



# Natural Refrigerants in Europe: The Drivers and Challenges for European Food Retailers

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Data insights from new survey of  
food retail professionals

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# Contributors

## **Thierry Jomard**

President,  
Carrier Commercial Refrigeration, Europe

Thierry Jomard holds a Master's degree in Mechanical Engineering and a PhD in Heat Transfer from Lyon National Institute for Applied Sciences.

He joined Carrier in 1993, working in the field of air conditioning and refrigeration. During his time in this field he implemented the concept of 'Virtual Factory' by completely reorganising the production in Carrier's largest factory in Europe. Thierry led the Carrier Commercial Refrigeration engineering efforts from 2005 to 2009, which resulted in the launch of Carrier's CO<sub>2</sub> transcritical system for stationary refrigeration. After the successful launch he took increasing business responsibilities within Carrier Commercial Refrigeration, covering both manufacturing and distribution entities. In January 2014, he was appointed President of Carrier Commercial Refrigeration, Europe.



## **Nina Masson**

Deputy Managing Director,  
shecco

Nina holds two Masters' degrees, one in Business Management and the other in Environmental Management. After serving in a communications role for Norsk Hydro, for the last 7 years she has been working in the field of environmental technologies, where she specialised in natural refrigerants.

Today, she is active in business development for market intelligence and consultancy services, as well as special projects and publications. She drafted global studies for United Nations agencies, including UNEP and UNIDO. Nina is Associate Member of the Institute of Environmental Management and Assessment (IEMA).



## **Christoph Brouwers**

Director Mechanical Systems Programs,  
Carrier Commercial Refrigeration, Europe

Christoph Brouwers has a wealth of experience in refrigeration, which dates back to 1990 when he started an apprenticeship as a refrigeration mechanic. He joined the former Linde Kältetechnik – later acquired by Carrier Corporation – in 1992 working as a field inspection and commissioning engineer in commercial and industrial refrigeration across Europe. This role allowed him to familiarise himself with nearly all types of refrigeration systems and refrigerants.

After having taken over different management positions in the areas of technical services, installation and project engineering, Christoph led the CO<sub>2</sub> OLtec product management effort and successfully introduced the first CO<sub>2</sub> refrigeration systems to the market. Currently, Christoph is responsible for Carrier's Mechanical Systems Programs, in particular focusing on a holistic system solution by combining refrigeration, space heating and cooling for all types of food retail shop formats based on natural refrigerants.



# Introduction

Over the past decade, the use of alternative technologies to the hydrofluorocarbon (HFC) direct-expansion system for supermarket refrigeration has gained interest and momentum, with European food retailers leading the adoption of natural refrigerant technologies globally. The uptake of natural refrigerants in food retail has doubled in the last two years alone. Today, as energy consumption and leakage of traditional fluorinated gases are increasing areas of concern, a growing number of food retailers are revising their strategies to incorporate more sustainable refrigeration solutions.

Fluorinated gases (F-gases) found in synthetic coolants are significant contributors to global warming, relative to natural coolants. While F-gases replace ozone-depleting and high global-warming chlorofluorocarbons (CFCs), they still have a global warming potential (GWP) up to 23,000 times greater than carbon dioxide (CO<sub>2</sub>)<sup>1</sup>. F-gases can escape into the atmosphere from leaks within the miles of pipework involved in refrigeration systems in supermarkets.

While CO<sub>2</sub> is not the most effective solution for all refrigeration and air-conditioning applications, it has proven especially economically and environmentally effective for food retail applications. CO<sub>2</sub> as a refrigerant is environmentally sustainable, safe and energy-efficient for food retail applications; it also has unlimited availability. Despite being a greenhouse gas itself, CO<sub>2</sub> as a natural refrigerant is considered to be climate-neutral because it is captured from the atmosphere into hermetically sealed systems and then released when the system reaches the end of its life. CO<sub>2</sub> is a more effective refrigerant for food retail because of its thermodynamic properties even though it requires higher pressures to function than HFCs.

Some believe the introduction of European F-gas Regulation, including a phase-out of high GWP HFCs used in refrigeration by 2022, will be

the tipping point the industry needs for mainstream adoption of sustainable refrigeration solutions. Others believe the combination of public pressure from environmentally aware consumers and the commercial imperative to reduce energy costs have been, and will continue to be, the real catalysts for industrywide change.

Evidence from countries leading the adoption of natural refrigerants suggests legislation is a key factor when it comes to deciding what types of refrigeration systems to invest in for the long term. This is especially true in Denmark where taxes on HFCs have been introduced. Similar initiatives can be seen in Norway and Switzerland, sometimes in combination with incentives for research and training.

Other countries have opted for government-funded financial incentives for end users. Germany, for example, has provided research and development support for pilot projects for halogen-free substances and direct financial incentives for using natural refrigerants in commercial refrigeration.

Finally, some countries, like the UK and Sweden, have shown an industry-driven swing toward natural refrigerants. Pressure from environmental groups has contributed to this move in the UK, where food retailers are proactively communicating about the use of natural refrigerants in their stores to their customers.

This report, developed by Carrier in partnership with market development specialist shecco, seeks to provide a clear picture of the key drivers for and against the adoption of sustainable refrigeration and refrigerant options, and the impact of legislation on such developments across Europe.

# Methodology

Market development company shecco undertook research to reveal attitudes toward sustainability and carbon-footprint reduction among major food retailers, with a particular focus on investment in refrigeration and natural refrigerant technologies.

The findings are drawn from qualitative research with quantitative elements, conducted by shecco among food retailers located in western and northern Europe, with a focus on Germany, France, the UK, Denmark and Norway. The research project was carried out Jan. 10 – Feb. 17, 2014.

The market research received responses from 50 food retailers across Europe, 34 of those 50 respondents provided valid results which have been included in the report.

**Most respondents opted to remain anonymous, but the following food retailers agreed to be mentioned in the final report:** METRO Group – Germany; Coop Norge Handel AS (Coop Norway) – Norway; Dansk Supermarked – Denmark; SPAR Gruppe Schweiz (Spar Group Switzerland) – Switzerland; Migros-Genossenschafts-Bund (Migros) – Switzerland; Tesco – UK

## About the respondents

The vast majority of respondents were drawn from large food retailers with more than 250 employees. Nearly one in five (17.7 percent) respondents came from representatives of organisations with more than 5,000 stores across Europe. More than half of the responses were from food retail organisations with 1,001 or more stores.

French food retailers contributed the highest number of respondents, followed by Germany, Denmark, the UK and Norway. Respondents from outside of these countries are accounted for in the “other” category and include representatives from Belgium, Switzerland, the Netherlands, Spain and Hungary.

Roughly one-fifth (23.5 percent) of respondents represented the strategic management level, including CEOs, owners and board members. Nearly half (47.1 percent) of the respondents came from staff members at an operational management level, including department heads, supervisors and team leaders.

The charts on the following page show a breakdown of the respondents.

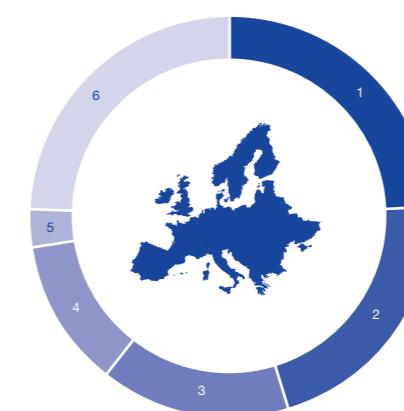
## About the respondents



Food retailers are often part of a bigger enterprise group



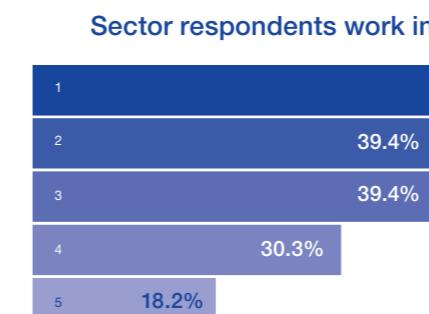
Size of respondent food retailers by employee count



Respondents across Europe



Company positions held by respondents



Sector respondents work in

- 1 Sustainability, Corporate Social Responsibility (CSR), etc.
- 2 Environment, energy management, etc.
- 3 Technical equipment, refrigeration, etc.
- 4 Facilities, building management, etc.
- 5 Strategic management, business development, etc.

# Executive Summary

## Natural refrigerant uptake reaches its tipping point

The last two years have seen marked changes in the European natural refrigerant market. The latest research from shecco, released at the ATMOSphere Europe 2013 conference in Brussels, indicates that uptake of transcritical CO<sub>2</sub> systems for food retail in Europe has more than doubled since 2011. Now this new study, carried out in coordination with Carrier, provides some of the strongest evidence to date that natural refrigerant technology is now a mainstream solution in the commercial refrigeration sector.

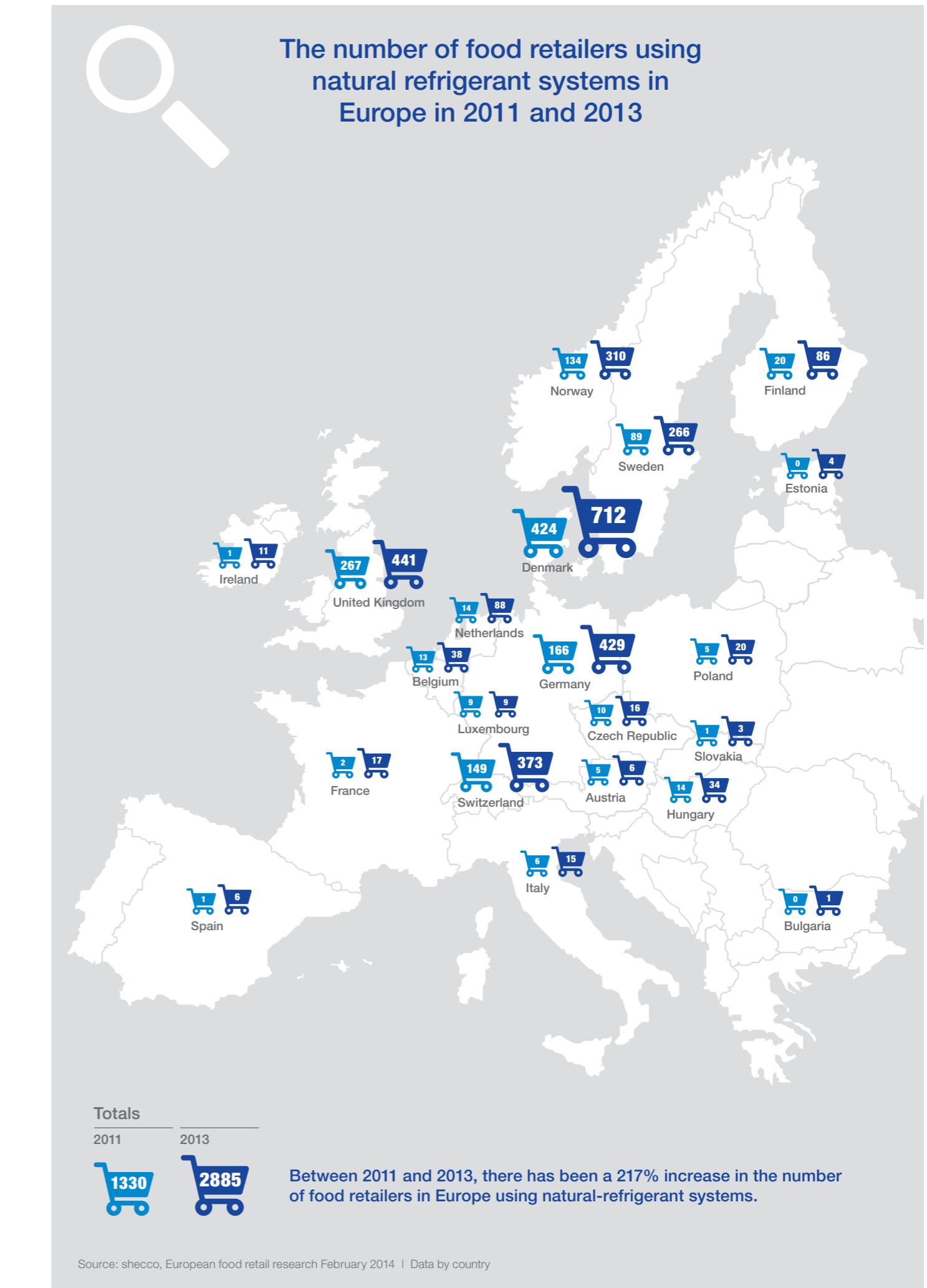
The striking headline figure from this study tells us that virtually two-thirds of the supermarkets surveyed are now using natural refrigerants in their stores. The EU's proposals on the fluorinated gases (HFCs or F-gases) that natural refrigerants are replacing have just been finalised. So the question is, why has the industry been so proactive in adopting the technology? Legislation has certainly played its part in fuelling the uptake of natural refrigerants. All of the participating food retailers were aware of the proposed phase-down of F-gases in certain applications, suggesting the issue is already high on the agenda for companies that want to future-proof their businesses.

Nevertheless, the acceleration in uptake of natural refrigerants over the past two years suggests other factors are influencing the move. It is notable how many European retailers decided to go HFC-free before the direction of F-gas regulation was in any way clear. Given the high GWP of many F-gases, companywide sustainability policies have been a key driver, along with a desire to show environmental

leadership. These factors come through strongly in the research. Seventy-one percent of the food retailers surveyed stated policies have been initiated at the highest levels of their organisations to drive carbon-footprint reduction.

Food retailers adopting natural refrigerants today benefit from being more "environmentally sustainable" toward their consumers, while saving money through increased energy efficiency. Respondents were keen to point out the potential commercial benefits of moving to natural refrigerants in terms of both efficiency and performance. They were also confident natural refrigerants are safe and reliable, delivering return on investment (ROI) on par with HFCs.

Natural refrigerants make commercial sense for food retail, with CO<sub>2</sub> the preferred choice for centralised systems. Such are the perceived benefits of this approach that more than half the food retailers surveyed would shorten investment cycles to adopt the technology in their stores. There is still room for improvement; the initial capital cost of a natural refrigerant system is a little higher than traditional HFC systems, and servicing and maintenance requires further investment. The evidence suggests, however, that the combination of market, policy and technology drivers is creating a virtuous circle, fuelling research, development and investment, bringing down cost and encouraging growth in the supply base. A key challenge will be to carry the momentum forward to a point where the technology is within reach for smaller convenience stores and food retailers in southern Europe. The signs are encouraging that this second tipping point may not be far away.



# Key findings

## Attitudes towards the environment

1

### Sustainability high on the corporate agenda

#### Findings in focus

Food retailers agree carbon-footprint reduction is an important factor in ensuring future business success

69 percent of survey respondents claim an enterprise or group-level strategy within their organisation to encourage carbon-footprint reduction

German food retailers are most motivated to reduce their carbon footprint to boost overall bottom line

As the single largest contributor to a store's energy bill, refrigeration is seen as the No.1 priority for investment

53 percent of respondents claim they would reduce normal investment cycles to promote the uptake of more environmentally friendly refrigeration technology

The food retail industry is under pressure to reduce operating costs and environmental impact, even though energy prices are spiralling, energy consumption is increasing through longer store opening hours, and the range of goods to be refrigerated is expanding. Regulation or no regulation the business case for switching to climate-friendly, less energy-intensive technologies appears impossible for food retailers to ignore.



#### Food retailers rank the use of energy efficient and low-GWP refrigerants as the most important environmental feature to increase a store's energy efficiency.

#### Carbon-footprint reduction equals business success

Retailers are increasingly acknowledging the link between carbon-footprint reduction and the bottom line. Respondents across all territories rated reducing carbon footprint as "important" to overall future business success, with an average value of 3.84 on a scale of 1 (not at all important) to 5 (very important). German food retailers attached the greatest value to carbon-footprint reduction as a way to increase or maintain future business, with an average value of 4.43.

#### Technology decisions informed by corporate sustainability policy

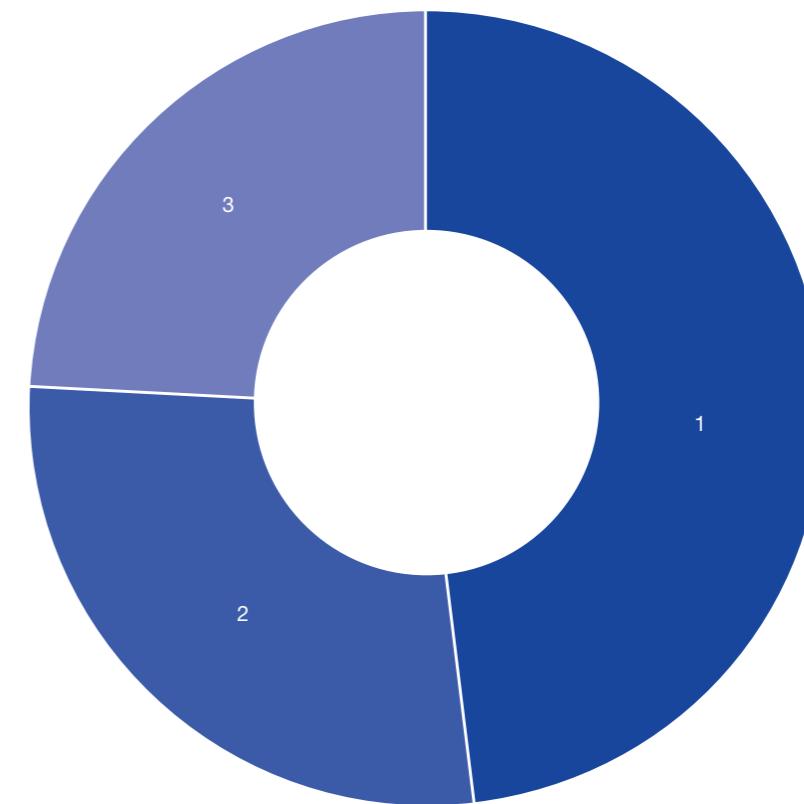
Responses indicate that strategic, operational and procurement decisions must now fall within a sustainability threshold. A clear majority (69 percent) of primarily large food retailers surveyed claimed policies to reduce their organisation's carbon footprint are initiated at the very highest internal levels. These policies, respondents reported, have a strong impact on strategic decisions regarding new technology purchase and use.

#### Refrigeration targeted to increase energy efficiency

In today's supermarkets, refrigeration systems are by far the single biggest users of energy. In fact, more than 40 percent of the average store's total energy consumption is attributable to refrigeration. Plus, up to 60 percent of the Total Equivalent Warming Impact (TEWI) of a refrigeration system is caused by energy consumption.

Food retailers have placed the energy efficiency of refrigeration firmly within their sights. With a score of 4.3 out of 5, respondents ranked the use of energy-efficient and low-GWP refrigerants as by far the most important environmental feature to increase a store's energy efficiency. In terms of energy efficiency,

#### Willingness to reduce investment cycles to promote the uptake of more environmentally sustainable systems



#### Conclusions

More than half of all respondents would be willing to shorten their normal investment cycles to promote the uptake of more environmentally sustainable refrigeration technology

Among those, 24.1% would even be willing to reduce investment cycles by more than 2 years

The average investment cycle for refrigeration systems in surveyed food retailers is mostly between 9–15 years

1 No 48.3%

2 Yes, by less than 2 years 27.6%

3 Yes, by more than 2 years 24.1%

studies by Carrier indicate that a CO<sub>2</sub>-based system has a clear energy efficiency advantage over traditional versions – up to 13 percent – that will increase further if an integrated system (combining refrigeration, space heating and cooling) is used.

#### Food retailers see potential of returns for early investment

Technology investment cycles among respondents averaged 14 years, yet more than half (53 percent) of food retailers surveyed would be willing to cut this cycle to hasten their uptake of more environmentally responsible refrigeration. Moreover, half of these respondents were willing to shorten investment cycles by more than two years to acquire natural refrigerant technology. These food retailers see the potential commercial benefits of early investment in natural refrigerant technologies, regardless of any perceived loss associated with not amortising equipment to the maximum possible extent.

#### World's second largest retailer in France

Carrefour, one of the world's largest retailers, chose the CO<sub>2</sub>OLtec refrigeration system for one of its Lyon stores as part of its initiative to limit CO<sub>2</sub> emissions and reduce the store's environmental impact.

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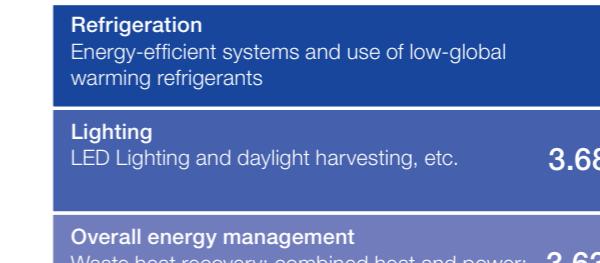
More food retailers are proactively seeking new substances and technologies to align with their companies' sustainability agendas. This is irrespective of legislation, challenging the perception that legislation is a key driver.

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Nina Masson  
Deputy Managing  
Director, shecco

#### No waste heat for the Swiss

A SPAR supermarket in Schüpfen, near Bern, has a CO<sub>2</sub>OLtec Integral system that takes the waste heat created during the refrigeration process and transports it around the entire store, eliminating the need for a conventional gas heating system. During warm months, it also provides cooling via the ventilation system. Carrier's intelligent building management system controls the interactions of the components of the commercial refrigeration, heating, cooling, ventilation and lighting systems to achieve optimal levels of energy efficiency.



0 1 2 3 4 5  
Importance (5 = most important)

#### Importance of environmental features to increase energy efficiency in stores

##### Conclusions

Refrigeration – energy-efficient systems and the use of low-global warming refrigerants – has the highest priority among surveyed European food retailers, translating to “rather important / important” in their strategy to increase their stores' energy efficiency

German food retailers attach equal value to the different means of increasing a store's energy efficiency

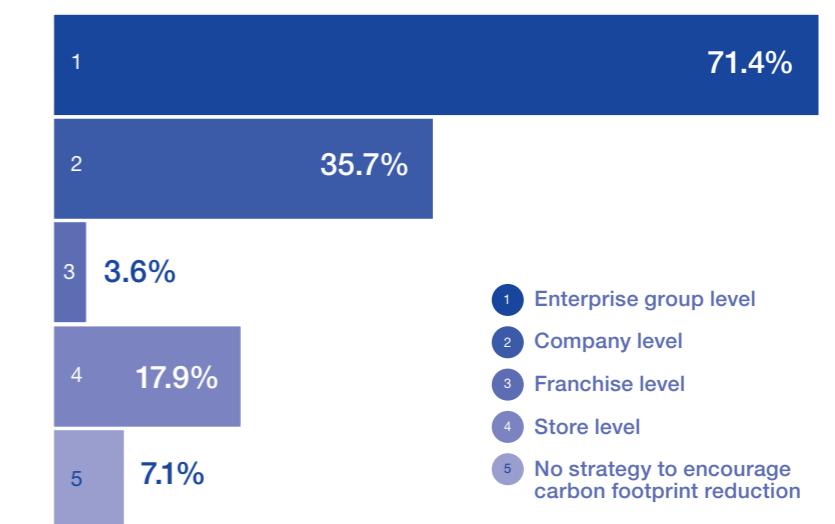
#### Strategy in place to encourage carbon footprint reduction in stores

##### Conclusions

An overwhelming majority follow a strategy in place at enterprise group level, which encourages carbon footprint reduction across all enterprise group members. Carbon footprint reduction is driven from the highest-possible level

More than 1/3 follow a strategy, which is in place exclusively at company level or above

Only very few state there is no such strategy available at any level



- 1 Enterprise group level
- 2 Company level
- 3 Franchise level
- 4 Store level
- 5 No strategy to encourage carbon footprint reduction

# Key findings

## Refrigeration

2

### Rapid acceleration of CO<sub>2</sub> systems in food retail outpaces legislation

#### Findings in focus

65 percent of respondents claim to have already started implementing natural refrigerant technology

Number of CO<sub>2</sub> transcritical stores across Europe has doubled in two years

All respondents claim to have considered implications of F-gas restrictions

A quarter of food retailers surveyed are preparing to adapt refrigeration strategy as soon as F-gas agreement becomes official

CO<sub>2</sub> centralised systems emerge as industry standard. Scepticism exists over viability of hydrocarbons in large systems

The European Union's decision to greatly strengthen their F-gas rules marks the end of using high-GWP HFCs in food retail refrigeration in Europe. The regulation, which includes a ban on HFCs with GWP over 150 in new centralised refrigeration systems and plug-in units from 2022, marks a clear direction, delivering much-needed clarity to better inform future technology investment decisions. There is, however, a strong indication that the recent outcome of negotiations in Brussels is less a call to action than a confirmation of the decisions major food retailers have already taken governing refrigeration.



**Data suggests uptake of natural refrigerants across Europe has doubled in the past two years.**

#### No room for ignorance of F-gas regulation

Awareness of the F-gas rules has now reached a level where no food retailer, particularly large ones, can afford not to have considered how legislation will affect their overall business strategy. Consequently, all respondents have become familiar with restrictions on F-gas use, claiming they had already implemented appropriate strategies or would soon do so. Sixty-five percent of respondents said the F-gas regulation would have no impact on their current refrigeration strategy as they have already begun implementing alternatives in new stores and systems.

#### Tipping point for natural refrigerants as legislation beckons

Recent data from shecco suggests uptake of natural refrigerants across Europe has doubled in the past two years, from 1,330 CO<sub>2</sub> transcritical stores in 2011 to 2,885 stores in 2013. Ratification of the F-gas regulation should further accelerate this shift. Twenty-six percent of respondents said they would be adapting their refrigeration strategy as soon as the F-gas agreement becomes official. Just 9 percent of food retailers surveyed said they would wait until the F-gas restrictions in 2022 get closer before addressing their refrigeration strategy. The fact this figure is so low indicates that food retailers have high confidence that their investment in today's natural refrigerant technologies will remain compliant with legislation.

#### Industry sceptical over hydrocarbons in large-scale systems due to risk concerns

Among the natural refrigerant options favoured by food retailers, CO<sub>2</sub> is emerging as the standard option for centralised systems. Eighty-three percent of respondents already using natural refrigerants have chosen CO<sub>2</sub> for their centralised system, versus 17 percent who opted for a hydrocarbon (HC) system. Respondents indicated they were sceptical about whether HC

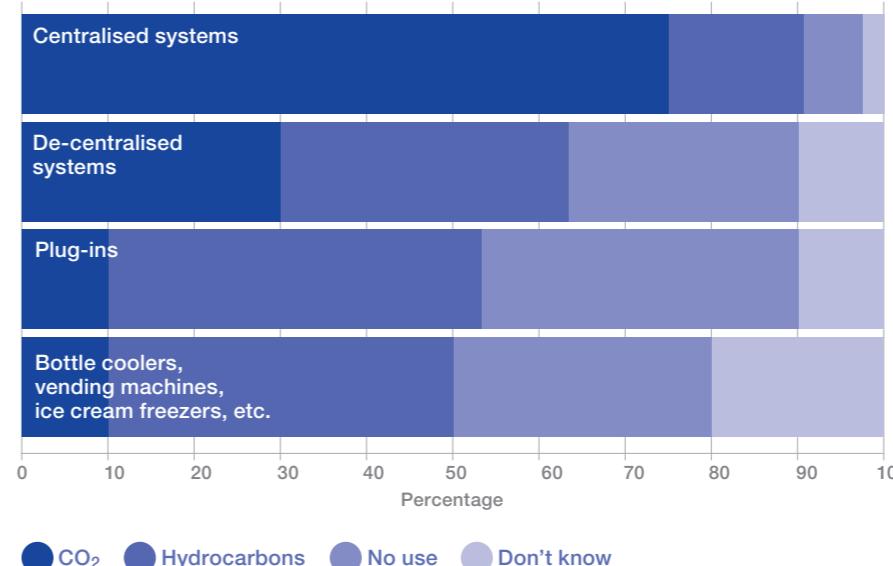
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Legislation rewards first movers and motivates laggards, while at the same time enabling economies of scale, which will make natural refrigerants more accessible for smaller retailers.

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Nina Masson  
Deputy Managing Director, shecco

#### Use of natural refrigerants among European food retailers, by application



#### Conclusions

83% of respondents already use CO<sub>2</sub> as a natural refrigerant in centralised systems. This is a clear indication that CO<sub>2</sub> centralised systems are becoming, or have already become, a standard option for the majority of respondents. This trend has rapidly evolved in the last few years.

refrigerants would become a mainstream solution in larger systems. Despite agreeing that HC use should be expanded to more applications than currently offered by suppliers, they also expressed some concern that adoption of large-scale HC systems would shift more liability and risk potential to the food retailers.

“

We welcome the strong push by the European Union to use natural refrigerants for refrigeration. The technology for food retail applications already exists to enable a smooth transition to non-HFC refrigeration well before 2022.

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Christoph Brouwers  
Director Mechanical Systems Programs, Carrier Commercial Refrigeration, Europe

#### Greenhouse gases cut by half in Germany

The CO<sub>2</sub>OLtec system was installed in the Famila supermarket in Friesoythe. The system uses CO<sub>2</sub> for refrigeration as well as for heating and cooling, cutting energy costs by 35 percent while reducing greenhouse gas emissions by more than 50 percent.

# Key findings

## Regulation

3

### Technology and legislation create a virtuous circle

#### Findings in focus

Natural refrigerants now outperform HFC refrigerants in terms of efficiency

Reliability and safety are on par with conventional HFC systems

Return on investment and life cycle costs of natural refrigerants are no different than HFC systems

Early adopters see advantages of natural refrigerants in terms of competitive advantage and brand recognition

Initial investment/maintenance cost remains higher for natural refrigerants, but the gap is closing

A combination of market, policy and technology drivers has led to an impressive increase in the number of European stores using CO<sub>2</sub>-based commercial refrigeration systems in just two years. Legislation has certainly played its part as a catalyst for adoption, but first movers seeking commercial and reputational advantages from early investment in climate-friendly technologies are far more likely to be motivated by the solid business case.



**Respondents across Europe now place natural refrigerant systems on par with HFC systems in terms of reliability and safety.**

“

Investment in CO<sub>2</sub> systems has to make financial sense, and the price of CO<sub>2</sub> installation is becoming more accessible. There is still work to be done, but there is strong evidence that the difference in initial investment cost between CO<sub>2</sub> transcritical and traditional systems is coming down.

”

Nina Masson  
Deputy Managing Director, shecco

#### Natural refrigerants seen as safe and reliable

Respondents saw legislation as a fairly important driver in the decision-making process governing the purchase of new refrigeration technology, but the reliability and safety category was ranked the most important factor of all.

Research carried out at the ATMOsphere Europe 2010 conference on natural refrigerants found concern over safety was the biggest barrier to the adoption of CO<sub>2</sub> refrigeration solutions. It is significant, then, that respondents across Europe now place natural refrigerants on par with HFC systems in terms of reliability and safety. The acceleration in adoption of natural refrigerants seen over the past two years simply could not have happened if confidence in the technology were not absolute.

#### Efficiency savings support business case

Food retailers also agreed that natural refrigerants now outperform traditional HFC systems in terms of efficiency and performance, suggesting respondents believe the technology makes solid business sense regardless of any incentives. This perception is further enhanced by the belief among respondents that HFCs are growing increasingly expensive.

Compatibility with corporate sustainability goals was the area where natural refrigerants had the greatest advantage over HFCs, indicating that consumer pressure and environmental stewardship by legislators are influencing operational decision-making. Natural refrigerant solutions performed well against HFC systems in terms of competitive advantage and brand recognition.

#### Installation costs coming down

Food retailers also considered natural refrigerants to have parity with HFCs in terms of return on investment and life cycle costs. Initial capital cost and investment remain higher than traditional HFC solutions, but the data suggests

#### Performance of natural refrigerant technology compared to F-gas solutions



- Natural refrigerants more competitive than F-gas solutions
- Natural refrigerants on par with F-gas solutions
- Natural refrigerants less competitive than F-gas solutions

+/= These figures represent how food retailers rate natural refrigerant systems compared to technologies that don't use natural refrigerants (HCFCs, HFCs) on a scale of +3 to -3.

+3 = highly positive  
-3 = highly negative

#### Conclusions

Reliability, safety, energy and performance are the most important factors food retailers consider when it comes to refrigeration. Natural refrigerant solutions edge out F-gas solutions in all of these fields and are also in line with sustainability strategies and legislation.

a relatively small gap that is likely to be bridged as development gains pace. Smaller retailers and discount stores for whom cost remains a significant barrier to adoption are likely to be encouraged to invest.

#### Cracking the CO<sub>2</sub> equator in Spain:

In Alzira, Spain, where temperatures average 30 degrees Celsius in the summer, Carrier and Carrefour are trialing an adapted CO<sub>2</sub>OLtec system with incorporated economizers linked to a hydro-carbon mechanical subcooler. This system set-up allows Carrier to overcome the challenge of the so-called 'CO<sub>2</sub> equator' – where warm temperatures prevent transcritical CO<sub>2</sub> booster systems from functioning effectively. This would also help Carrefour to be in accordance with its global sustainable strategy, developing trans-critical CO<sub>2</sub> in warm regions.

**“**

Pro-natural refrigerant legislation and increased acceptance of natural refrigerant technologies can contribute toward the overarching goals of carbon-footprint reduction and increased energy efficiency.

**”**

Thierry Jomard  
President,  
Carrier Commercial  
Refrigeration, Europe

### Impact of F-gas bans in centralised refrigeration systems as of 2022

#### Conclusions

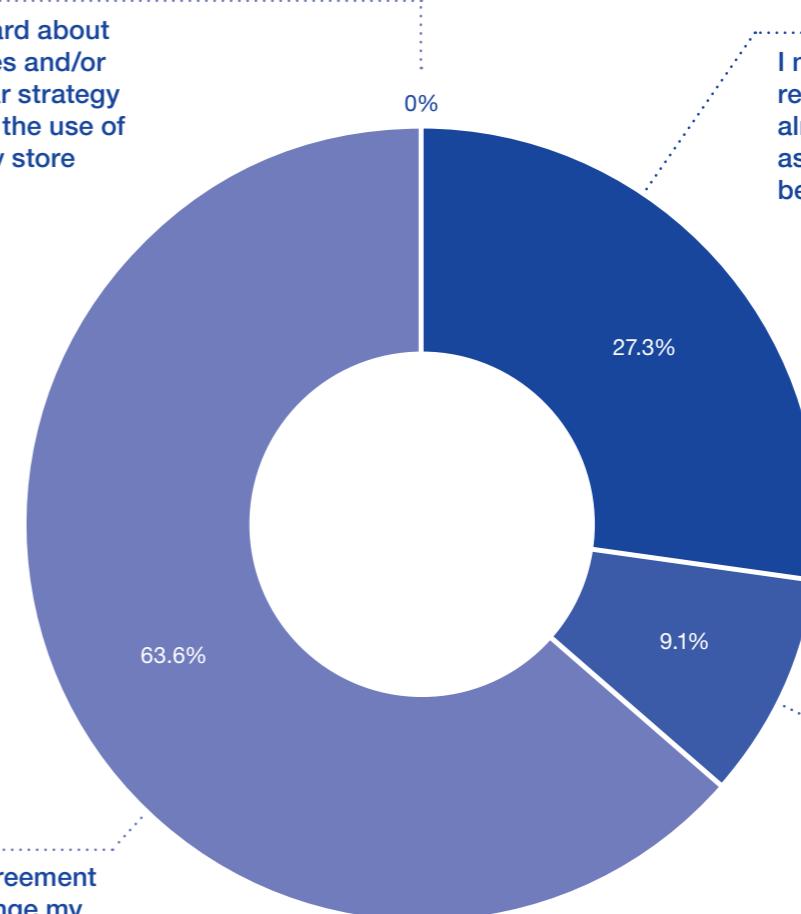
More than 3 out of 5 food retailers anticipated the impending bans on the use of HFCs and have already adapted their refrigeration strategy to use non-fluorinated (natural refrigerant) gases

Those retailers are now well-positioned to combine long term legislative compliance with investment security, independent of upcoming F-gas rules

Without exception, all food retailers have already heard about the upcoming HFC bans and have developed an appropriate strategy

Only a minor share has adopted a wait-and-see strategy to adapt their refrigeration strategy closer to the 2022 deadline

I have not heard about the F-gas rules and/or I have no clear strategy yet regarding the use of F-gases in my store



I need to adapt my refrigeration strategy already today/or as soon as the F-gas agreement becomes official

I need to adapt my refrigeration strategy, but closer to the 2022 date

# Conclusion

## Mind-set shift

This research reflects the shift in mind-set we've observed across the industry over the past 18 months. While F-gas restrictions and a cap and phase-down on HFCs are now widely regarded as inevitable, food retailers no longer view this as a threat to their business.

Responses indicate the recognition that carbon footprint reduction and energy efficiency can be achieved through the acceptance of natural refrigerant technologies for food retail applications.

## A holistic approach

Among the major food retailers surveyed, the switch to natural refrigerants is proving the catalyst for more holistic thinking about combining heating and cooling and hence using integrated system solutions to optimise overall energy management.

This trend has been particularly pronounced in Scandinavia, where food retailers now attach equal importance to overall energy management systems and refrigeration when it comes to prioritising investments to improve the energy efficiency of their stores.

There are solid commercial reasons for this approach. Carrier's CO<sub>2</sub>OLtec Integral system uses the natural refrigerant CO<sub>2</sub> to provide fully integrated in-store refrigeration, space heating through heat recovery, cooling and ventilation. The technology offers measurable gains in increasing energy efficiency, cutting a store's carbon footprint in half and delivering up to 30 percent savings on energy costs.

Transcritical CO<sub>2</sub> systems are now widely accepted as the technology of choice for major food retailers across western and northern Europe. Confidence in the technology is high, the return on investment is proven and the direction of European legislation is clear. For the sector to move forward, however, lessons learned must now be applied to delivering cost-effective natural solutions for convenience stores and hot climates.

## New technologies open frontiers

Already, the so-called "CO<sub>2</sub> efficiency equator" is moving further south, thanks to technologies such as economizers, ejectors and subcooling, designed to improve the efficiency of CO<sub>2</sub> transcritical systems in climates with extended periods of high temperatures and also climates with high peak temperatures. In Italy and Spain, for example, several CO<sub>2</sub>OLtec refrigeration systems have been installed that have been improved specifically to allow for greater energy efficiency at higher ambient temperatures.

Carrier has also made significant progress in bringing natural refrigerant technologies within the reach of convenience stores through the MiniCO<sub>2</sub>OL® range of refrigeration racks. The compact MiniCO<sub>2</sub>OL system is significantly less expensive than other natural refrigerant systems. It also boasts a low footprint ideally suited to small and medium-sized store formats where space is often at a premium.

## A confident outlook

Since the first CO<sub>2</sub>OLtec installation in Europe was completed in 2004, over 980 systems have been installed in just 10 years. The doubling of new CO<sub>2</sub> refrigeration systems in commercial refrigeration applications over the last two years is an indication of just how fast the industry is now moving. Costs are coming down, safety is no longer seen as an issue and technology has evolved significantly.

Carrier will have the right refrigerant solution for every application, while not every application may have the same refrigerant solution. Given the trends validated in this survey, natural refrigerants should be the common technology in most of the food retail applications in Europe in just five years from now.

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