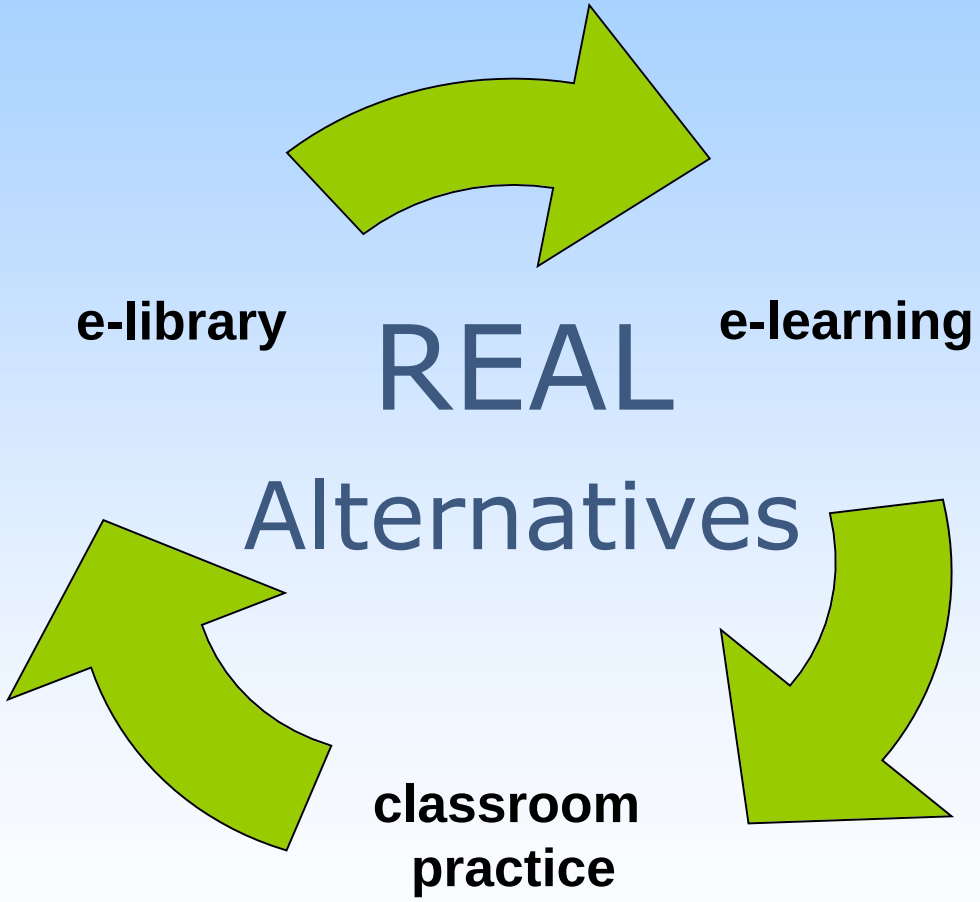
Refrigerant Emissions and Leakage-blended learning for alternative refrigerants in new equipment

safety, efficiency, reliability and containment



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Refrigerant Emissions and Leakage-blended learning for alternative refrigerants in new equipment

Developed as part of a collaborative Leonardo da Vinci European project to address skills needs in technicians in the refrigeration, air conditioning and heat pump sector in:

- Carbon dioxide
- Ammonia
- Hydrocarbon
- Low Flammables (HFO/R32 etc)

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Refrigerant Emissions and Leakage-blended learning for alternative refrigerants in new equipment

Addresses safety, efficiency, reliability and containment aspects of service and maintenance.

Critical safety factors associated with alternative refrigerants:

- Higher system pressures
- Flammability
- Toxicity

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Consortium of Expert Project Partners - INDIPENDENT

Associazione Tecnici del Freddo, Italy

Institute of Refrigeration, UK

London South Bank University, UK

Foundation for the Protection of the Ozone Layer, Poland

European Association for Refrigeration, Air Conditioning and Heat Pumps (AREA)

Limburg Catholic University College, Belgium

Informationszentrum für Kälte- Klima- und Energietechnik, Germany

With the co-operation of the International Institute of Refrigeration

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The 2 year work programme
started Oct 2013 - ending next Oct 2015

STEPS	
1 - Research to clarify training needs and opportunities	LSBU
2 - Review of existing resources	LSBU
3 - Developing training booklets, e-learning pages, library	KHLim
4 - Piloting, testing and translation	ATF
5 - Measuring impact, evaluating and adjusting	IKKE
6 - On going dissemination and stakeholder engagement	AREA / IOR
7 - Project Management	IOR
8 – Explore sustainability options post funding	PROZON
Launch of free resources and training schemes in English, Polish, German, Dutch and Italian	Spring 2015

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Conclusions - industry needs

- 104 responses from major stakeholders to define industry needs
- 63 individuals from 12 European countries took part in the pilot test

- Need for improved skills – especially for CO2 and HFO/low flammable refrigerants
- Retraining to address safety, reliability and leakage
- Assessed and certificated classroom based training, with supporting on line technical information

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REAL Alternatives blended learning resources:

- flexible learning programmes and schemes for use by individuals, companies or training providers.
- multi-lingual website
- e-learning & booklets study materials in Dutch, English, French, German, Italian, Polish
- searchable e-library (over 100 free documents) of resources users can add to and can also rate
- tracking spreadsheets, report formats and other tools
- standard on-line tests and controlled assessment papers in classroom with optional certification
- stakeholders contribute materials and resources
- opportunities for more translations, training programmes etc

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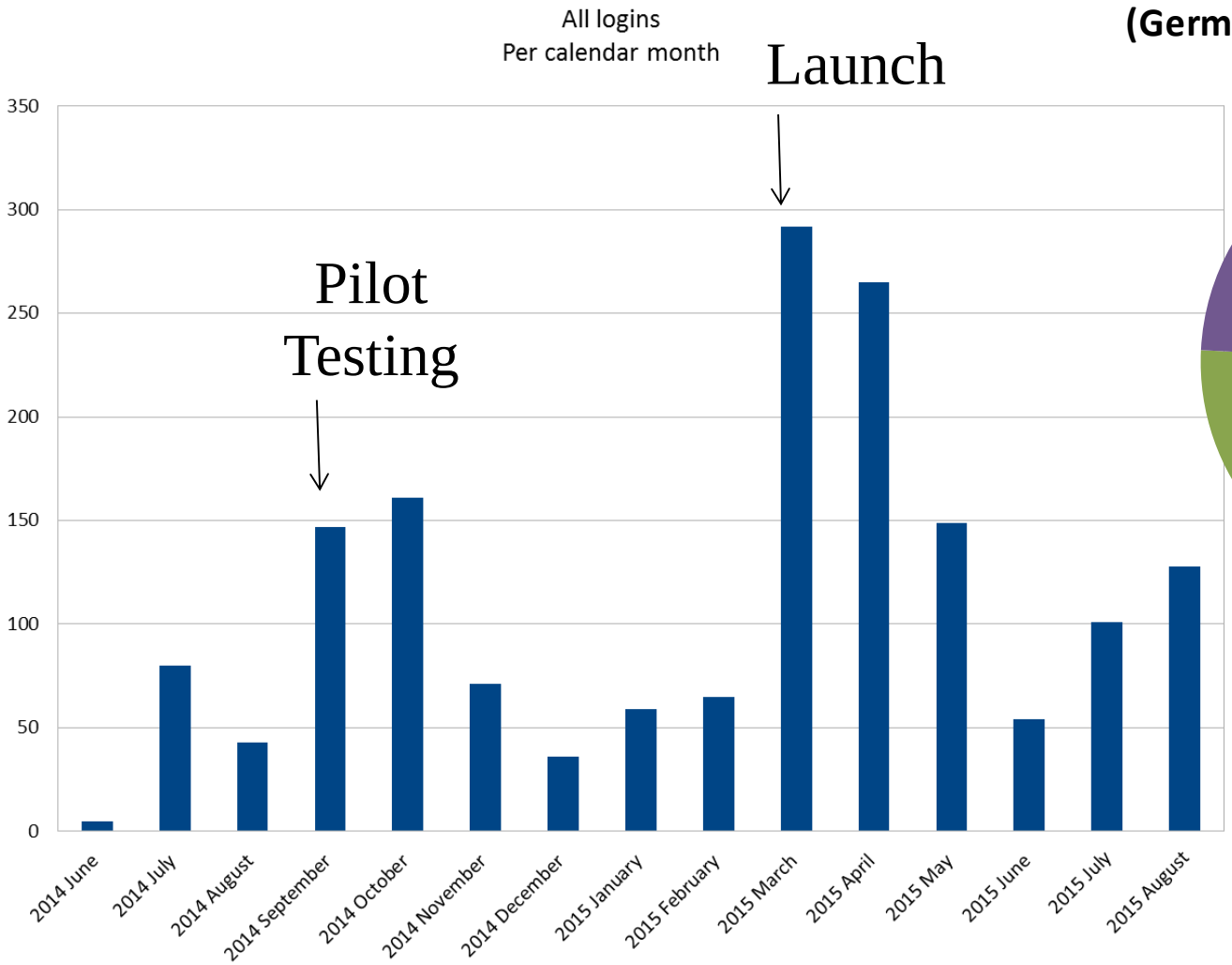
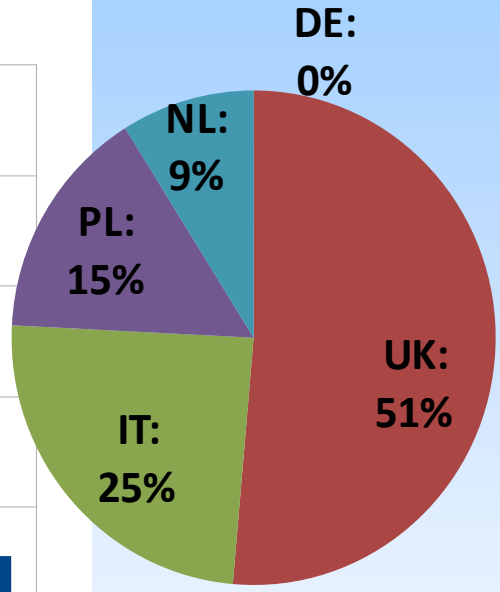
Numbers – Elearning Login



DIVIDED BY LANGUAGE

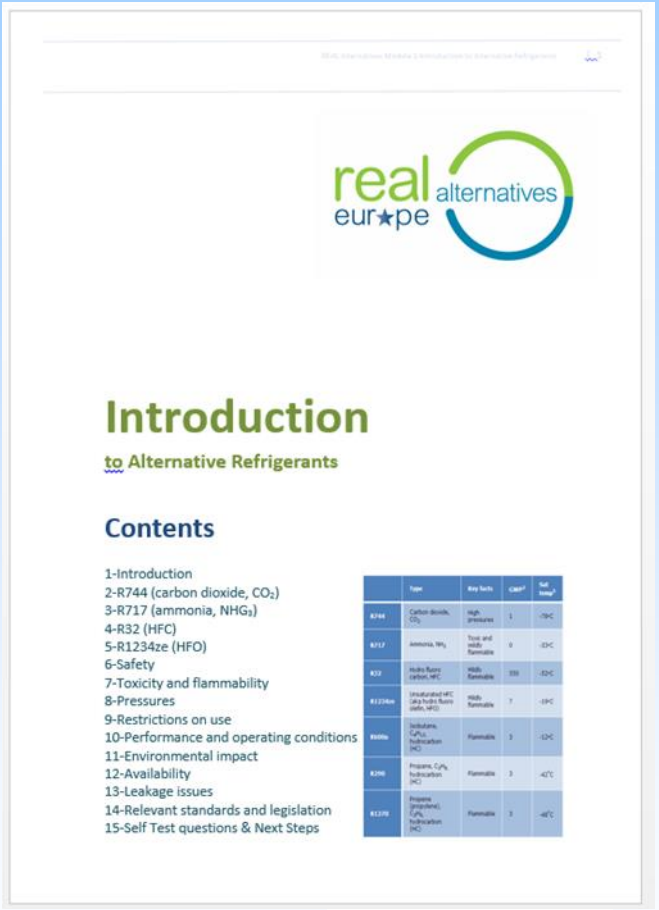
(German too early for consistent data



549 have registered to use the website and download library/download booklets

Learning materials in 8 modules

Real Alternatives Europe programme modules:
1. Introduction to Alternative Refrigerants - safety, efficiency, reliability and good practice
2. System design using alternative refrigerants
3. Containment and leak detection of alternative refrigerants
4. Maintenance and repair of alternative refrigerant systems
5. Retrofitting existing systems with low GWP alternatives
6. Checklist of legal obligations
7. Measuring the financial and environmental impact of leakage
8. Tools and guidance for conducting site surveys



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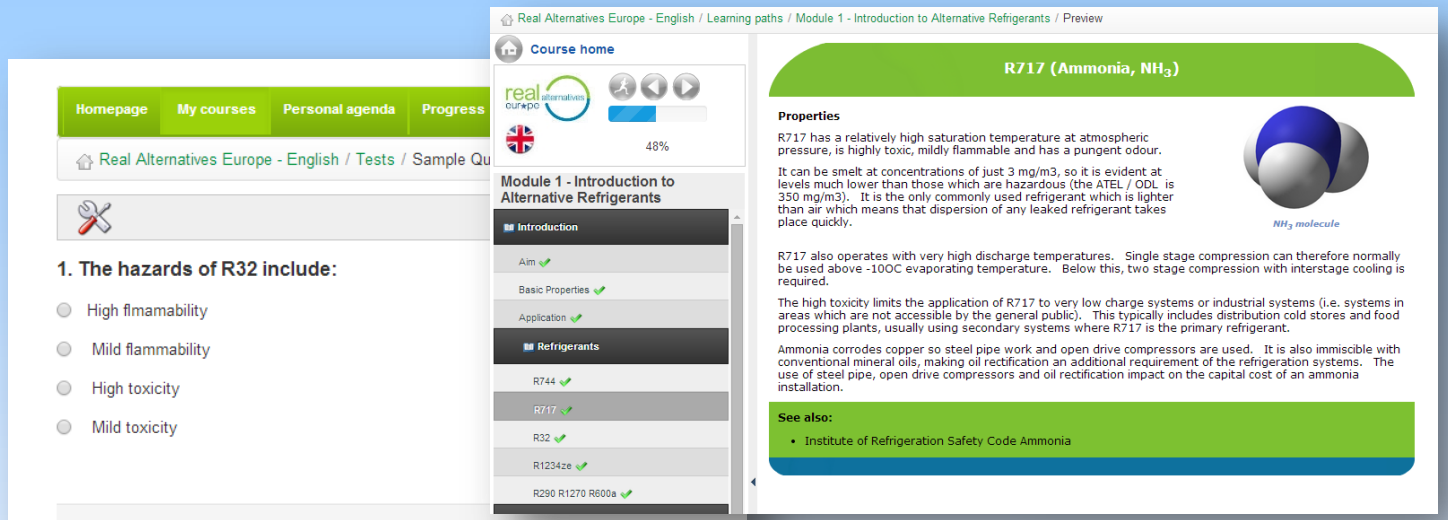
Multi language e-learning with free registration (English, French, German, Italian, Polish, Dutch)



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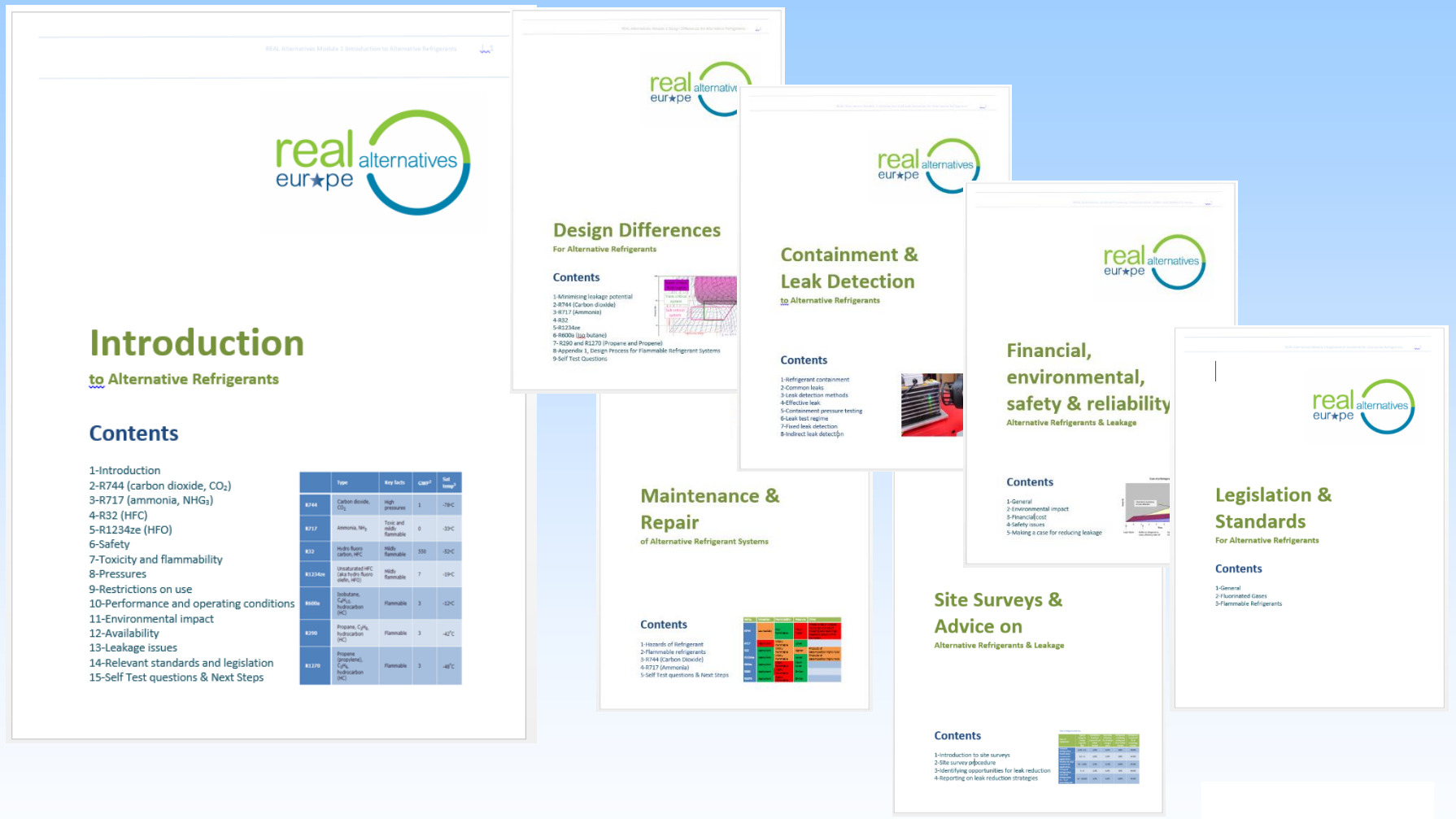
Each module offers downloadable Learning Booklets (PDF)



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Register at the project Website and searchable e-library

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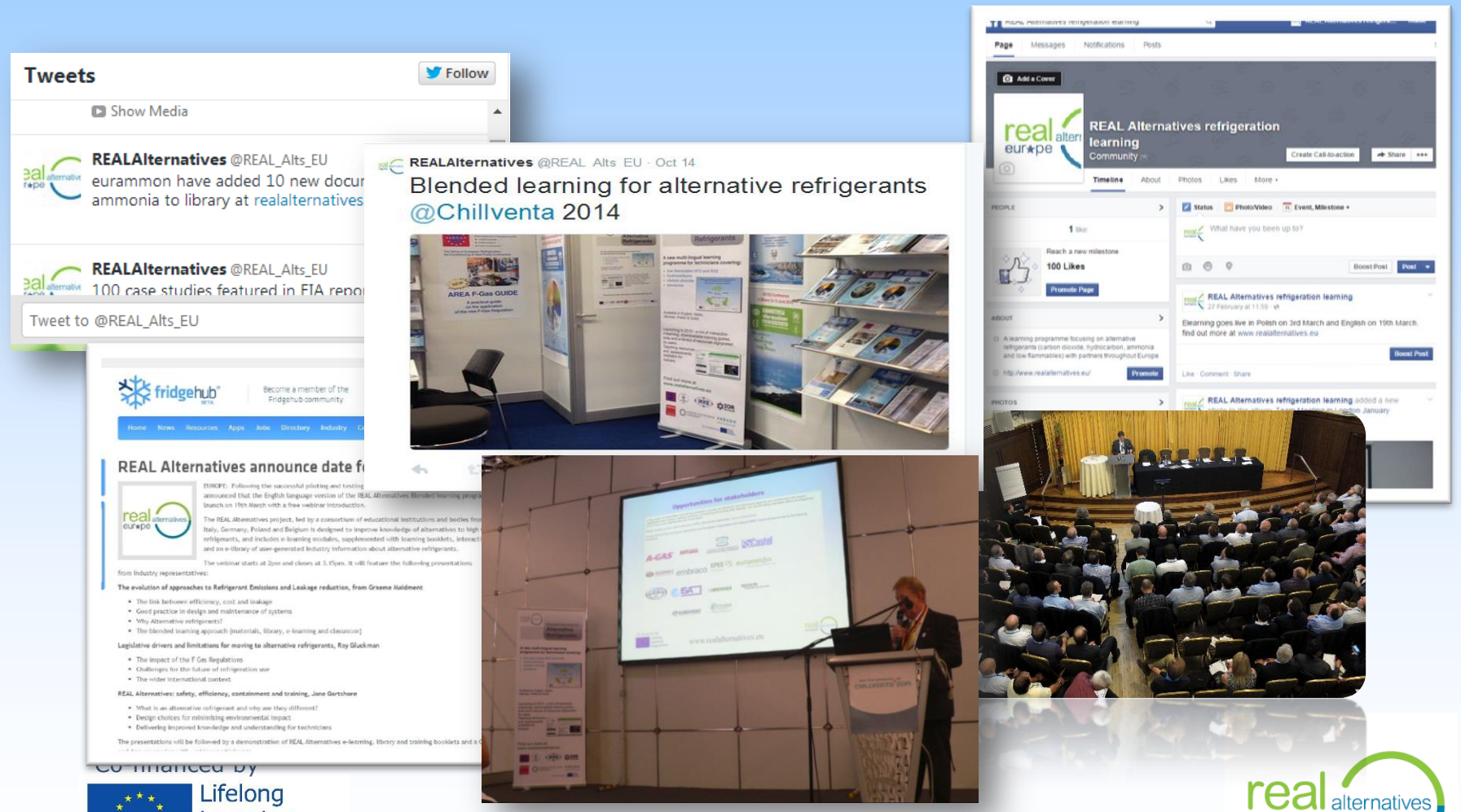
Promoting the use of Alternatives at international meetings and events



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Thanks also to our stakeholders, who helped during the project

we are proud to have among our stakeholders
European Commission DG Clima & UNEP OzonAction

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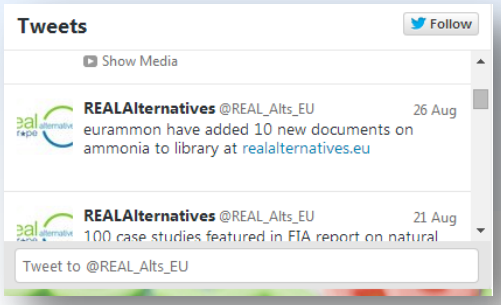
How you can get involved

- become a stakeholder
- add technical material to the e-library now
- **sign up technicians for the FREE e-learning courses launched in MARCH 2015**
- register to deliver classroom training courses using these materials as an employer or training provider
- register for updates at the website, follow us on twitter
- translate in other languages
- spread the word…



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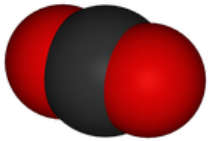
Module 1 - Introduction to Alternative Refrigerants

R744 (Carbon Dioxide, CO_2) WP = 1

Properties

R744 has high operating pressures, a low critical temperature (31°C) and a high triple point. Its volumetric cooling capacity is between 5 and 8 times that of HFCs, reducing the required compressor displacement and pipe size. Its properties have an effect on how the system is designed and operates, especially in high ambient temperatures. It has a high discharge temperature, necessitating two stage compression for low temperature systems. The document highlighted below has detailed information on how these properties effect the application of R744.



CO_2 molecule

Usage

R744 is used in the following system types:

- Pumped secondary – where R744 is the secondary fluid cooled by a primary system. R744 is a volatile secondary which, coupled with the high capacity and density, reduces the required pump power compared to other secondary fluids such as glycol.
- Cascade – where the heat rejected by the condensing R744 is absorbed by the evaporating refrigerant in a separate high stage system. In these systems the R744 operates below the critical point and the high side pressure is generally below 40 bar g. The high stage system can be R744 (see below), or it can be HFC, HC, HFO or R717.
- Transcritical systems – where the R744 heat is rejected to ambient air and at ambient temperatures above approximately 21°C the R744 will be above the critical point (31°C) – i.e. it will be transcritical. The R744 does not condense – it remains a super critical fluid until its pressure is reduced to below the critical pressure (72.8 bar g).The high side pressure is typically 90 bar g when transcritical.

Currently (2014) R744 has been used in several thousand retail systems and in industrial systems in Europe. It is starting to be used in heat pumps and in integral systems. Some examples of R744 are shown below:

The application of R744 has required additional skills for design engineers and service technicians, and availability of new components.

This video gives an introduction to carbon dioxide properties when used in refrigeration

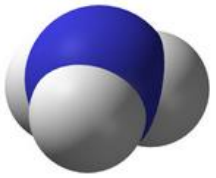
Module 1 - Introduction to Alternative Refrigerants

R717 (Ammonia, NH_3) GWP = 0

Properties

R717 has a relatively high saturation temperature at atmospheric pressure, is highly toxic, mildly flammable and has a pungent odour.

It can be smelt at concentrations of just 3mg/m^3 so it is evident at levels much lower than those which are hazardous (the ATEL / ODL is 350 mg/$m^{3)}$. It is the only commonly used refrigerant which is lighter than air which means that dispersion of any leaked refrigerant takes place quickly.



NH_3 molecule

R717 also operates with very high discharge temperatures. Single stage compression can therefore normally be used above -10°C evaporating temperature. Below this, two stage compression with interstage cooling is required.

The high toxicity limits the application of R717 to very low charge systems or industrial systems (i.e. systems in areas which are not accessible by the general public). This typically includes distribution cold stores and food processing plants, usually using secondary systems where R717 is the primary refrigerant.

Some examples of Ammonia packaged systems are shown below:

Ammonia corrodes copper so steel pipe work and open drive compressors are used. It is also immiscible with conventional mineral oils, making oil rectification an additional requirement of the refrigeration systems. The use of steel pipe, open drive compressors and oil rectification impact on the capital cost of an ammonia installation.

The video below shows an example of an adsorption ammonia system used in a building services application

Module 4 - Guidance on the Maintenance and Repair for Alternative Refrigerant Systems

The safe working environment and PPE

Flammable Refrigerants

This section covers the safe handling of:

- Hydrocarbons (R600a, R290, R1270);
- R32 (also refer to the section on F Gases);
- R1234ze (also refer to the section on F Gases);
- R717 (also refer to the section on R717).

The safe working environment and PPE

The safe working environment and PPE When you work with flammable refrigerants the area must:

- Be well ventilated
- Have no source of ignition within 3 m (a typical safe area when working on flammable refrigerant systems).

If necessary introduce forced ventilation using a suitable fan assembly. This has an Ex rated fan motor and a 5m cable which enables it to be switched on outside the safe work area.

Figure 1, suitable ventilation fan

When carrying out invasive work, or if a leak is suspected, check and monitor the work area using an HC detector.

It is important that the detector cannot be zeroed out to background flammable refrigerant levels and alarms at 20% of the lower flammability level.

The photo shows suitable detectors for HCs.

Figure 2, flammable gas detectors

You should also have a fire extinguisher to hand.

This should either be a dry power type with a capacity of at least 2 kg, or an equivalent sized CO_2 type.

Figure 3 (left), dry powder fire extinguisher
Figure 4 (right), CO_2 fire extinguisher

Real Alternatives to comply to 517/14 Article 10 Training and Certification

8. Member States shall ensure that all natural persons holding certificates under certification programmes provided for in paragraphs 1 and 7 have access to information regarding each of the following:

(a) technologies referred to point (e) of paragraph 3

9. Member States shall ensure the availability of training for natural persons who wish to update their knowledge in relation to the matters referred to in paragraph 3

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- ***Melting glaciers***
- ***Rising seas***
- ***Increasing temperatures***

For our environment, one of the solution is

→ Competence

THANK YOU!

Email: buoni@centrogalileo.it

Marco Buoni

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Secretary General Italian Association of Refrigeration Technician, ATF (www.associazioneATF.org)

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