Increase Competence in RAC
for energy saving, safety and the environment:
Real Alternatives

Marco Buoni,
Vice-President International Affairs
Air Conditioning Refrigeration European Association (AREA)

With contribution of the LIFE programme of the European Union

Our world needs refrigeration, air conditioning and heat pumps systems

Applications	Sectors	Equipment	Number of units in operation
Refrigeration and food (see § 2.1.)	Domestic refrigeration	Refrigerators and freezers	1.5 billion [1] [2]
	Commercial refrigeration	Commercial refrigeration equipment (including condensing units, stand-alone equipment and centralized systems)	90 million [1] [2]
	Refrigerated transport	Refrigerated vehicles (vans, trucks, semi-trailers or trailers)	4 million [3]
		Refrigerated containers (« reefers »)	1.2 million [2]
Air conditioning (see § 2.2.)	Air conditioners	Air-cooled systems	600 million [2] [4]
		Water chillers	2.8 million [2]
	Mobile air-conditioning systems	Air-conditioned vehicles (passenger cars, commercial vehicles and buses)	700 million [5]
Refrigeration and health (see § 2.3.)	Medicine	Magnetic Resonance Imaging (MRI) machines	25,000 [6]
Refrigeration in industry (see § 2.4.)	Liquefied Natural Gas (LNG)	LNG receiving terminals	110 [7]
		Liquefaction trains	92 [7]
		LNG tanker fleet (vessels)	421 [7]
Heat pumps (see § 2.5.)		Heat pumps (residential, commercial and industrial equipment, including reversible air-to-air air conditioners)	160 million [8] [9]
Leisure and sports (see § 2.6.)		Ice rinks	13,500 [10]

- Number of refrigeration systems in operation worldwide per application

Source: 29th Informatory Note on Refrigeration Technologies / November 2015 “The Role of Refrigeration in the Global Economy”, *International Institute of Refrigeration IIR*

Increase in use of Refrigeration, air conditionign and heat pumps systems. Two consequences:

- 1) Energy consumption in refrigeration equipment, including air conditioning equipment, must be reduced. Or using renewable energy: heat pumps, photovoltaic, solar and wind energy…
  - Latest estimation (*): 10% of total energy consumption - 17% of the worldwide electricity consumption (more in hot countries) ➔ lack of energy infrastructures and indirect global warming impact.

- 2) Most refrigeration, including air-conditioning, equipment, uses refrigerants.
  - CFCs and HCFCs destroy the stratospheric ozone layer. Most of them (CFCs, HCFCs, HFCs) are potent greenhouse gases. HCFCs will be phased out.
  - HFCs will be phased down: an international agreement took place in Kigali (Rwanda).

➢ Consequences will be very important for the whole world.

(*) 29th Informatory Note, IIR

RAC contributes 10% of all worldwide GHG emissions. 8% through electricity use and 2% through leakage

With contribution of the LIFE programme of the European Union

Financial, energetic, environmental, safety & reliability: Alternative Refrigerants & Leakage

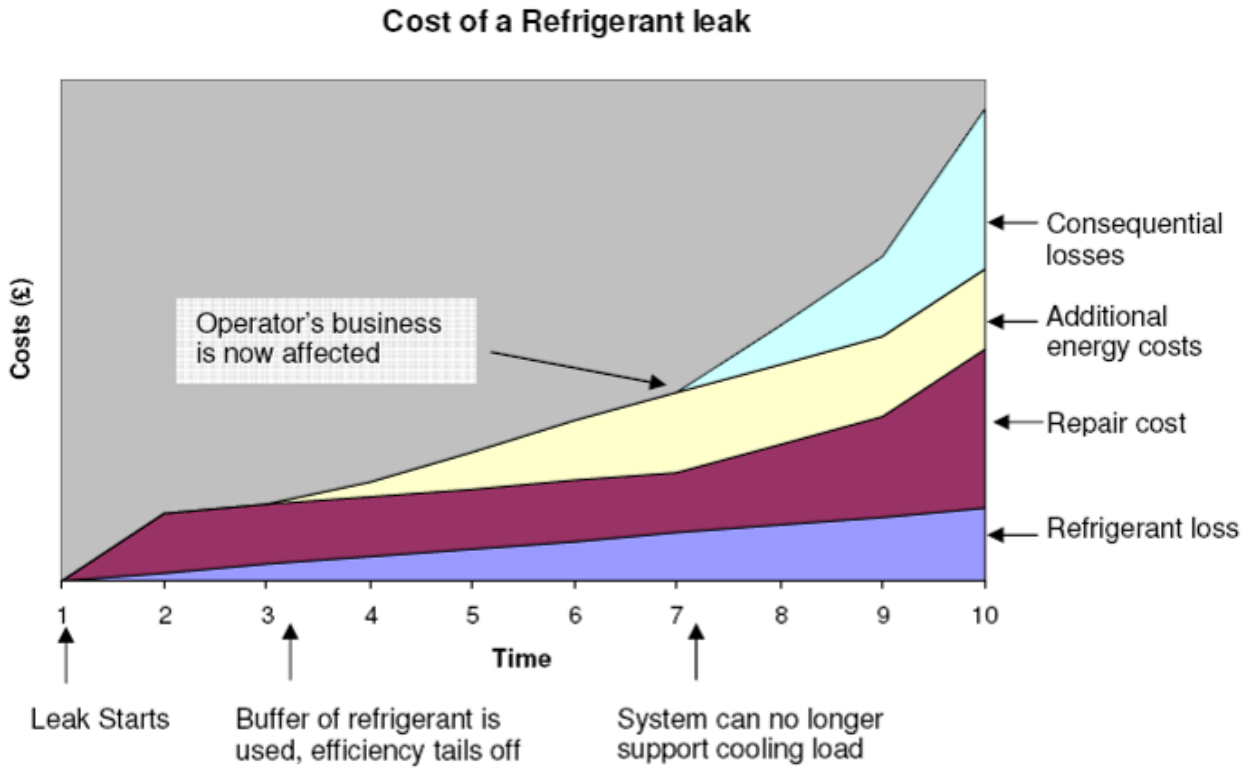
Table: Range of values for charge and emission factors for RACHP systems

Type of Equipment	Typical Range in Charge Capacity (kg)	Installation Emission Factor (% of initial charge)	Operating Emissions (% of initial charge/ year)
Domestic Refrigeration	0.05 - 0.5	0.2 - 1.0	0.1 - 0.5
Stand-alone Commercial Applications	0.2 - 6	0. 5 - 3	1 - 15
Medium & Large Commercial Applications	50 - 2,000	0.5 - 3	10 - 35
Transport Refrigeration	3 - 8	0.2 - 1	15 - 50
Industrial Refrigeration (inc. food processing and cold storage)	10 - 10,000	0.5 - 3	7 - 25
Chillers	10 - 2,000	0.2 - 1	2 - 15
Residential and Commercial A/C including Heat Pumps	0.5 - 100	0.2 - 1	1 - 10
Mobile Air Conditioning	0.5 - 1.5	0.2 - 0.5	10 - 20

Source: IPCC (2006), Guidelines for National Greenhouse Gas Inventories

With contribution of the LIFE programme of the European Union

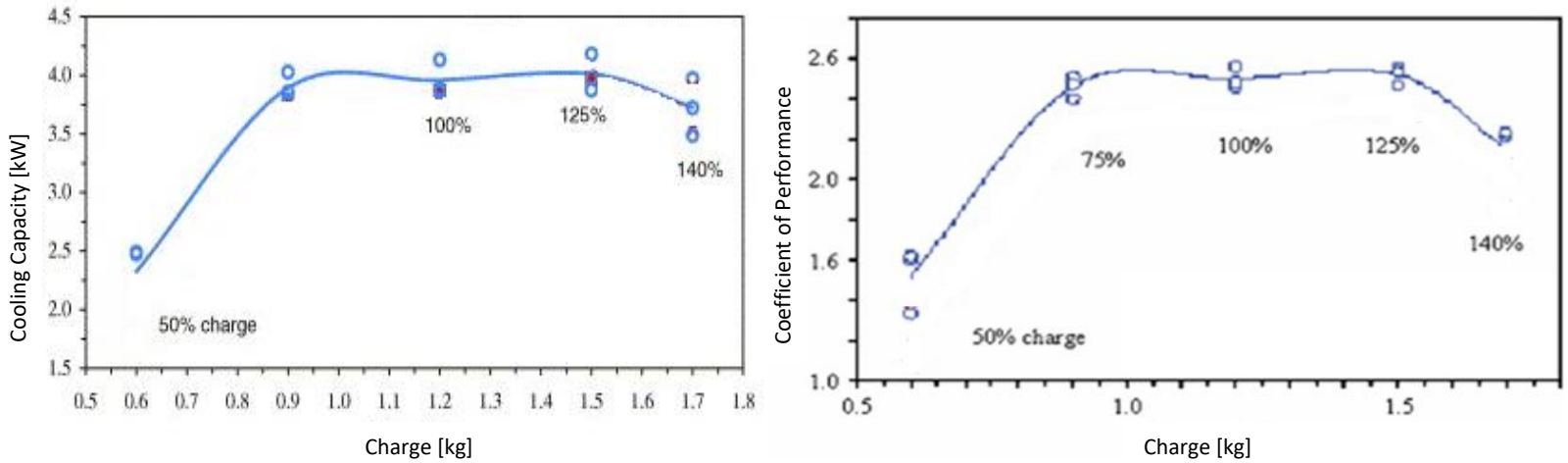
Financial and Energetic cost



Source: After ETSU (1997), Cutting the cost of refrigerant leakage, Good Practice Guide 178, Energy Technology Support Unit, Didcot, UK

With contribution of the LIFE programme of the European Union

Research on one system type to determine the effect of leakage on one system



Source: Grace, I.N., Datta, D. and Tassou, S.A. (2005), Sensitivity of refrigeration system performance to charge levels and parameters for on-line leak detection. Applied Thermal Engineering, 25 (2005),

With contribution of the LIFE programme of the European Union

Reduction of leakage due to increase in competence and EU Fgas regulation – one example

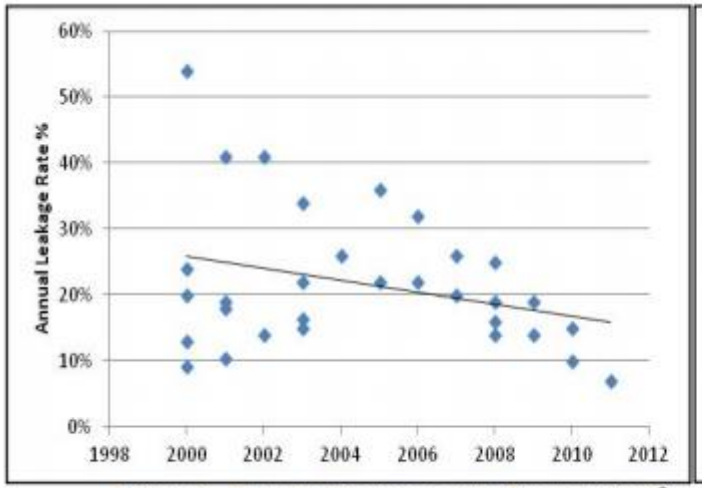


Figure 1. Reported leakage rates from studies[2]

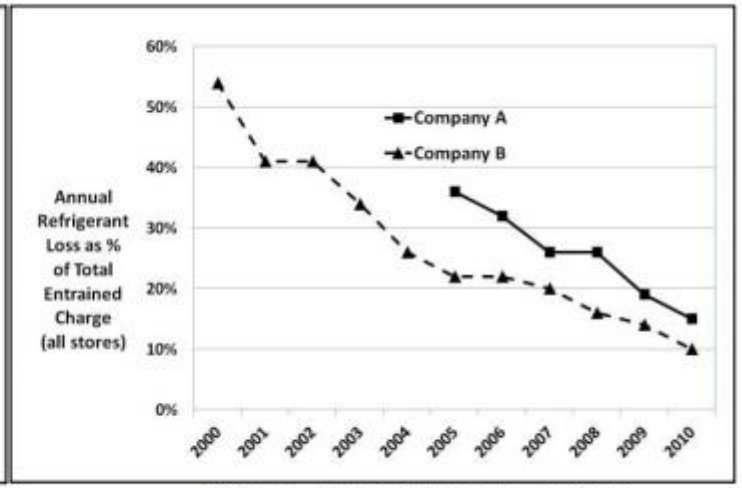


Figure 2. Leakage rates reported by two end users (supermarkets)[3]

Source fig.1: Updated from Cowan D, Gartshore J, Chaer I, Francis C, Maidment G. (2010), REAL Zero – reducing refrigerant emissions & leakage - feedback from the IOR project, Proceedings of the Institute of Refrigeration, Proc. Inst. R. 2009-10. 7-1
Source fig.2: Cowan D, Beermann K, Chaer I, Gontarz G, Kaar K, Koronaki I, Maidment G, Reulens W. (2011), Improving F-Gas containment in the EU – results from the REAL SKILLS EUROPE project.

With contribution of the LIFE programme of the European Union

Making a case for reducing leakage and change refrigerants

- Reducing leakage makes business, financial and environmental sense. The benefits to business include:
  - Compliance with legislation including the F Gas regulation;
  - Improved “green” credentials;
  - Reduced production down time / increased sales fixture availability / improved staff comfort as a result of improved reliability;
  - Less health and safety risk from refrigeration or air conditioning – directly from refrigerant emissions and, for food applications, indirectly as a result of improved reliability.
- In addition there are financial benefits:
  - Less refrigerant cost;
  - Less service cost;
  - Lower costs associated with plant down time;
  - No loss of energy efficiency associated with reduced refrigerant charge. These costs may need to be offset against increased maintenance or some additional capital expenditure, but usually the difference is positive.
- The environmental benefits are in parallel with the benefits identified above and include:
  - More efficient operation of RAC systems and hence lower emissions of CO2 at the power station;
  - Lower emissions of greenhouse gases.

With contribution of the LIFE programme of the European Union

To increase energy efficiency and safety → Training and certification

The Refrigeration, Air Conditioning and Heat Pumps systems containing fluorinated refrigerants in EU should have:

- Logbook
- Periodical inspections
- Installation, repair only by certified craftsmen
- Right equipment (also suitable for alternative refrigerants)

Mandatory Certification to handle all refrigerants

With contribution of the LIFE programme of the European Union

The right equipment and tools

Equipment and tools of the certified personnel to be supplied by his employer			RC
	Manifold		x
	Vacuum Gauge or Vacuum Meter		x
	Temperature meter		x
	Portable leak detector		x
	Refrigerant weight Scale		x
	Vacuum pump		x
	Recovery set		x
	Nitrogen pressure regulator		x
	Recycling cylinder		x

Figure 4 Recovery cylinder, how to label it

Figure 5 Vacuum pump

Figure 8 Scale

Figure 9 Vacuum Gauge

Figure 7 Leak detector

Figure 6 Refrigerant recovery machine

Figure 10 Pressure Manifold

Figure 11 Temperature Meter

With contribution of the LIFE programme of the European Union

Training and certification worldwide

- Together with the UN implementing agencies UNEP, UNIDO, UNDP over the past few years AREA has been deeply involved in helping developing countries through **training RSS technicians** to install, repair, maintain and design RAC systems and **numerous Certification Sessions in Africa and Asia.**
- **Pics from top: Rwanda, Former Soviet Union Rep, Benin, Gambia, China and also, Ghana, Tunisia, Eritrea, Montenegro, Saudi Arabia, Turkey… etc…).**

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

Table 2: Analysis of training in climate-friendly alternative refrigerants to fluorinated greenhouse gases

	Ammonia	CO_2	Hydrocarbons: small hermetic systems	Hydrocarbons: larger systems (split systems, chillers)	HFOs
Training available in country (% of Member States)	71%	52%	48%	35%	20%
Proportion of certified fluorinated gas personnel trained in alternative refrigerants	2.3%	2.2%	0.7%	0.05%	0%

In EU:
Report of EU commission presented at Consultation Forum 1st December

Kigali Amendment includes 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.

! Fgas Certified Technicians in EU: nearly 500.000 !

With contribution of the LIFE programme of the European Union

FREE Blended learning for alternative refrigerants in new equipment

safety, efficiency, reliability and containment

REAL

Alternatives

www.realalternatives.eu

We are proud to have among our stakeholders **the European Commission DG Clima & UNEP Ozone Action**

With contribution of the LIFE programme of the European Union

REAL Alternatives blended learning resources:

Already available @ www.realalternatives.eu

- flexible learning programmes for use by individuals, companies or training providers.
- multi-lingual website
- interactive e-learning in eight languages English, French, Spanish, German, Italian, Polish, Finnish and Dutch (*more countries interested to translate it*)
- searchable e-library with over free 100 downloads you can add to
- tracking spreadsheets, report formats and other tools
- standard on-line tests and controlled assessment papers with optional certification
- opportunities for stakeholders to contribute and update the materials and resources
- downloadable guides and training booklets

With contribution of the LIFE programme of the European Union

Free – E-learning usable from Smartphone, Tablet, Desktop etc…

Real Alternatives for LIFE (next phase 2)

Refrigerant Emissions, Alternatives and Leakage – blended learning for low GWP refrigerants

Objectives

1. Increase knowledge amongst technicians in partner and stakeholder countries.
2. Address inconsistencies in skills across the whole of the EU and worldwide
3. Overcome equipment operator and distributor concerns over safety, reliability, containment, efficiency and standards restrictions
4. Support implementation of F Gas Regs, Kigali amnd and transition to low GWP alternatives

With contribution of the LIFE programme of the European Union

Key Project information

- Project co-ordinator - IOR (UK)
- Management Team – includes original REAL Alternatives project (2016)
- Stakeholders group of seven new organisations
- At the end of the project will be translated in 13 languages
- 9 Modules (8 existing ones revised plus 1 new)
- Train the Trainer resources, Licences and Certification
- Study visits (4 in training centres eg Belgium, Germany, UK, Poland, Italy)
- Train the Trainer events (5 in stakeholder locations – 20 people at each)
- Project presence at conferences, trade shows and exhibition, international governmental meetings, policy makers
- Generating regular articles/newsletters/social media
- Together we have the potential to reach 228,0000 employers, 26,000 RACHP installation businesses and 100 suppliers across Europe and internationally

With contribution of the LIFE programme of the European Union

Project Management team

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 Het Pumps (AREA)

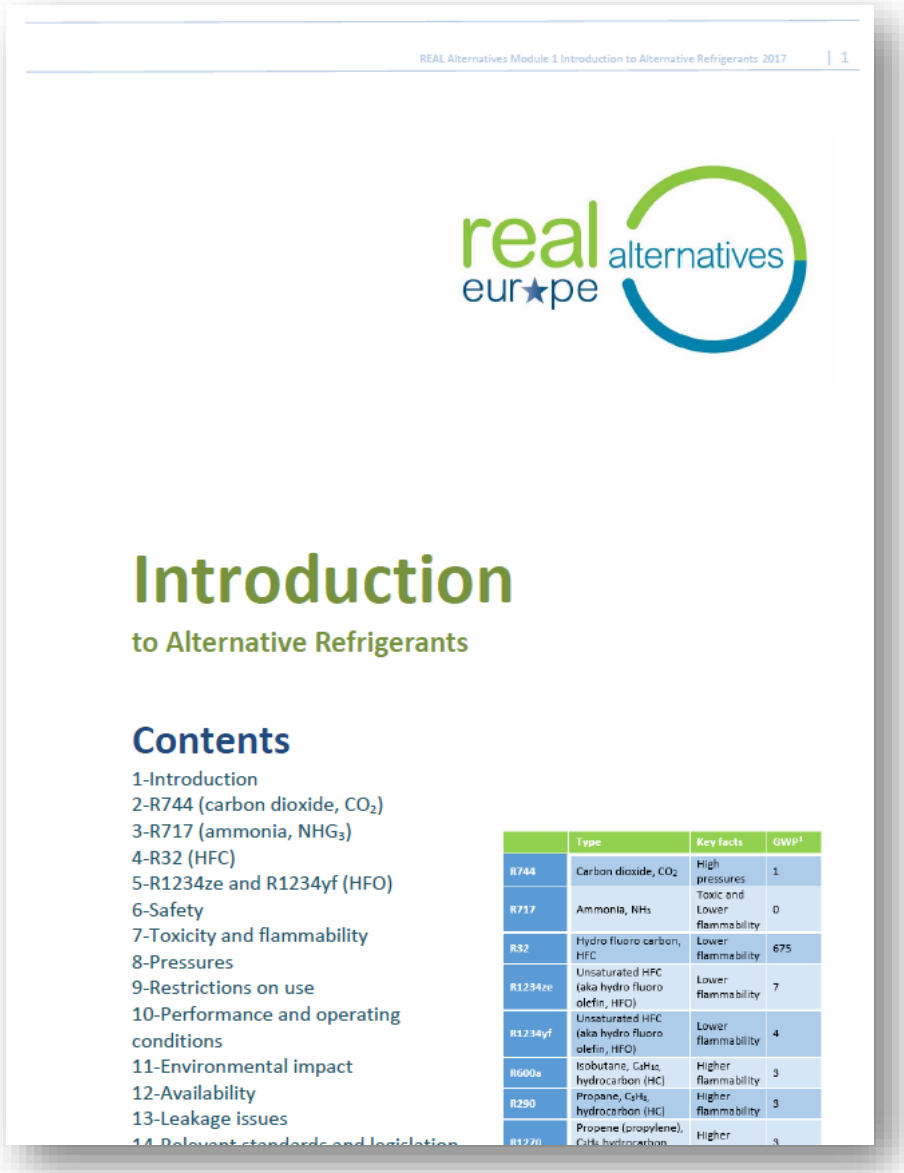
Limburg Catholic University College, Belgium

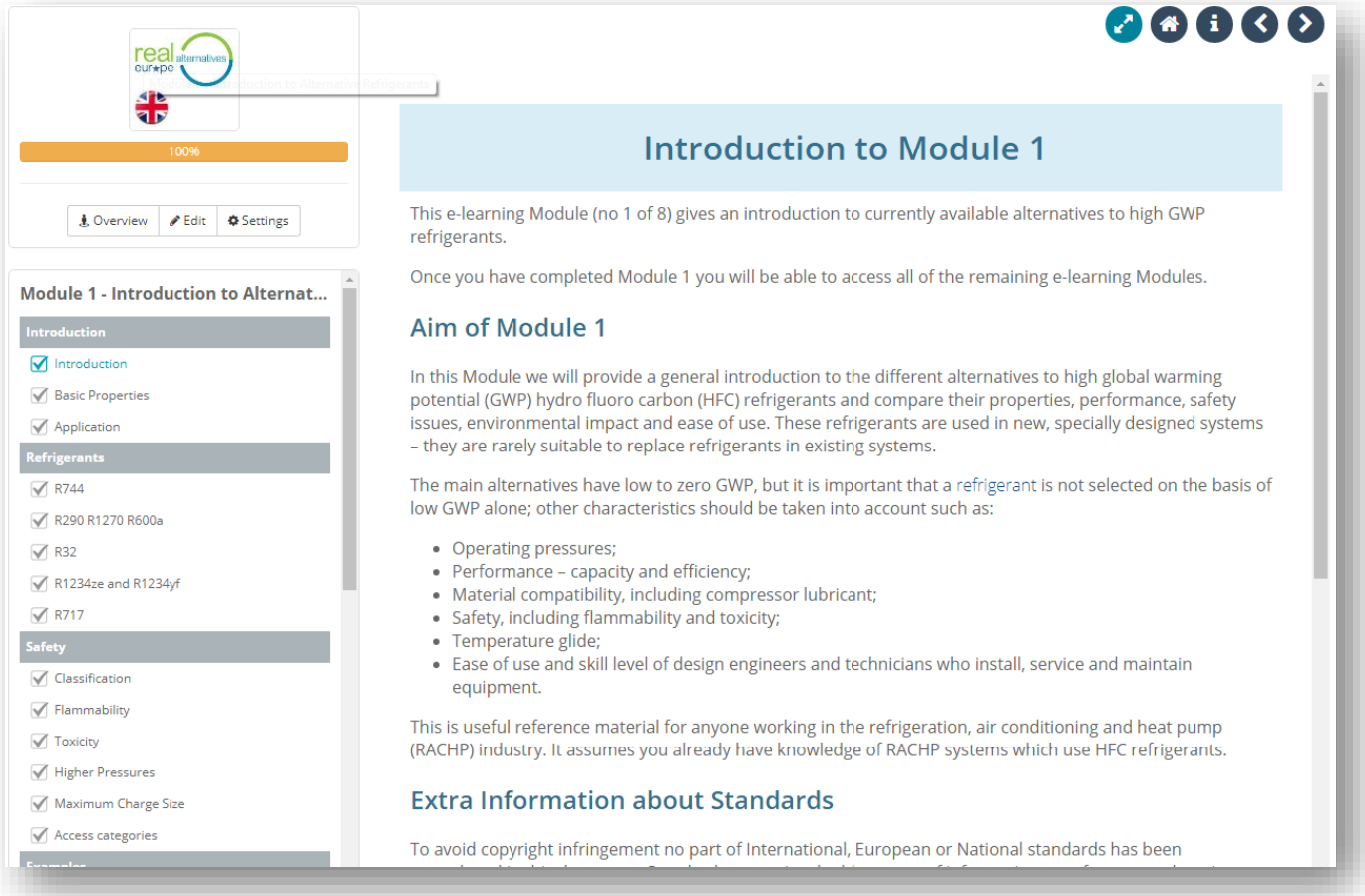
Informationszentrum für Kälte- Klima- und Energietechnik, Germany

With the co-operation of the International Institute of Refrigeration

With contribution of the LIFE programme of the European Union

Elearning and booklets – being updated and extended





With contribution of the LIFE programme of the European Union

Project website (multilingual)

www.realalternatives.eu

www.realalternatives.eu

With contribution of the LIFE programme of the European Union

LET'S MOVE TO ALTERNATIVE REFRIGERANTS TOGETHER!

	Option 1 Global Partner	Option 2 National Lead Partner	Option 3 Training Partner	Option 4 Assessing Partner	Option 5 Sponsor Partner	Option 6 Free User
WHO	Institutions, Associations, Government representatives	Training Centres, Associations, Certifying Bodies, Institutions	Companies, Training Centres, Associations, Institutions	Training Centres, Associations, Certifying Bodies, Institutions	Businesses in the HVAC/R&HP sector	Training Centres, Associations, Certifying Bodies, Institutions, Companies
WHAT	Translate the training into national language* and be official representative for your Country	Be the official REAL Alternatives© representative for your Country	Licence trainers to deliver theoretical & practical training in your Country	Can carry out Assessments and issue Certificates to technicians***	Have your Company's logo displayed on websites and newsletters	Disseminate Real Alternatives© free online material and e-learning platform within your network
WHY	Spread knowledge globally, improve consistency of training standards and support training in your Country	Become REAL Alternatives reference point for your Country**, help to implement national legislation, standards, etc.	To ensure consistent standard of technician training using REAL Alternatives© programme materials	Use ready-made REAL Alternatives© assessment and certification standards	Connect with thousands of businesses worldwide and show your active participation	Share the innovative and free online platform of Real Alternatives© to enrich the culture and knowledge on new alternatives
HOW LONG	unlimited	unlimited	3 years	3 years	3 year	unlimited

*Already available languages: English, Italian, French, German, Polish, Spanish, Finnish, Dutch; under development languages: Russian, Portuguese, Czech, Slovakian, Romanian, Croatian, Turkish

**Possible only when training material is already available in the official language of your Country

*** Certificate fee: 30€

With contribution of the LIFE programme of the European Union

CONCLUSIONS:
Promote the certification of RAC Service Technicians

For the success of training and certification some important recommendations should be considered:

- Certification should be made compulsory by law for every technician who is handling refrigerants
- Certification should be necessary to buy refrigerants and the equipment (if not hermetically sealed)
- Certification should be properly and publicly advertised at all levels (end-users, service companies, manufacturers, government institutions) as an added value to guarantee professionalism through seminars. Information should be made available to the technicians and the end users

Possible barriers before and after the certification should be considered, such as:

- technicians may see Certification as an added cost, a tax to enter the sector
- the process may be very bureaucratic , it must be made simple

With contribution of the LIFE programme of the European Union

Email: buoni@centrogalileo.it

Marco Buoni

VicePresident, AREA

Air Conditioning & Refrigeration European contractors' Association

(www.area-eur.be)

Secretary General Italian Association of Refrigeration Technician, ATF

(www.associazioneATF.org)

With contribution of the LIFE programme of the European Union