environment (2019). Climate Change Response (Zero Carbon) Amendment Act. Available online at: https://www.mfe.govt.nz/climate-change/zero-carbon-amendment-act

Chapter four: 'Convenience store (small) applications'

1. Koegelenberg, I. (2020). South African Retailers Share Advantages of Switching to CO2. Available online at: https://accelerate24.news/regions/south-african-retailers-share-advantages-of-switching-to-co2/2020/

2. Williams, A. (2018). CO2 at heart of new Delhaize convenience store. Available online at: http://r744.com/articles/8422/co2_at_heart_of_new_delhaize_convenience_store

3. Battesti, M. (2018). Carrefour's first CO2 transcritical convenience store. Available online at: http://r744.com/articles/8184/carrefourandrsquo_s_first_co2_transcritical_convenience_store

4. Williams, A. (2018). Coles goes CO2 transcritical in small Melbourne store. Available online at: http://r744.com/articles/8720/coles_goes_co2_transcritical_in_small_melbourne_store

5. Williams, A. (2019). Lawson targets 4,000+ CO2 stores by 2020. Available online at: http://r744.com/articles/8849/lawson_targets_4_000_co2_stores_by_2020

6. Yoshimoto, D. (2020). Tokyo Department Store Puts CO2 Water-Loop System in High Rise. Available online at: http://r744.com/articles/9499/tokyo_department_store_puts_co2_water_loop_system_in_high_rise

7. Koegelenberg, I. (2020). Japanese C-Store Chain Lawson Opens Its First NatRef Store in China. Available online at: http://r744.com/articles/9394/japanese_c_store_chain_lawson_opens_its_first_natref_store_in_china

Chapter five: 'Commercial/super-market applications'

1. Koegelenberg, I. (2020). South African Retailers Share Advantages of Switching to CO2. Available online at: https://accelerate24.news/regions/south-african-retailers-share-advantages-of-switching-to-co2/2020/

2. Koegelenberg, I. (2020). Future-proofing HVAC&R: The Natural Choice. P12-13. Available online at: https://issuu.com/shecco/docs/acorp_sphere

3. Stausholm, T. (2019). South African Grocer Does Workaround for First CO2 System. Available online at: https://accelerate24.news/regions/africa/south-african-grocer-does-workround-for-first-co2-system/2019/

4. Garry, M. (2020). Transcritical CO2 in Warm, Muggy Florida. Available online at: https://accelerate24.news/regions/transcritical-co2-in-warm-muggy-florida/2020/

5. Garry, M. (2019). Weis Markets reports dramatic energy savings with transcritical CO2. Available online at: http://r744.com/articles/9096/weir_markets_reports_dramatic_energy_savings_with_transcritical_andnbsp_co2

6. Macnamara, M. (2019). South African built CO2 pack for Australian retailer. Available online at: http://www.refrigerationandaircon.co.za/index.php/projects/395-south-african-built-co2-pack-for-australian-retailer

7. Yoshimoto, D. (2019). ALDI Australia aims for 100 transcritical CO2 stores by 2025. Available online at: http://r744.com/articles/9047/aldi_australia_aims_for_100_transcritical_co2_stores_by_2025

8. Yoshimoto, D. (2018). Australian retailer's third transcritical CO2 store integrates HVAC. Available online at: http://r744.com/articles/8715/australian_retailer_s_third_transcritical_co2_store_integrates_hvac

9. Cooper, N. (2020). Woolworths Converts New TC CO2 Store to Temporary Warehouse During Pandemic. Available online at: http://r744.com/articles/9484/woolworths_converts_new_tc_co2_store_to_temporary_warehouse_during_pandemic

10. Williams, A. (2018). Migros targets CO2 transcritical as standard. Available online at: http://r744.com/articles/8527/migros_targets_co2_transcritical_as_standard

11. Stausholm, T. (2019). To Russia with CO2, as Germans Open Transcritical Stores. Available online at: https://accelerate24.news/regions/to-russia-with-co2/2019/

12. Williams, A. (2019). Romanian grocer adopts CO2 transcritical. Available online at: http://r744.com/articles/9039/romanian_grocer_adopts_co2_transcritical

13. Garry, M. (2018). Casa Ley installs Mexico's first transcritical system. Available online at: http://r744.com/articles/8547/casa_ley_installs_mexico_s_first_transcritical_system

14. Yoshimoto, D. (2019). METRO AG Commissions China's First Transcritical CO2 Ejector and Second Parallel Compression Systems. Available online at: https://accelerate24.news/regions/china/chinas-first-tc-co2-ejector-store-commissioned/2019/


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