European Experience in Certification of competence in ODS substitutes:
F-gas and Alternative Refrigerants

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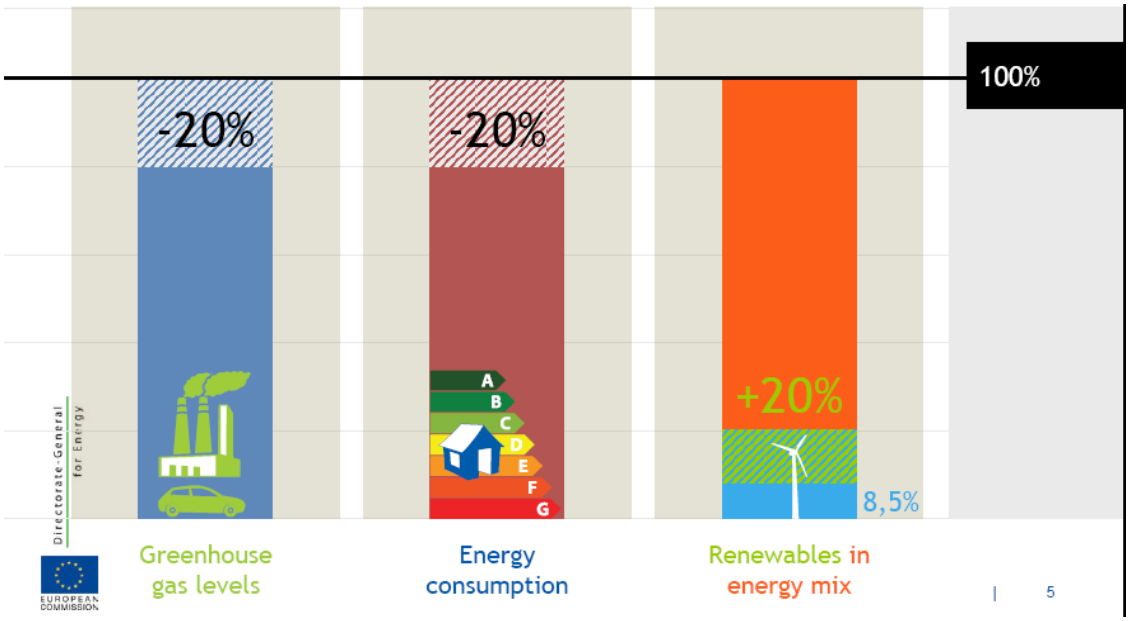
AREA
The indisputable voice of European RACHP contractors

- Funded in 1988 in Brussels, Belgium
- Represents RACHP contractors
- AREA in figures:
  - 20 national member associations
  - 18 countries from EU and beyond
  - > 9,000 companies (mainly SMEs)
  - +/- 125,000 work force
  - +/- € 20 bn annual turnover

Design, installation, maintenance and repair of all **Refrigeration, Air Conditioning and Heat Pumps** RACHP systems

Europe: The current political context
The EU 20 – 20 – 20 target

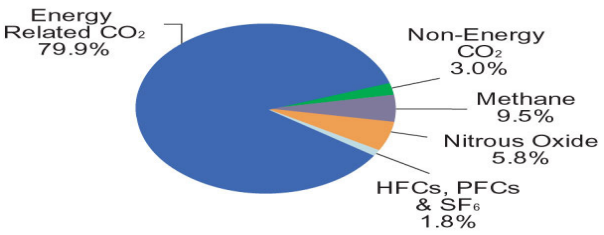


To stay below 2°C every country will have to reduce its greenhouse gas emissions (GHGs), but developed countries will need to take the lead by targeting a cut of 80-95% below 1990 levels by 2050.(1)

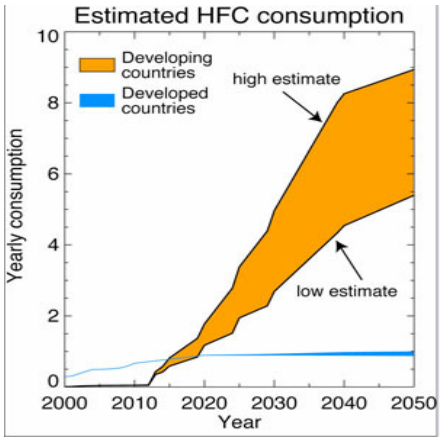
(1) EU Commission Climate Action - FAQ

Impact of refrigeration, air conditioning and heat pumps – and refrigerants

Air-conditioning, refrigeration and heat pump equipment is using 15 to 20% of the electrical energy globally.



Actual contribution
Source US
Similar in all developed countries



Trends
Source NOAA
National Oceanic and Atmospheric Administration

To prevent HFCs emissions In Europe: F-gas regulation and certification

REGULATION (EC) 842/2006

In synthesis the Refrigeration, Air Conditioning and Heat Pumps systems with HFCs should have:

- Logbook (each unit above 3kg of charge)
- Periodical inspections
- Installation, repair only by certified craftsmen

Table 8-2: Overview of requirements for regular leakage control

Frequency of leak checks of stat. equipment and systems	System charge Normal	System charge Hermetically sealed
None	<3 kg	<6 kg
Annually	3 kg – 30 kg; 30 kg – 300 kg if automatic leak detection system in place	6 kg – 30 kg; 30 kg – 300 kg if automatic leak detection system in place
6 monthly	30 kg – 300 kg; >300 kg if automatic leak detection system in place	30 kg – 300 kg; >300 kg if automatic leak detection system in place
3 monthly	>300 kg	>300 kg

REGULATION (EC) 303/2008
MINIMUM COMPETENCE OF PERSONNEL

		CATEGORIES			
	DUTIES AND KNOWLEDGE	I	II	III	IV
1	Basic thermodynamics	T	T		T
2	Environmental impact of refrigerants and corresponding environmental regulations	T	T	T	T
3	Checks before putting in operation, after a long period of non-use, after maintenance or repair intervention, or during operation	P	P		
4	Checks for leakage	T/P	T/P		T/P
5	Environment-friendly handling of the system and refrigerant during installation, maintenance, servicing or recovery	P	P	P	
6	Component: installation, putting into operation and maintenance of reciprocating, screw and scroll compressors, single and two-stage	P	P		
7	Component: installation, putting into operation and maintenance of air cooled and water cooled condensers	P			
8	Component: installation, putting into operation and maintenance of air cooled and water cooled evaporators	P			
9	Component: installation, putting into operation and servicing of Thermostatic Expansion Valves (TEV) and other components	P			
10	Piping: building a leak tight piping system in a refrigeration installation	P	P		

REGULATION (EC) 303/2008
ARTICLE 4 – PERSONNEL CERTIFICATION

	Activities			
	C	R	I	M
Category I	OK	OK	OK	OK
Category II	OK	OK (below 3kg of charge)	OK (below 3kg of charge)	OK (below 3kg of charge)
Category III	OK			
Category IV		OK		

Where, C= leak check on the refrigeration system
direct or indirect method

R = recovery;

I = installation ;

M = maintenance

Technology and knowledge Training, Assessment (1)

Strengthening national refrigeration & air-conditioning (RAC) associations in Eastern European & Central Asian countries

27 November 2012 – Casale Monferrato: The Italian Centro Studi Galileo, the European Association of Refrigeration, Air-conditioning and Heat Pump Contractors (AREA) and the United Nations Environment Programme (UNEP) joined forces to strengthen national refrigeration & air-conditioning (RAC) associations in Eastern European and Central Asian countries.

Technology and knowledge Training, Assessment (2)

Representatives of national RAC associations participate since 2009 in the meetings of the Regional Ozone Network for Europe & Central Asia (ECA network) and they play a crucial role in implementing the national HCFC phase-out management plan. The meeting focused on those countries with relatively young RAC associations and those which are planning to establish such associations in the near future. So far, the ECA network supported the creation of national RAC associations in Bosnia & Herzegovina, Croatia, and Macedonia FYR.

All participants successfully passed the theoretical and practical assessment and were certified under the F-gas regulation. This certification is mandatory in the member countries of the European Union and will shortly become mandatory in accession countries like Croatia.

Contractors' training with low GWP refrigerants: mind the gap!

If the use of HFCs is legislatively decreased and consequently the use of natural refrigerants is pushed, there will be a gap between training offer and training needs resulting in a shortage of trained contractors

The European Commission is working on a revision of the F-Gas Regulation that could include measures in favour of a decreased use of HFCs in RACHP equipment. Such measures would, in turn, result in an increased use of alternatives, namely low GWP (global warming potential) refrigerants, and in particular the so-called "natural refrigerants" (CO2, hydrocarbons and ammonia). Mindful of the key role played by contractors in the safe, efficient and reliable functioning of equipment working with natural refrigerants, AREA sought an overview of the availability and level of training in the EU.

Solution could be starting from the F-Gas certification of personnel adding modules for natural refrigerants

Applications / low GWP alternative refrigerants

No refrigerant represents the ideal solution in all cases and for every equipment – each cooling application has to be looked at in its own merits and a professional choice must be made taking into account many more factors than simply GWP

Applications	Refrigerant
Industrial Refrigeration	HFO 1234ze (?)*
All kind of Industrial Ref.	Ammonia
Cascade systems	Carbon Dioxide + Ammonia
Secondary fluids	Carbon Dioxide
Commercial Refrigeration	HFO 1234ze*
Cabinets	Hydrocarbons
Bottle coolers	Hydrocarbons
Supermarkets	Carbon Dioxide
Domestic Refrigeration	
freezers	Hydrocarbons
Air Conditioning	R32
Heat Pumps Hot Water	Carbon Dioxide Trans-critical
Large Chillers	Ammonia
Small Monobloc Air Conditioning	Hydrocarbons
Automotive	HFO 1234yf

no refrigerant represents the ideal solution in all cases and for every equipment – each cooling application has to be looked at in its own merits and a professional choice must be made taking into account many more factors than simply GWP

From AREA guidance on LOW GWP refrigerants

*more applications for HFOs and HFO blends will probably be developed with full commercialisation of the refrigerants

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HFOs – R32 (3)

- Mildly flammable

	LFL (Vol.%)	UFL (Vol.%)	Δ (Vol.%)	MIE (mJ)	BV (cm/s)
Propane	2.1	10	7.8	0.25	46
R-152a	3.9	16.9	13	0.38	23
R-32	14.4	29.3	14.9	~30-100	6.7
Ammonia	15	28	13	~100-300	7.2
HFO-1234yf	6.2	12.3	6.1	>3000	1.5
HFO-1234ze(E) @ 23°C	-	-	-	-	-

- LFL lower flammability limit
- BV burning velocity
- → A2L refrigerant
- Is it managable?

AREA position on training and certification of LOW GWP refrigerants (1)

- A future phase-down of HFCs will lead to a higher use of alternative refrigerants / low GWP refrigerants. Low GWP refrigerants have issues on safety, flammability, toxicity and high pressure which will need to be properly considered when handling those refrigerants. With this guidance document, AREA would like to recommend to worldwide and European decision-makers minimum requirements for training and certification of contractors handling low GWP refrigerants.
- It is not AREA's intention to create a new certification scheme – only to add specific modules to the existing HFCs certification scheme based on Regulation 303/2008. While HFC certification will be the basis for every contractor who want to handle every refrigerant, each added module will focus on the specificities of the respective LOW GWP refrigerant (i.e. Hydrocarbons – Flammability).

Minimum Requirements listed for the Specific module HC – NH_3 – CO_2 – HFO*

	HC	NH_3	CO_2
BASIC THERMODYNAMICS AND PHYSICS			
Thermodynamic properties of Low GWP refrigerant: temperature, pressure, density, thermal capacity, p/h diagram	T	T	T
Differences between Low GWP refrigerants and HFCs	T	T	T
Toxicity characteristics, grades and limits for the human body	----------	T	T
Characteristic of Flammability of the substances, velocity of propagation, LFL, UFL, occupancy	T	T	----------
Specific components for that refrigerant in the refrigeration cycle	T	T	T
Material compatibility	----------	T	T
Oil compatibility, requirements and oil return	T	T	T

**HFO1234yf: same, minimum requirements as Hydrocarbons HC*

**HFO1234ze: same minimum requirements as HFCs*

R32 as Hydrocarbons HC

Minimum Requirements listed for the Specific module HC – NH_3 – CO_2 – HFO*

	HC	NH_3	CO_2
GOOD PRACTICE			
Identify typical application of Low GWP refrigerants RAC systems[2] (refer to AREA: Low GWP Refrigerants Guidance)	P	P	P
State and identify the commonly used refrigerants designation	P	P	P
State the requirements for safely labeling Low GWP refrigerant RAC systems[6]	P	P	P
Select appropriate tools, equipment and PPE for work on Low GWP RAC systems[6]	P	P	P
Recovery of the refrigerant	P	P	P
Venting the refrigerant in a safe way (according to national legislation)	P	P	P
Calculate the safe fill weight for the recovery cylinder (density difference between HFCs and Low GWP refrigerants)[2]	P	P	P
Leak check direct assessment with the correct equipment	P	P	P
Make vacuum of the refrigerant preventing moisture in the system and without refrigerant emissions	P	P	P
Make charge of the refrigerant with no emission relief	P	P	P
Make a connection without brazing with alternative connections	P	P	P
Check the correct functioning of the safety ventilation system		P	P
Check the correct functioning of the safety system controls	P	P	P

[1] All practical trainings should include theoretical training
[2] City and Guilds, Level 2 and Level 3 Refrigeration and Air Conditioning CPD Pathways, March 2012 v1.0
[3] It is normally accepted to vent hydrocarbons with low charges (please refer to national legislation)
[4] It is normally accepted to vent CO2 (please refer to national legislation)

Minimum Requirements listed for the Specific module HC – NH_3 – CO_2 – HFO*

	HC	NH_3	CO_2
HEALTH AND SAFETY REQUIREMENTS			
Safe system shutdown and isolation[2]	P	P	P
Extinguish a fire, identify the appropriate fire extinguisher	P	P	----------
First aid care treatment for frostbite	P	P	P
First aid due to fire burn	P	P	----------
First aid suffocation due to breathing problems	----------	P	P
Safety issues related to high pressures	----------	----------	P
Calculate LFL (confined space)	T	T	----------
Calculate confined space for asphyxiation (heavier than air)	T	----------	T
Check that Health and Safety rules in the refrigeration system location are respected (emergency exits, fire alarms, leak detectors...)	T	T	T
Correct use of Personal Protective Equipment	P	P	P

Minimum Requirements listed for the Specific module HC – NH_3 – CO_2 – HFO*

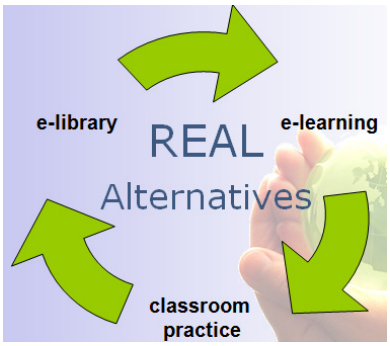
	HC	NH_3	CO_2
REGULATIONS AND STANDARDS			
Knowledge of European and National Regulations and standards	T	T	T
Storage of the refrigerant	T	T	T
Transport of the refrigerant	T	T	T
Describe the process for handing over system to costumer completing and passing on appropriate commissioning documentation[2]	P	P	P

Equipments

- ***Characteristic: Flammable proof***
- Leak detector
- Recovery unit
- Charging station (automotive)

- A **flammable gas detector** should be used to monitor the air in the work area.
- If an **electronic leak detector** is used it must be safe and sensitive to the flammable refrigerant. Most HFC leak detectors do not need this requirement. Leak detection fluid can be used.
- HFC **recovery machines** have not been assessed for use with flammable refrigerants. Approval must be sought from the manufacturer before using a standard HFC recovery machine with any flammable refrigerant – they may be safe to use with flammable HFCs but not HCs. A recovery machine suitable for use with HCs is available and could be used with other flammable refrigerants.
- More accurate **scales** are necessary when charging small, critical charged systems with some flammable refrigerants such as HCs. An accuracy of ±5 g is often necessary – most scales used for service are not this accurate.
- A dry powder or CO_2 **fire extinguisher** must be available at the location.
- A suitable **ventilation fan** should be used when working inside if there is insufficient natural ventilation.
- *Source: BRA Guide to Flammable Refrigerants, July 2012*
- You will need to determinate if your current R-134a detector can be used with a mildly flammable refrigerants
- *Source: Dupont Guidelines for Use and Handling of HFO-1234yf*

Refrigerant Emissions and Leakage-blended learning for alternative refrigerants in new equipment safety, efficiency, reliability and containment



REAL alternatives is European project that will address skills shortages amongst technicians working in the refrigeration, air conditioning and heat pump sector

The focus will be on carbon dioxide, ammonia, hydrocarbon and HFO refrigerants. It will cover safety, efficiency, reliability and containment in service and maintenance. There will be a focus on refrigerant emissions and leakage.

Delivered through innovative blended learning - a mix of e-learning, face-to-face training materials and an e-library of learning resources from across Europe. Building on the success of REAL Skills Europe & REAL Zero containment programmes

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