INDUSTRY VIEWPOINT – ON AMMONIA TRAINING...

Carsten Dahlgaard,
industrial refrigeration global
marketing director at Danfoss

"The biggest challenge today is the lack of skilled people able to operate these systems [NH_3/CO_2 systems], from both the engineering and contractor side. The knowledge today on how to handle and build such systems is still very limited, although we have seen some improvements. Danfoss' strategy is therefore to also help our customers by providing support with training."

Peter White,
director
of Polar Pumps

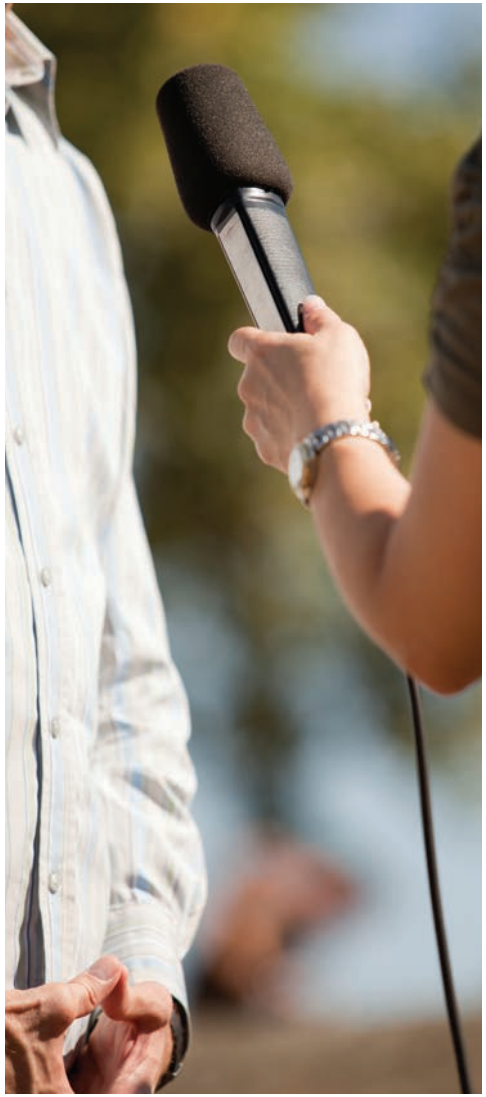
"50% of those we train are for ammonia and this seems to be growing. The industry is changing as refrigerants have gone from CFCs, HCFCs, HFCs and now on to HFOs. People want a bit of security; ammonia has been here since forever and it will stay here forever."

Jason Clark,
senior training consultant
at the Grimsby Institute of Refrigeration

"The industry leads and we follow along. There's no point us putting out training if there's no industry out there wanting it... And as the industry introduces all of these natural refrigerants, the training sector will catch up and it will mingle in. I do think it is just a matter of time".

INTERVIEWS

Vittorio Iormetti
D&AM Technical Support - Embraco



What has been your balance so far regarding training on natural refrigerants?

Embraco is committed to educating the market on the safety and handling of hydrocarbons, providing trainings to OEMs, distributors and end-users, supporting training providers, being stakeholders of EU Alternative Refrigerants e-learning and organizing webinars.

The scope is to improve technical skills and the attention to regulations, standards and guidelines, with a particular focus on safety, duty of care, risk assessment and responsible approach.

The spread of hydrocarbons is increasing once more, both for having negligible impacts on the environment and for the important role on the reduction of the equipment's energy consumption, which means that it solves both direct and indirect CO2 emissions at once.

What has been the feedback from people participating in the natural refrigerants training sessions organized by your organization?

The interest in Natural refrigerants training is very high, and is intended to grow, due to a low knowledge on the use and management of hydrocarbons inside the system.

There are still some concerns and misconceptions regarding the flammability and safety of hydrocarbons, and a low confidence on its use, that's why trainings in this directions are needed.

Prepared and responsible technicians will facilitate the diffusion of Natural Refrigerants, optimizing performance, energy saving, environmental protection, reducing TCO of the applications, all fields where Embraco is considered as a reference.

One of the main requests coming from OEMs attending trainings on Natural Refrigerants, is the increase of the charge limit of propane (now is <150g) and there is a common effort to make it up to 300-500 grams to cover all plug-in range with single circuit solution recommended, in order to best exploit the potential of propane in bigger systems.

What do you see as the main challenges and barriers to offer natural refrigerants training in Europe?

Right now a certification for hydrocarbons training doesn't exist but the EU Directive 517/2014 requires that those who get the existing certification for HFC gases will be informed also about the use of hydrocarbons.

Since Embraco believes on the R290 as the refrigerants of the future worldwide, having an official certification would be very important, in order to dissolve risks of hydrocarbons linked to flammability and safety. It could moreover help installers to adopt solutions with these refrigerants earlier, by offering them security and trust on hydrocarbons.

A big challenge to support the spread of hydrocarbons is the need of high financial investment in order to install the charge station for propane.

How many people has your organization trained last year, and what is your estimate for the coming years on this number?

Since years Embraco is committed to educating the market on the safety and handling of hydrocarbons, providing hundreds of trainings to OEMs, distributors and end-users, supporting training providers, being stakeholders of EU Alternative Refrigerants e-learning and organizing webinars.

In the last years are growing in numbers training providers and Embraco is willing to focus even more to support them with material and resources; they attract producers and installers in all Europe and in the world and they release a certification of attendance at the end.

Volker Stamer, SCHAUFLER Academy Director - Bitzer

BITZER's SCHAUFLER Academy opened last year to provide training specifically designed for technicians/engineers in the HVAC&R sector. What has been your assessment so far regarding training on natural refrigerants?

The interest in our training at the SCHAUFLER Academy in Rottenburg (Germany) has been immense. Our CO_2 and ammonia seminars in particular are much in demand, but propane is constantly growing in importance too. One reason for this is that the complexity of the systems and thus the need for training is increasing. CO_2 (R744) for example has a global warming potential (GWP) of 1, making it virtually climate-neutral. However the thermal loads and the high operating pressures require well-trained specialists for efficient operation.

What has been the feedback from people participating in the natural refrigerants training sessions organised by your organisation?

The feedback from our seminars has been unanimously positive. The participants are enthusiastic about the amount of information and the concrete example applications. Our courses are led by employees with plenty of practical experience from the application engineering department, from sales and from product management. In specially equipped rooms we can also simulate real system conditions. On request, visitors on a guided academy tour can learn more about the SCHAUFLER Academy's energy concept which has won several awards, and how modern systems can be used efficiently so as to protect the environment.

What do you see as the main challenges and barriers to offer natural refrigerants training in Europe?

The sector is strongly characterised by small businesses employing craftsmen, who simply don't have the time to send employees on training courses. It is also comparatively expensive for them. Everyone has to try hard to take suitable measures and create the right motivation. Apart from that, there are currently not enough training options. For about 2,850 specialist companies in this country for example, there are just a handful of training facilities, so with the international SCHAUFLER Academy, BITZER has created a modern facility which is open to everyone.

How many people did your organization train last year, and what is your estimate for the coming years on this number?

In 2016 we trained 2,300 specialists at the SCHAUFLER Academy. A number that we are proud of. Nevertheless, now and in the future we have a clear goal. At BITZER we count on the quality of the training and not on the quantity. After a seminar at the SCHAUFLER Academy you are at the latest state of the art.

Giovanni Dorin Marketing Manager - Dorin

What has been your balance so far regarding training on natural refrigerants?

We have handled in 2016 several training courses for our partners in handling and reparation of CO_2 compressors on different applications. We strongly consider that the training of operators is deeply important in order to make transcritical applications easier and more appreciated. Technicians confidence in this relatively new and very interesting technology is absolutely the basis for a further development of Natural Refrigeration

What has been the feedback from people participating in the natural refrigerants training sessions organized by your organization?

All the participants were profoundly interested and grateful for the very much interesting information given. They also appreciated very much the chance to have a hands on experience with the machines while attending the course.

What do you see as the main challenges and barriers to offer natural refrigerants training in Europe?

We do not foresee any significant barriers to offering natural refrigerant training neither within Dorin nor within Europe.

How many people has your organization trained last year, and what is your estimate for the coming years on this number?

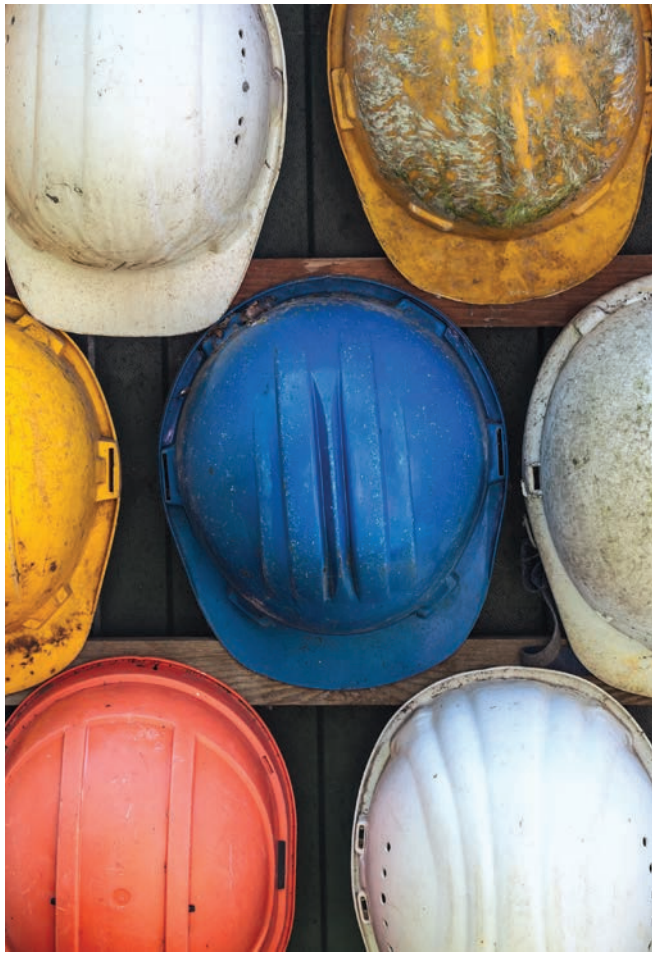
We trained about 25 people in 2016 and we expect more or less the same number in 2017. As I said, it is not an open training but it's reserved for our partners and their technicians on demand.

4 Market for natural refrigerant training today & tomorrow

GIVEN AN INCREASING MARKET SHARE OF NATURAL REFRIGERANT-BASED TECHNOLOGY IN EUROPE AND GROWING COMPLEXITY OF COMPONENTS AND NEW SYSTEM SOLUTIONS, INCLUDING ELECTRONIC MODULATING EJECTORS, INTEGRATED FREQUENCY INVERTERS, ELECTRONIC COMPONENTS OR COMPRESSORS, DEMAND AND SUPPLY OF PROPER TRAINING ON NATURAL REFRIGERANTS IS STEADILY RISING.

This chapter looks closely at the current status and future situation when it comes to availability of natural refrigerant training from the side of training providers as well as interest in such training from the side of training receivers. A map of natural refrigerant training providers shows there are already close to 200 organisations offering training on CO_2, ammonia and hydrocarbons, while the survey analysis demonstrates this number will likely grow over the next few years.

A survey conducted among more than 340 industry experts provides insights into types of training, most popular ways of training delivery, applications, topics covered and others. The findings indicate that most industry representatives that provide or receive natural refrigerant training are involved in training on CO_2. Training related to this refrigerant is also expected to register the strongest growth in the next 5 years - this is a clear correlation with the market developments as CO_2 is becoming a refrigerant of choice for a number of applications, especially commercial refrigeration, but increasingly also industrial refrigeration as well as smaller equipment.



NATURAL REFRIGERANT TRAINING TODAY

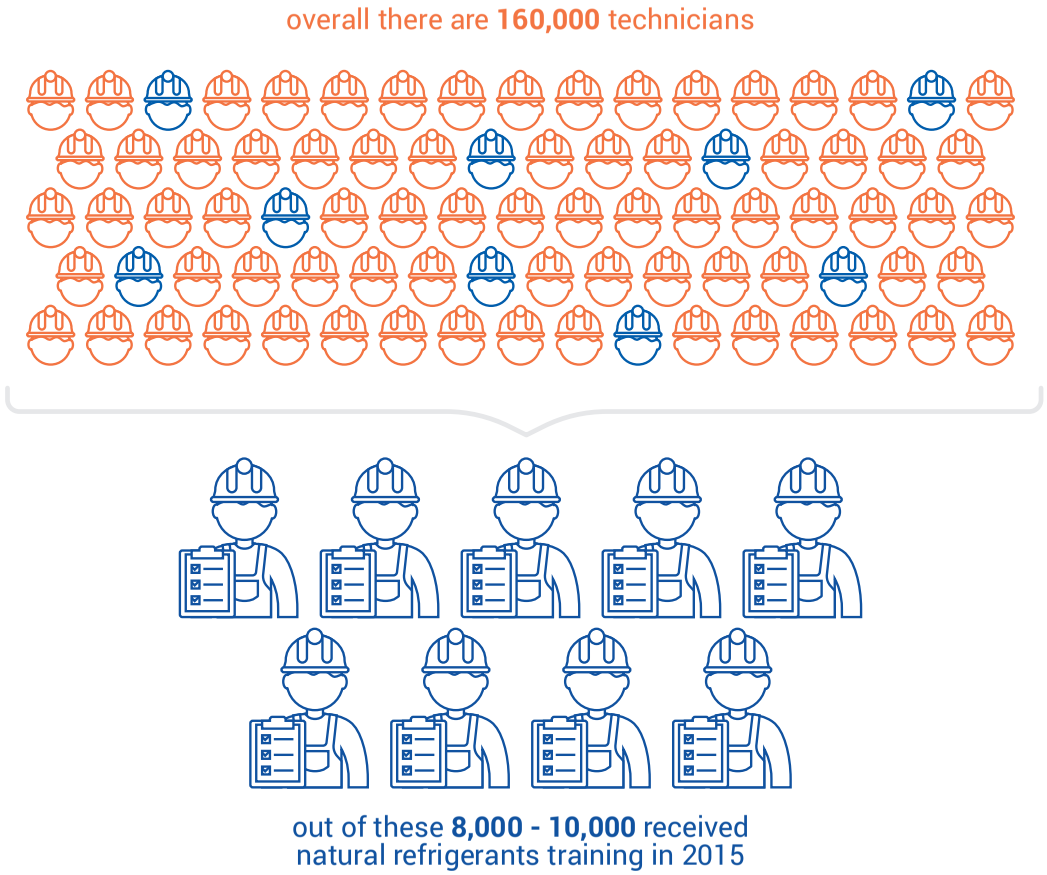
TODAY THERE ARE AROUND 160,000 TECHNICIANS WORKING FOR 40,000 CERTIFIED COMPANIES IN 21 EU MEMBER STATES, ACCORDING TO A REPORT PUBLISHED BY THE EUROPEAN COMMISSION IN DECEMBER 2016, WHICH EVALUATED THE AVAILABILITY OF TRAINING REGARDING SAFE HANDLING OF F-GAS ALTERNATIVES.

The research conducted by Gluckman Consulting and Ricardo-AEA on behalf of the European Commission indicated that there was a significant level of uncertainty about the number of technicians trained to handle natural refrigerants. This is due to the fact that currently there is no requirement to report on natural refrigerant training to central authorities (unlike for f-gas training). The data was collected from national authorities while it did not investigate about the situation amongst the industry representatives.

The findings indicate that there is a higher level of training available for ammonia, while there seem to be a significant gap in availability of training for CO_2 and hydrocarbons. Based on the records of national authorities, more than 4,700 technicians were trained to handle ammonia in the EU, which represents only 2.3% of the total number of f-gas trained technicians. The training on hydrocarbons seems to be the least available. Nevertheless, the data should be treated as underestimate as it does not fully reflect the actual market situation.

Ammonia	71%	2.3%
CO_2	52%	2.2%
HC smaller equipment (plug-in)	48%	0.7%
HC larger equipment (chillers, split systems)	35%	0.05%

Source: European Commission (2016), Report from the Commission on availability of training for service personnel regarding safe handling of climate-friendly technologies replacing or reducing the use of fluorinated greenhouse gases



To get a more comprehensive picture of the number of technicians trained in natural refrigerants, shecco conducted a survey among HVAC&R industry experts. The findings indicate that the number of technicians who received training on natural refrigerants in 2015 was at least 8,000-10,000.

This estimate is based exclusively on the results of the survey and the actual number was likely higher given that several respondents (10% of training providers) could not estimate how many technicians they have trained. In addition, there are other training providers who have not taken part in the survey.

Close to 200 companies provide natural refrigerants training in Europe

For this first edition of GUIDE Training, shecco compiled a directory of companies in Europe that provide training on natural refrigerants in any form. The list is not comprehensive but rather serves to get an idea of what trainings and formations are available in which country. Furthermore it helps interested parties to get to know the institutions and companies active in the sector and find useful contacts for own training requirements.

Several companies in Europe are already taking steps to provide training on natural refrigerants. shecco has identified close to 200 companies in Europe, including training institutes, system and component manufacturers, universities, research institutes, associations and other organisations, who offer training related to natural refrigerants.

The majority of the training providers (approximately half of the total) are universities, vocational schools or training institutes. These play a key role in providing entry-level education as well as continuous learning to more experience engineers and technicians. About a third of the training providers are from the supplier side of the HVAC&R industry, such as system or component manufacturers, refrigerant suppliers or engineering and installation firms. This shows that there is active involvement of the industry itself to promote natural refrigerants and train their staff or people from outside accordingly to adopt these new technologies. Besides these, there are a number of associations that provide courses on natural refrigerants or are in some way involved in coordinating the activities on such training for its members.

The wide spectrum of training providers is a reflection of the whole market realising the potential of natural refrigerants and the importance an appropriate training will have on the future industry. Engineers and technicians need to have access to the relevant training on natural refrigerants during their initial stages of education and throughout their careers to be able to keep up with the market development.

Most training providers identified in this research offer on-site training and more than half of the organisations offer some sort of practical training besides the theoretical one, which is provided in all cases.

In this directory, about 80% of the organisations provide training on CO_2 as a refrigerant, while 50% provide training on ammonia and hydrocarbons each.

The United Kingdom and France appear to be hotspots for training on natural refrigerants, followed by Germany, Spain, Italy and Sweden. It is important to note though that the number of training providers does not necessarily correspond with the number of trained technicians by country - one training facility could train more people than others.

The available natural refrigerants training outlined in this map also depend on each organisations' communication about these. It can be noted that while the market for natural refrigerants training is highly varied with different actors, universities, associations, suppliers and others are increasingly becoming more outspoken, which goes hand in hand with growing interest in these kind of courses.

The directory, which is an integral part of this report, lists the European natural refrigerant training providers by country. It provides additional information that helps guide those looking for suitable courses to enhance their practical and theoretical training on CO_2, ammonia and hydrocarbons.

leading organisations that provide training active in the European market in 2016

40	France	4	Greece
34	UK	4	Ireland
18	Germany	4	Norway
15	Spain	3	Bulgaria
11	Italy	3	Poland
11	Sweden	3	Portaugal
9	Netherlands	2	Austria
9	Switzerland	2	Hungary
8	Denmark	2	Russia
5	Belgium	1	Czeck Rep.
4	Finland	1	Georgia
193	Total		

Disclaimer: These figures are based on analyses of leading organisations active in the European market in 2016. While reasonable efforts have been made to identify the number training providers as close to reality as possible, these figures are not exhaustive and shall serve as an indication of the market for natural refrigerants training.

Please contact research@shecco.com if you would like to be included in this map and the directory of natural refrigerant training providers.

Natural refrigerant training providers

In Europe, practical and theoretical training on natural refrigerants is offered by universities, training institutes, system manufacturers, component manufacturers, associations, end users, private training providers, consulting, contracting, engineering firms, vocational/professional schools, certification bodies, research institutes.

The choice of a training provider depends on a number of factors, including the level of prior knowledge, accessibility of training offered, cost of a training course, relationship with the training provider and others. According to the survey results, the most preferred training providers are system manufacturers, followed by component suppliers and consulting, contracting and engineering firms. Servicing, repair, maintenance firms and end users were the least two favourite choices among training receivers that took the survey.

System manufacturers

Carrier's CO_2OLacademy, a training facility opened in 2015 in Mainz, Germany, provides the company's technicians from across Europe with knowledge of CO_2 refrigerant technologies.

Carrier organises five-day courses for 7-10 key trainers who come from different countries. A few weeks after the training, these key trainers return to Mainz with technicians from their respective countries, and the key trainers teach these technicians in their mother tongue. These two-day sesions are organised in small groups of not more than ten participants. Before the course, technicians receive e-learning material, ensuring they already have a certain level of knowledge before arriving in Mainz. The training is 40% theoretical knowledge and 60% practical exercises.

Since the opening of the training facility, Carrier has targeted to train approximately 600 people by the end of 2016 by organising training courses for 25 countries – first concentrating on the regions with the highest density of CO_2 installations, but also planning to expand the programme to other countries later on.

EPTA SPA , system manufacturer based in Italy, is providing CO_2 training in commercial and domestic refrigeration areas to qualify internal staff. The training is available in English, Italian, French and German and covers topics, such as basic thermodynamics and physics, material compatibility, lubricants, application area, case studies, regulations and standards, safety aspects, efficiency, COP evaluation, practical handling of refrigerant, system design, installation, operation and maintenance.

Danish system manufacturer **Advansor** provides practical and theoretical training on site, as well as theoretical courses online for CO_2 refrigerant. Applications covered by training are commercial and industrial refrigeration, air conditioning and heating. The purpose of the programme, which is free of charge, is to train the company's own staff as well as its customers. Following a two-day course, a certificate is provided at the end of the training.

Component manufacturers

BITZER's training centre, the **SCHAUFLER Academy**, had its official inauguration in February 2016. The Academy seeks to develop a close and constructive relationship with schools and universities, while spreading knowledge about new HVAC&R technologies and refrigerants beyond Germany's borders.

All the academy's refrigerant training sessions cover issues like thermodynamics, safety, material compatibility and system design. Courses on transcritical and subcritical CO_2 systems also offer hands-on training: participants are equipped with the necessary skills to deal with day-to-day operating demands, as well as learning how to fill systems up properly or start them up from scratch.

The academy welcomes consultants, system manufacturers, service staff and operators from all over the world to its courses. The Schaufler Academy has five rooms for theoretical work and three rooms for practical training. It also contains an office space for instructors and a canteen with seating for 110 training participants as well as employees of the production facility and competence centre.

In November 2016, **Danfoss** has launched a mobile CO_2 training unit, equipped with CO_2 technology and interactive learning modules. The CO_2 solutions presented in the mobile training unit range from simple gas-bypass systems to more complex parallel compression solutions with or without heat reclaim. The training unit introduces Danfoss' brand new ejector technology. The training unit can accommodate up to 12 people at a time. As it travels to new locations, it will be updated with new components, know-how, and learning modules to reflect these changes. The company's goal is to launch several training containers that can serve its primary markets in North America, Europe, and Asia.

Universities

IES Llombai and **Jaume I University of Castellón** are pioneers in CO_2 training in Spain. Thanks to collaboration with secondary schools and private companies, the training courses have been successfully run since 2011.

In 2014, the universities successfully ran a training course that was specifically provided for refrigeration technicians, food retailer sector in particular, and focused on subcritical CO_2 systems. In 2015, they offered two courses: one focused on subcritical CO_2 systems, including new features such as plate heat exchangers and micro-channel condenser technology sessions, the other one focused on CO_2 transcritical applications and secondary systems for commercial refrigeration applications.

In the frame of the IESCO_2 project, the universities have developed and commissioned four cascade systems at four secondary schools and the Jaume I University of Castellón. These installations, which are monitored and running, provide valuable information and are open to all students.

Associations

The **AFPA**, the French Association for Vocational Training, together with the distributor Eberhardt Frères is providing training to installers on hydrocarbons R600a (isobutane) and R290 (propane). Taking theory, safety measures and support for the general use of these refrigerants into account, the association sees it necessary to keep up to date with their increased use in the professional refrigeration sector, especially given the implementation of the EU F-Gas Regulation promoting the use of low-GWP refrigerants.

Georgian Association of Refrigerating, Cryogenic and Air Conditioning Engineers provides theoretical and practical training on ammonia industrial refrigeration systems in Tibilisi, Georgia. The course covers basic thermodynamics and physics, material compatibility and lubricants, regulations and standards, safety aspects and practical handling of ammonia refrigerant. The course costs €200 per person and a certificate recognised in Georgia can be achieved after successful completion of the training.

A Spanish association, **Confederación Nacional de Instaladores, C N I**, provides on-site practical courses and online theoretical training for CO_2 and ammonia systems. The training covers different kinds of applications where these refrigerants are commonly used, including commercial and industrial refrigeration. The topics covered during the course include: basic thermodynamics & physics, material compatibility, lubricants, application areas, case studies, regulations and standards, safety aspects, efficiency, COP evaluation, practical handling of refrigerant, system design, installation, operation and maintenance. The courses are free of charge and available in Spanish, English, German and French.

End users

UK retailer **Sainsbury's** launched a Carbon Academy in 2011 to raise awareness and improve skills among its contractors, retailers and employees. The training ranges from explanations of how small changes in everyday working practices can reduce carbon impact, to highly-specialist skill acquisition such as CO_2 refrigeration. The declared objective is to train 20,000 people by 2020.

Private training providers

CO_2Academy by **Frigo Natural** provides transcritical CO_2 technology training for technicians. Both practical and theoretical aspects are covered during the course. The two-day professional training includes topics such as introduction, practical operation with CO_2 as a refrigerant, commissioning

and adjustment of CO_2 systems, the Pressure Equipment Directive and general rules for using CO_2 as a refrigerant, CO_2 systems, knowledge of materials and brazing technology. The courses are available in Swedish, English and Dutch. All courses are taking place in the PTC+ (Practical Training Center) in Ede, the Netherlands.

Consulting, contracting engineering

Tewis Smart Systems , a consulting, contracting, engineering firm based in Spain, provides theoretical and practical training for CO_2 and ammonia refrigerants for commercial and industrial systems. Trainees need to have semi-professional level of knowledge to be able to follow the course. No certification is provided at the end of the courses. The topics covered by the natural refrigerant training are basic thermodynamics & physics, material compatibility, lubricants, application areas, case studies, regulations and standards, safety aspects, efficiency, COP evaluation, practical handling of refrigerant, system design, installation, operation, maintenance. The classes are available in Spanish and French.

Certification body

Bavarian Environment Agency is providing theoretical training on hydrocarbon, CO_2, and ammonia in order to raise awareness in the region due to the phase down of HFCs. The training course in German is free of charge and covers topics such as application areas, case studies, regulations and standards, safety aspects, efficiency, COP evaluation, practical handling of refrigerant, system design, installation, operation and maintenance. The agency does not provide any practical training on natural refrigerants.

Research institute

Re/genT BV, a research institute, as well as consulting, contracting and engineering company based in the Netherlands, has recently started to provide theoretical and practical training classes on hydrocarbons and CO_2 in domestic and light commercial refrigeration areas. The company also provides general refrigeration courses related generally to all kind of refrigerants. The courses on CO_2 and HC cover basic thermodynamics & physics, regulations and standards, safety aspects, efficiency, COP evaluation, practical handling of refrigerant, system design, installation, operation, maintenance. The price per person is flexible, depending on what client needs.

Vocational / Professional school

Norddeutsche Kälte-Fachschule (NKF) provides training for CO_2, ammonia and water refrigerant-based technology. The training combines both theoretical and practical lessons on site and covers basic thermodynamics & physics, material compatibility, lubricants, application areas, case studies, regulations and standards, safety aspects, efficiency, COP evaluation, practical handling of refrigerant, system design, installation, operation, maintenance. The average cost per course per person is €700 and courses are available both in German and English. NKF is also a certification body. Therefore, the Master of Crafts certificate recognised in Germany can be achieved after successfully completing the course.

EU Funded Projects

SuperSmart, an EU-funded project that aims to speed up the uptake of more energy-efficient refrigeration, heating and cooling solutions for Europe's food retail sector, has published seven free reports to help food retailers and their partners select best-available HVAC&R technologies and practices. The reports provide concrete recommendations on how to map and reduce non-technological barriers, how to build new stores and refurbish existing ones, and how to select the right tools and methods to maintain high levels of energy-efficient operation.

The team has also developed a series of training modules for offering free-of-charge tailor-made or public training events across Europe. Interested food retailers, HVAC&R partners and other organisations are welcome to register their interest in a tailored training session via the project website: http://www.supersmart-supermarket.info/get-involved/

Types of natural refrigerant training

Theoretical and practical training are both important phases of learning - a balanced combination of both is necessary to ensure the desired level of knowledge.

Theoretical training forms the basis of knowledge and is indispensable to gain the necessary information that can then be further developed through practical experience. In the HVAC&R industry, theoretical training can be delivered on-site as well as through online (e-learning) and offline (long-distance learning) channels. According to the industry survey results, 98% of natural refrigerant training providers offer theoretical classes.

While theoretical training is essential, for certain types of HVAC&R professions it is not sufficient to ensure that the necessary skills & competencies are acquired. In case of engineers and technicians who need to handle natural refrigerant-based equipment in any way it is indispensable to go through a **practical training**. Such training enables technicians to get hands-on experience with the natural refrigerant-based technology in order to ensure maximum safety. Moreover, it develops a better understanding and helps retain the theoretical knowledge in mind. In practical training, students and technicians are usually confronted with situations that can possibly happen in real life, thereby preparing them for their jobs.

The results of the industry survey showed that 80% of natural refrigerant training providers offer practical training, either on-site or long-distance in form of participative webinars or similar.

THEORETICAL TRAINING...

98% of natural refrigerant providers offer theoretical training

90% on-site

33% online / e-learning

16% offline / distance learning

PRACTICAL TRAINING...

80% of natural refrigerant providers offer practical training

75% on-site

09% online / e-learning

06% offline / distance learning

On-site trainitng remains the most common type of training delivery

Trained teachers normally deliver on-site training in a classroom in a systemic intentional way within a school, college, institute, university, etc. Such training is suitable for both theoretical and practical types of training.

As compared to other types of training (online and distance offline), on-site training requires availability of a facility that can accommodate the desired number of trainees. In addition, training providers need to make significant investments in equipment and tools. In a number of cases, the investment burden can be overcome through collaboration between manufacturers, training providers and others as well as through financial support from governments.

On-site training has traditionally been the most popular in the HVAC&R sector due to the nature of the work. The survey demonstrated that this continues to be the case for training on natural refrigerants. According to the survey results, 90% of all natural refrigerants training providers offer theoretical training, while 75% provide practical training on site.

E-learning gaining popularity

E-learning is a learning environment which uses information and communication technologies as a platform for teaching and learning activities. E-learning is a practical way of learning theory especially for the adult learners having limitations in time, distance or finances. However, e-learning cannot replace practical training, especially in the HVAC&R field where technicians and engineers need to have an on-site practice in order to be able to handle heating and cooling equipment.

E-learning is becoming very popular in Europe, with 33% of HVAC&R training providers saying that they offer theoretical courses online. In addition, 9% of survey respondents indicated that they offer practical training online. A good example of an EU-wide free e-learning training platform is the Real Alternatives project that aims to increase the skills of people working in the refrigeration and air conditioning sector with CO_2, ammonia and hydrocarbon refrigerants. The project developed a free training material (e-learning, face-to-face training, practical exercise, assessments and e-library). It offers free e-learning modules and booklets - resources that can be studied individually or adapted by training providers to produce courses and in-house training sessions. The material integrates the existing industry guidance and on line tools, which have been reviewed by the project and collected into an evolving central electronic library. Those who successfully complete the end of course assessment are issued with a REAL Alternatives Certificate of CPD.

Besides the Real Alternatives e-learning platform, online natural refrigerant courses are also offered by a number of technology providers, for example Star Refrigeration and Danfoss.

Long-distance learning used to a limited extent

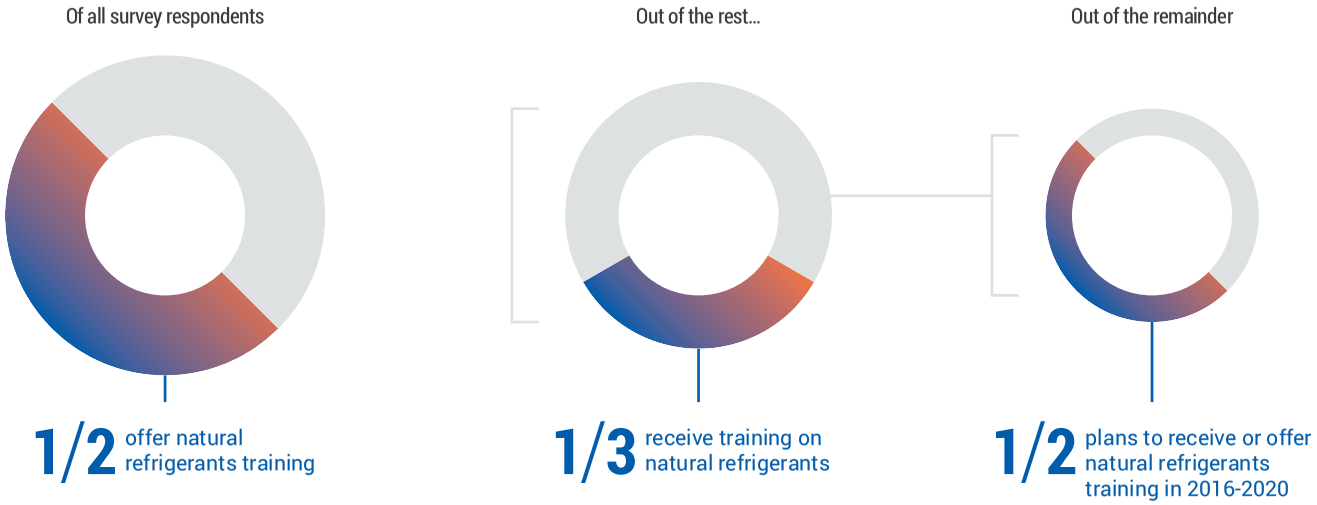
Offline / Long-distance learning is a type of education that offers the possibility to follow courses while not being physically present at a training facility. Offline/long distance learning is more suitable for learning theory rather than for practical learning, especially in the field of HVAC&R.

Survey results showed that offline/long-distance learning is not a very popular way of teaching and learning among HVAC&R training providers. This simply can be explained by the HVAC&R job nature itself – technicians and engineers need to be trained on how to practically use different tools, how to safely and efficiently handle refrigeration, heating and air conditioning systems, etc. Long-distance learning is more typical for theoretical training and it is often coupled with on-site training.

Survey on natural refrigerant training

To better understand the current market for natural refrigerant training, shecco's industry survey investigated among training providers different aspects of their training offerings, including which refrigerants, topics, applications, languages they cover as well as what is the average cost for a course. Receivers of natural refrigerants training were asked similar questions, which helps evaluate whether there is a match in demand and supply or if there are any gaps.

Majority of survey respondents are already involved in natural refrigerant training today

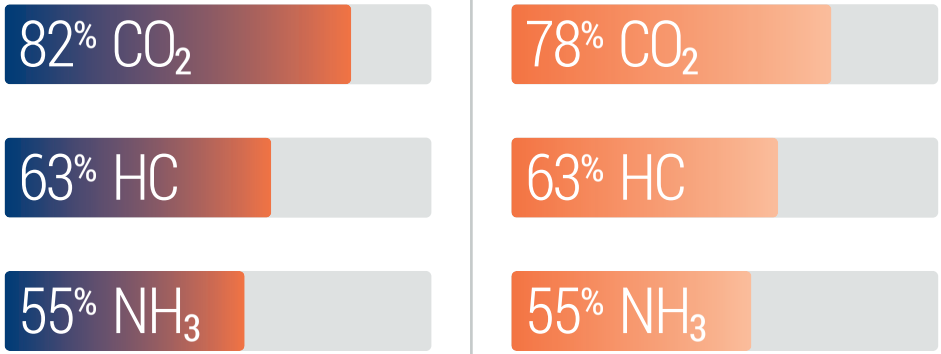


Close to half of all survey respondents (over 150 individuals) indicated they provide training on natural refrigerants. Of those that do not provide natural refrigerant training, over one-third responded they have received such training. The rest of survey participants were not yet involved in natural refrigerants training, but almost half of them indicated they were considering to get involved in the near future (between 2016-2020 horizon). Future plans are examined in more detail in the following section of this chapter 'Natural refrigerant training TOMORROW'.

The survey findings indicate there is a good correlation between training natural refrigerant providers and receivers when it comes to the type of natural refrigerant for which they either receive or provide training. Both groups of respondents indicated strong involvement in CO_2 training, with over 80% of providers offering this training and a similar proportion of training receivers who indicated they have participated in such training. Second most popular is training for hydrocarbons and ammonia comes in the third place for both groups of survey respondents.

Overall, a bit more than a third of all natural refrigerant training providers said they offer exclusively training on natural refrigerants, while the rest provides also training on f-gases, including HFCs (half of all natural refrigerant training providers) and unsaturated HFCs, so-called 'HFOs' (two-fifths of all natural refrigerant training providers).

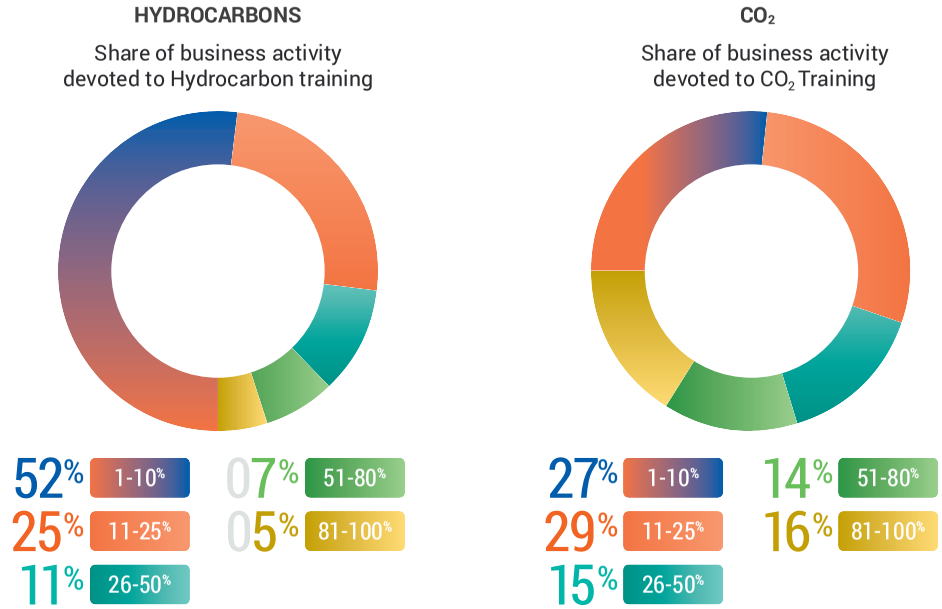
CO_2 training is a clear leader



Natural refrigerant training represents so far a small share of business

It is clear from the survey that for most training providers the share of business from individual natural refrigerants represents so far a small portion of their overall training offer. Over half of those offering hydrocarbon training indicated it represents around 1-10% on their overall business, while for another quarter it is between 11-25%. Only for a smaller proportion of hydrocarbon training providers it represents a larger share in business.

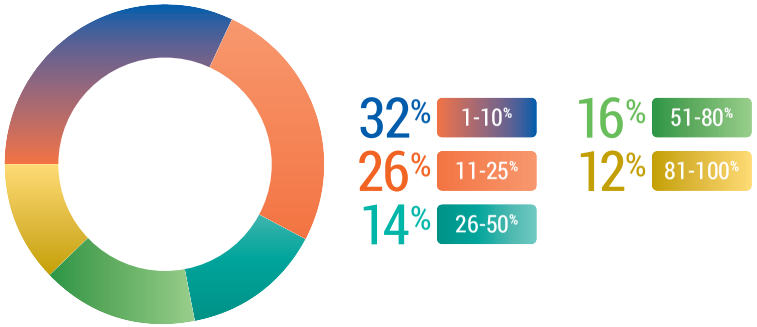
Providers of CO_2 training portrayed a slightly different picture, reporting a stronger interest in such training. For almost a third of the organisations operating in this field, CO_2 training represents 11-25% share on their total training activities. In addition, there are around 16% of CO_2 training providers for which such training is the main activity and represents 81-100% of their total business.



AMMONIA

Share of business activity devoted to ammonia training

In case of providers of ammonia training, for majority of respondents (a third) this training represents 1-10% in overall training activities, while for another quarter it is between 11-25%.



Natural refrigerant training for refrigeration applications prevail

The survey by shecco investigated whether the existing training offer on natural refrigerants matches the demand. To a large extent, training providers and receivers showed a similar assessment of the applications for which training is needed. Commercial, industrial and light commercial refrigeration rank the highest for both groups of respondents - this is in clear correlation with the market uptake of natural refrigerants in these sectors. A slight discrepancy can be observed for the sector of industrial refrigeration, where the natural refrigerant providers have indicated significantly higher supply compared to demand from the training receivers side.

Besides the refrigeration sector, both supply and demand side of the natural refrigerant training ranked commercial & industrial air conditioning as well as commercial & industrial heating relatively high. Transport refrigeration and mobile air conditioning sectors recorded the lowest interest from natural refrigerant training receivers. These were also the sectors for which there seems to be the lowest coverage in natural refrigerant training courses. This comes as no surprise given the current low level of natural refrigerant use in these applications.

Surprisingly, 20% of training receivers indicated they would be interested in general training on natural refrigerants that would cover a wider spectrum of applications. However, such training is currently offered by only around 10% of training providers, according to the survey findings, which seems to indicate a gap in the training market.

Applications most covered by natural refrigerant training providers:

1. Industrial refrigeration
2. Commercial & light commercial refrigeration
3. Commercial & industrial air conditioning
4. Commercial & industrial heating
5. Domestic refrigeration

Applications most desired in natural refrigerant training by receivers:

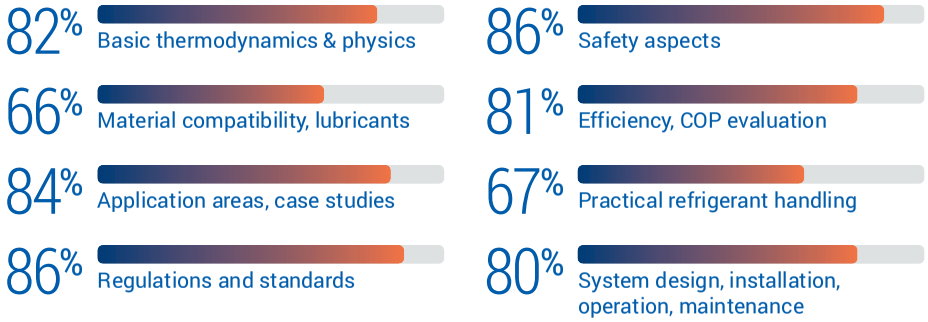
1. Commercial refrigeration
2. Industrial & light commercial refrigeration
3. Commercial & industrial air conditioning
4. General - all applications
5. Commercial & industrial heating

Training providers cover a wide range of topics, receivers are mostly interested in safety

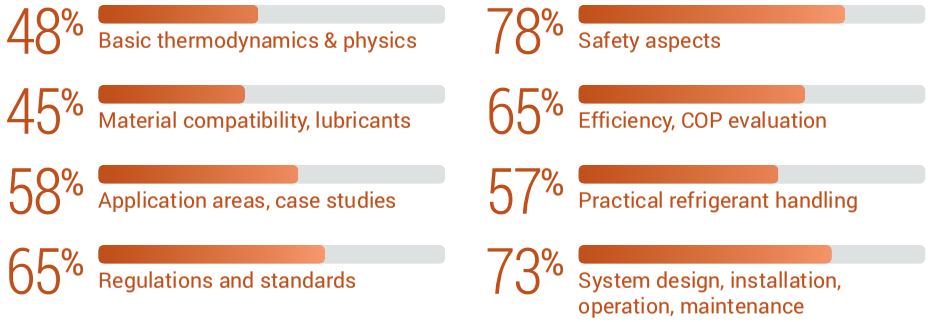
The survey findings indicate that training providers cover a wide range of topics in their natural refrigerant courses. Most of respondents who provide training on natural refrigerants said that their courses include safety aspects, regulations and standards, application areas and case studies, basic thermodynamics & physics, system design, installation, operation and maintenance. Topics that are covered less widely include practical refrigerant handling and material compatibility.

With regards to the topics that training receivers are most interested in, most ranked safety aspects the highest, followed by system design, installation, operation and maintenance. Respondents also indicated interest in efficiency and COP evaluation as well as regulations & standards. The least popular topics were basic thermodynamics & physics and material compatibility.

Toptics covered by natural refrigerant training providers:



Topics that natural refrigerant training receivers are most interested in:



Over a third of natural refrigerant training providers offer free courses

Investment costs were identified as a major barrier for a wider uptake of training on natural refrigerants. This is especially the case for small businesses that do not have the necessary resources to keep the employees up to date on the latest technologies. To get a better understanding of the real cost of training courses, the survey asked training providers how much they normally charge for a course on natural refrigerants per person. Surprisingly, over a third of the respondents said they offer their courses free of charge. It could be therefore concluded that there is currently a lack of awareness in the HVAC&R industry about the free courses and better communication could immediately improve the knowledge on natural refrigerants.

Training providers noted that payed courses range quite widely between €100 - €5,000 per course per person, depending on group size, location, contents, duration of the training, clients requirements, and others. The most common cost of a course on natural refrigerants quoted by training providers was €500.

The survey also asked training receivers how much they would be willing to invest in a course per person. Close to half of the respondents said that they do not know how much they would pay for a course, while 17% said that the course should be free of charge. This reinforces the argument that there is a low level of awareness of training courses that are available for free.

Over a third of training receivers indicated an average price per course they would be willing to invest. The price varied from €100 to €2,500, with €500 being the most popular answer among training receivers, which matches the most common cost charged by training providers.

Average cost for natural refrigerant course

Cost charged by **training providers**

38% offer free courses

34% indicated cost between €100 - €5,000 (€500 most common)

28% do not know

Cost that **training receivers** are willing to invest

17% think courses should be free

38% indicated cost between €100 - €2,500 (€500 most common)

45% do not know

Natural refrigerant courses geared mostly towards professionals

When asked what level of prior knowledge participants need to have to take a course, a large majority of training providers indicated that the courses are tailored for professionals who already possess substantial prior knowledge about HVAC&R technology. This seems to be the appropriate level from the point of view of a majority of respondents on the training demand side too.

Both training providers and receivers indicated courses targeting amateurs who have a basic level of prior knowledge as the second most common. The least common are the courses either for experts with a substantial level of prior knowledge or for beginners with no prior understanding.

Most of the training courses are without certification

Survey results show that training providers don't normally do not offer any certification for natural refrigerant courses. This trend was confirmed by three-quarters of providers of training on natural refrigerants. Around one fifth of the respondents said that national certification can be achieved after following their courses. Only a very small share of training providers noted that a certification recognised in their region or worldwide can be achieved.

In addition, some of the respondents named some of the certifications recognized in their respective countries, such as UK's City and Guilds certifications: C&G 2079 and C&G 6187-21.

NATURAL REFRIGERANTS TRAINING TOMORROW

BESIDES INVESTIGATING ABOUT THE CURRENT SITUATION OF NATURAL REFRIGERANTS TRAINING IN EUROPE, THE SURVEY ASKED THE INDUSTRY EXPERTS ABOUT THEIR EXPECTATIONS FOR FUTURE DEVELOPMENTS.

Industry highly optimistic about the uptake of natural refrigerant training in the next 1-2 years

To evaluate the number of people that received training on natural refrigerants the previous year, the survey asked training providers how many people they trained in 2015. A majority of the respondents said they trained 11-50 people, followed by another group that trained 51-100 people. There was also a small proportion of those that trained more than 500 people.

As for the organisations at the training demand side, over two-thirds specified that between 1-10 people received training on natural refrigerants in 2015 in their organisation. A smaller portion of respondents said that it was between 11-50 people that received such training and the rest did not have this information.

People trained on natural refrigerants in 2015 - training receivers

Training receivers' expectations for number of people trained

The receivers of training showed great optimism for future developments, with over 70% saying they expect more people from their organisations to take up training on natural refrigerants in the next 1-2 years. Slightly less than one fourth of respondents noted that the number of trained people would remain the same.

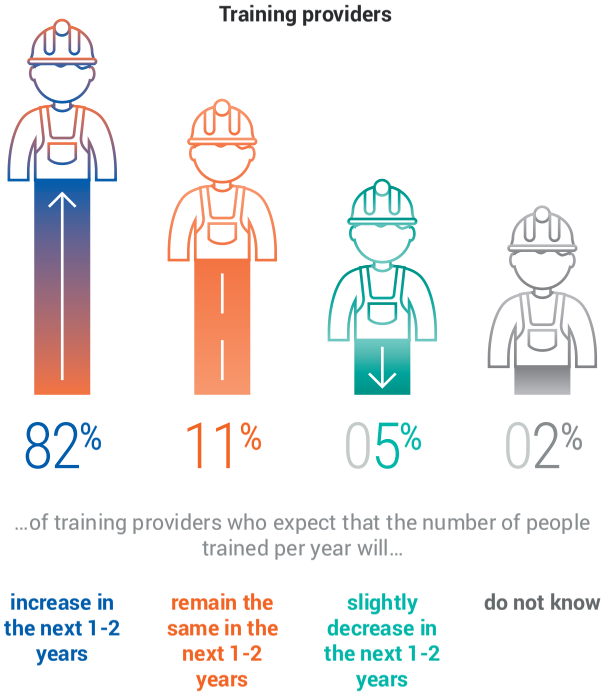
Training receivers

...of training receivers who expect that the number of people trained per year will...

increase in the next 1-2 years	remain the same in the next 1-2 years	slightly decrease in the next 1-2 years	do not know

Number of people trained on natural refrigerants expected to grow strongly

Natural refrigerants training providers expressed great optimism when it comes to the expected growth in the number of people trained on natural refrigerants per year. Four in five of HVAC&R industry experts expect to see this number increase in the next one to two years. In addition, just over one tenth of natural refrigerant training providers said that the numbers would remain the same. 5% of respondents were not so optimistic saying that it will decrease slightly, while 2% said they do not know how this will change.

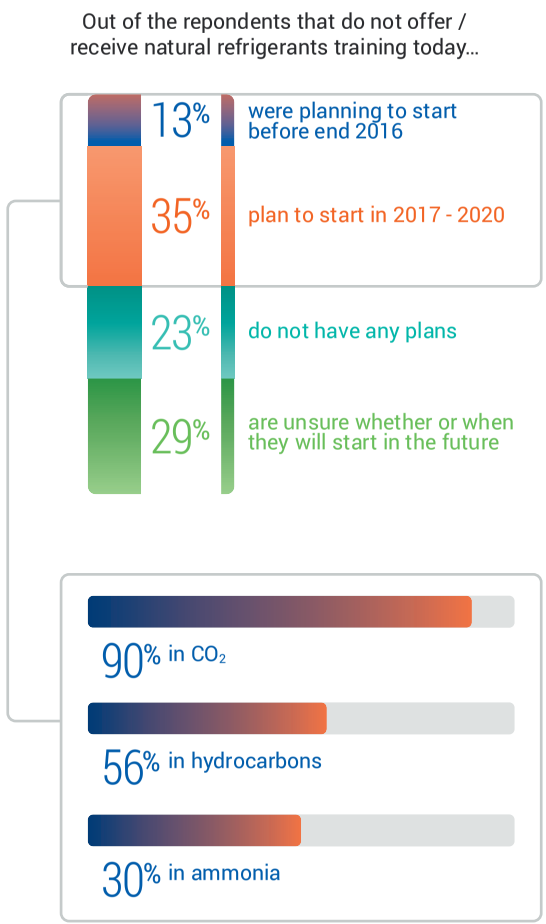


Future plans to offer / receive natural refrigerants training

Regarding the future plans to either provide or receive training on natural refrigerants, almost half of survey respondents who currently do not provide or receive training on natural refrigerants said that they plan to do so in 2016-2020. Considering that those that already provide / receive natural refrigerants training will also grow their offer and demand as the technology using natural refrigerants becomes more and more common, this trend shows that natural refrigerants training will see a steady growth in Europe.

The future is bright for the training on CO_2 refrigerant, with more than 90% of industry respondents saying that they plan to provide or receive training related to this refrigerant. The expectations are mostly linked to the strong growth in CO_2-based installations in commercial and industrial refrigeration. More than 50% of respondents plan to offer or receive training on hydrocarbons in the future and slightly less on ammonia.

Close to one third of those that do not offer / receive training on natural refrigerants today were not sure yet whether this will change in the future. Their decisions will likely depend on the market adoption of natural refrigerants in the coming years, as the effects of the F-Gas Regulation will become more pronounced.



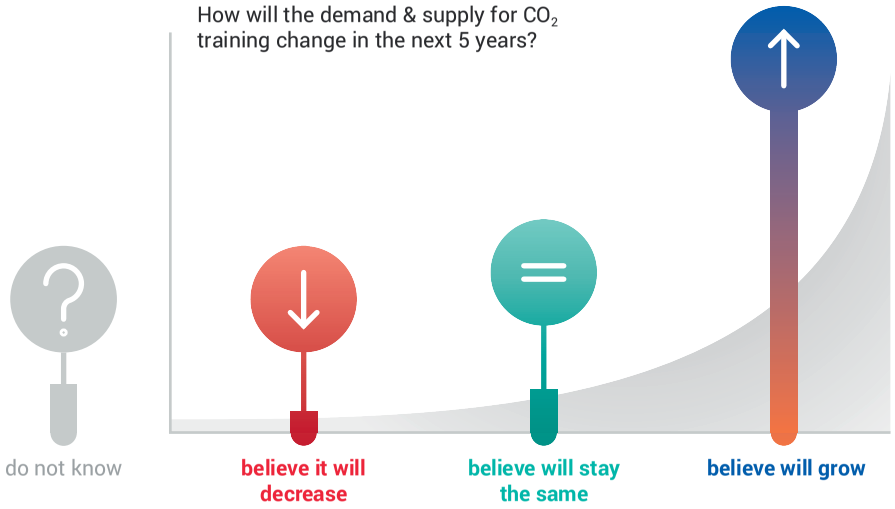
Future demand & supply of natural refrigerant training

The online survey asked industry representatives how they expect the demand and supply for natural refrigerants training to change in their region in the next five years. The findings indicate that the industry expectations for demand generally correlate with the expectations for supply, although it can be noted that the future demand is estimated to be slightly higher than supply.

The supply in natural refrigerants training is driven by demand. The key driver for demand is the legislation as well as other market factors. The EU F-Gas Regulation will introduce stricter measures over the next five years - such as 37% cut in HFC quotas by 2018 and 55% by 2021, a ban on certain HFCs in commercial refrigeration (plug-in and centralised) by 2022, which will inevitably create greater interest in technologies that do not rely on HFCs.

CO_2 training

The industry believes that CO_2 training will see the highest increase in demand and supply, with 79% and 74% of respondents, respectively, stating it will grow either strongly or slightly. This is an indication that CO_2 is already on a strong growth trajectory and the industry has already fully embraced this fact. In the next five years, CO_2 is expected to be a standard refrigerant in commercial refrigeration across Europe, where it has already gained significant market share - with well over 9,000 CO_2 transcritical stores, it has reached 8% of the overall market share in the food retail sector. Moreover, CO_2 is becoming more popular in both larger (e.g. industrial refrigeration) and smaller applications (e.g. heat pumps, vending machines), which will further fuel the demand and supply of relevant training to ensure safe and effective handling of the technology.

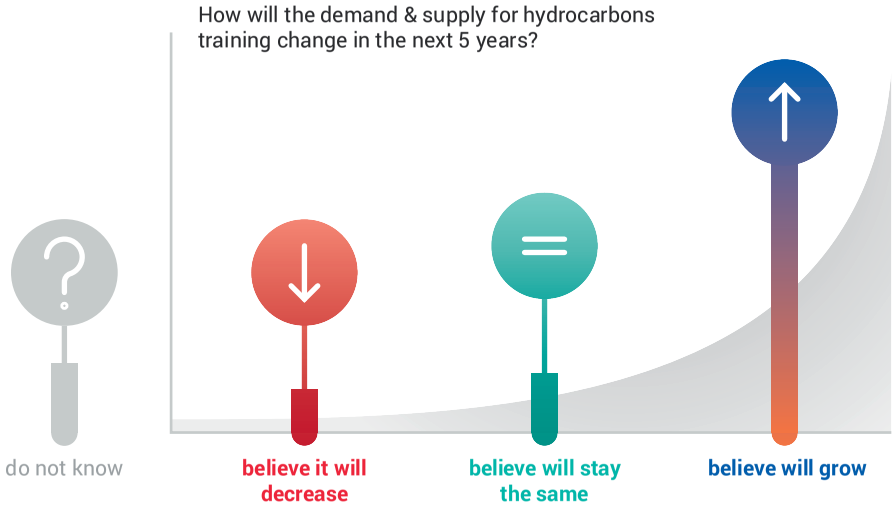


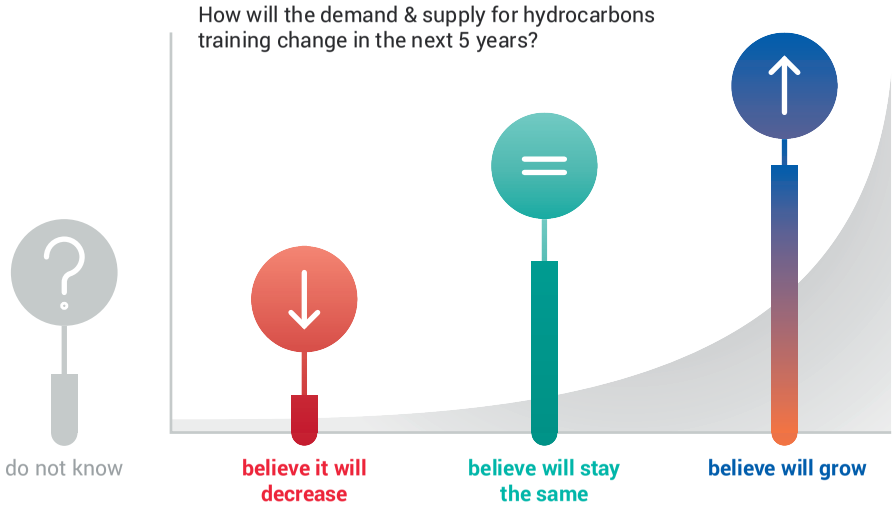
Hydrocarbon training

A large majority of respondents (over two thirds) expect that there will be a growth in supply and demand for hydrocarbons training in the next five years. Some respondents were unsure how the situation will evolve, which could be to some extent explained as uncertainty regarding the development of standards that currently limit the charge size for hydrocarbon-based equipment and thereby the growth potential of the technology. Another uncertainty factor is the acceptance of equipment using hydrocarbons among end users. Nevertheless, with the growing use even in larger equipment and awareness-building about the safety and energy efficiency, end users are expected to become more and more open to adopt this technology.

Ammonia training

Out of the three natural refrigerants, the industry representatives expect the demand and supply for ammonia training to grow the least. Nonetheless, still a significant number of experts (around 50%) predict it will increase in the next five years. A higher number of respondents (around 30%) compared to training on CO_2 and hydrocarbons believe that the supply and demand for ammonia training will remain stable. This comes as no surprise given that ammonia training is currently the most established out of these given the long tradition in use of ammonia-based technology. In the next five years, the market for ammonia is expected to grow in the its traditional sector of industrial refrigeration, but it will also become a solution for other medium and small refrigeration and AC applications.





INDUSTRY VIEWPOINT

Volker Stamer,
SCHAUFLER Academy director,
BITZER

"Education and knowledge are key elements to provide good solutions for the market. Training has always been important for BITZER, but now we finally have a facility that serves as a central hub."

Diego Malimpensa,
Business unit manager for retail solutions,
CAREL

"Worldwide, the situation is different, depending on the specific country, and the use of natural refrigerants is facing some of the same barriers that slowed down their deployment in Europe several years ago: there are gaps in the industry in terms of knowledge and training, the presence of local legislation that may help accelerate the introduction, and the presence and market acceptance of real alternatives that are now available."

Christian Heerup,
Technology manager, refrigeration,
Danish Technological Institute

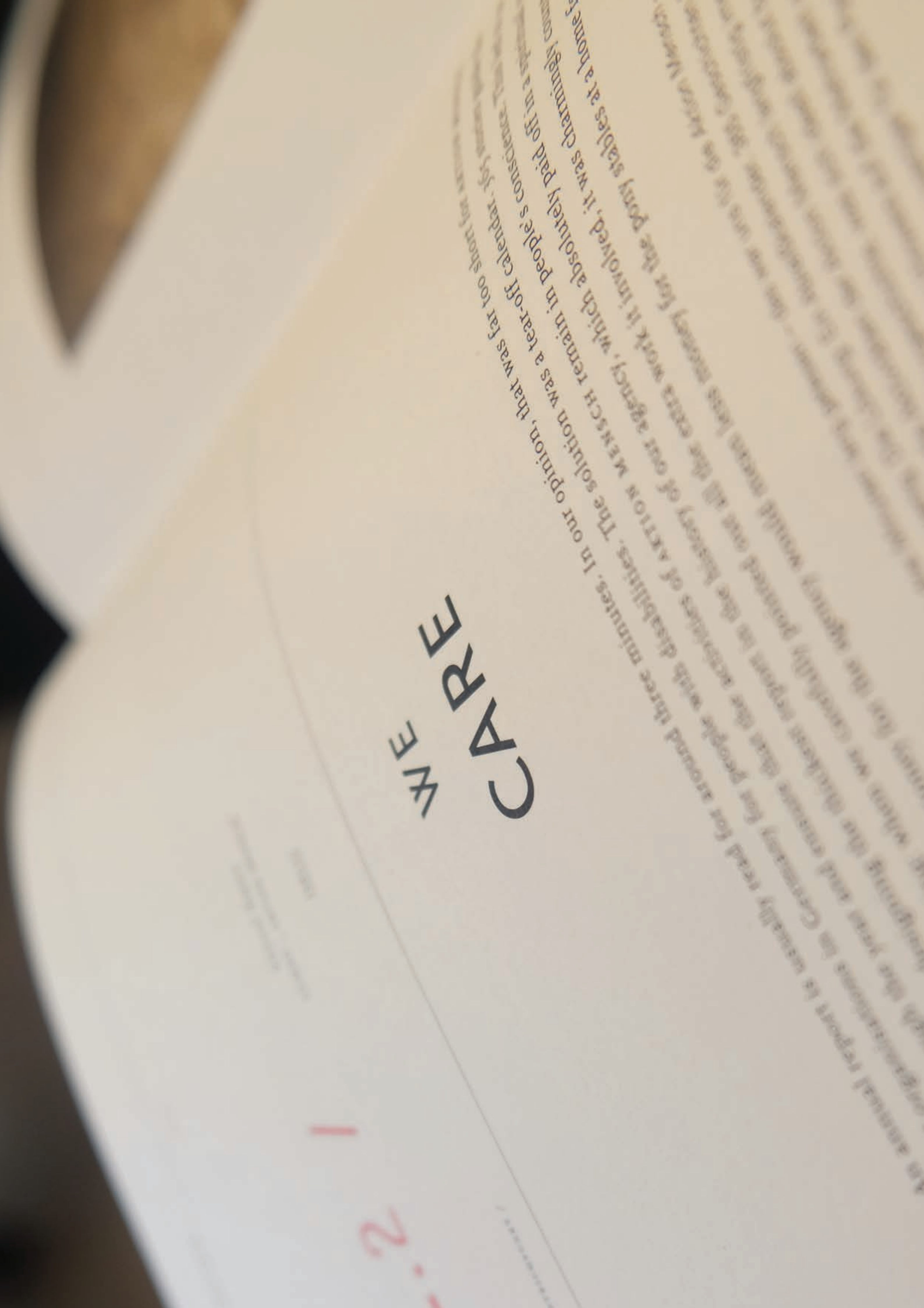
"There will be great opportunities for Danish companies manufacturing components and systems compatible with natural refrigerants to address the European market because this market will grow dramatically. Until now, there have been a limited number of experts who are skilled enough to handle CO_2 systems. This number must increase. And of course, there will be a need for training all over Europe."

Giovanni Dorin,
Marketing manager,
Dorin

"Many local associations are setting up training courses in CO_2 applications and alternative systems, and this has to be implemented more and more. Actually the government should support these trends in order to put professionals in the position to handle the new refrigerants safely."

Nacho Fandos,
Professor,
IES Llombai

"An increased interest in CO_2, new technologies and areas of application have resulted in a wider and more comprehensive offering of training. However, this topic is not included as a regular subject in schools. At the institutional level, there have not been significant developments."


WE
CARE
The solution was a tear-off calendar
In our opinion, that was far too short

5 Policy for natural refrigerant training

THE SURVEY AMONG EUROPEAN INDUSTRY EXPERTS INDICATED THAT POLICY IS THE MAIN DRIVER FOR NATURAL REFRIGERANT TRAINING. NATIONAL, REGIONAL AND INTERNATIONAL LEGISLATIVE MEASURES INCREASINGLY IMPOSE RESTRICTIONS ON HFCS, A GROWING MARKET FOR NATURAL REFRIGERANTS. INTERNATIONALLY, THE AMENDMENT TO THE MONTREAL PROTOCOL AGREED IN OCTOBER 2016 WILL SEE A GLOBAL PHASE DOWN OF HFCS, WHICH WILL INCREASE THE INTEREST OF INDUSTRY IN NATURAL REFRIGERANTS. GAINING NECESSARY KNOWLEDGE AND COMPETENCES TO HANDLE THESE SUBSTANCES WILL BE AN ESSENTIAL PREREQUISITE FOR A SUCCESSFUL TRANSITION.

At the EU level, the F-Gas Regulation acts as the main driver for the shift away from high GWP refrigerants. While it imposes gradual restrictions on HFCs it does not mandate training and certification requirements related to HFC alternatives, such as natural refrigerants, except for the need to cover information on f-gas alternatives during training on HFCs. Besides the EU F-Gas Regulation, other EU legislation exists that regulates safe handling of refrigerants and risks associated with the use of certain substances. Of particular importance are the Framework Directive on Safety and Health at Work and the ATEX Directives for hydrocarbons and the Pressure Equipment Directive for CO_2. It is through these directives and complementary safety standards that the safe handling of natural refrigerants is regulated. Unlike Regulations, EU Directives give member states a certain degree of flexibility in transposing the legislation in their national laws, which is why differences across the EU may occur.

In the absence of harmonised minimum training requirements and certification on natural refrigerants at the EU level, national initiatives play an important role. Denmark, Belgium or the Netherlands, for instance, have introduced a variety of measures to support uptake of natural refrigerants training, while others might be currently considering legislation to ensure safe handling of HFC-free refrigerants.