

Training in installing and maintaining systems keeping the high designed efficiency

Marco Buoni, President AREA

Eurammom Symposium, 16th June 2021



About AREA

Established in 1989

25 national associations

21 countries

13,000 companies

110,000 people

€23bn annual turnover



AREA Members



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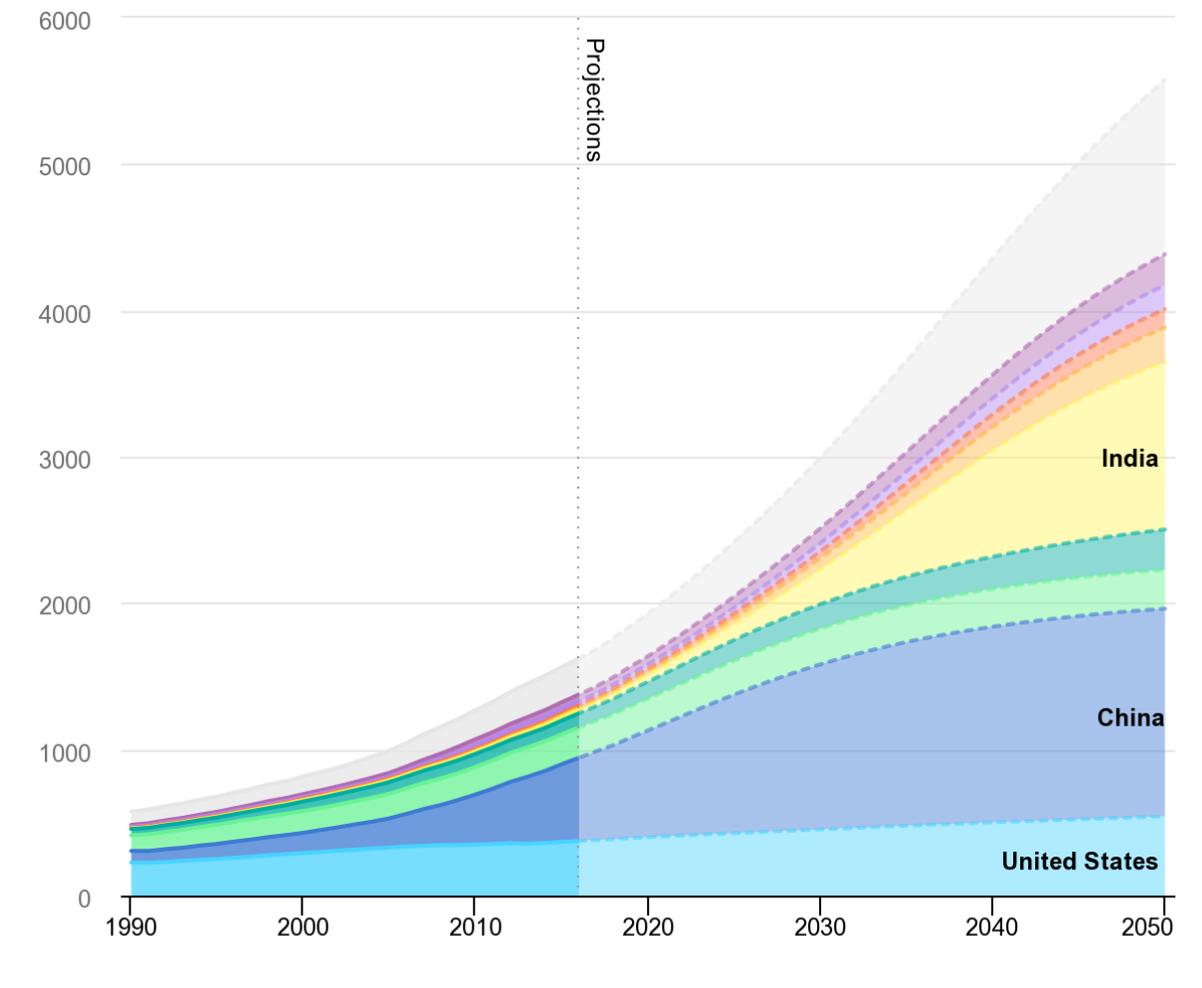
Agenda

1. Renewable Energy and Cooling/Heating to net zero buildings
2. Refrigerant leakage and its impact on energy efficiency
3. Importance of maintenance
4. Changing refrigerants
5. Training and certification

Renewable Energy and Cooling/Heating to net zero buildings

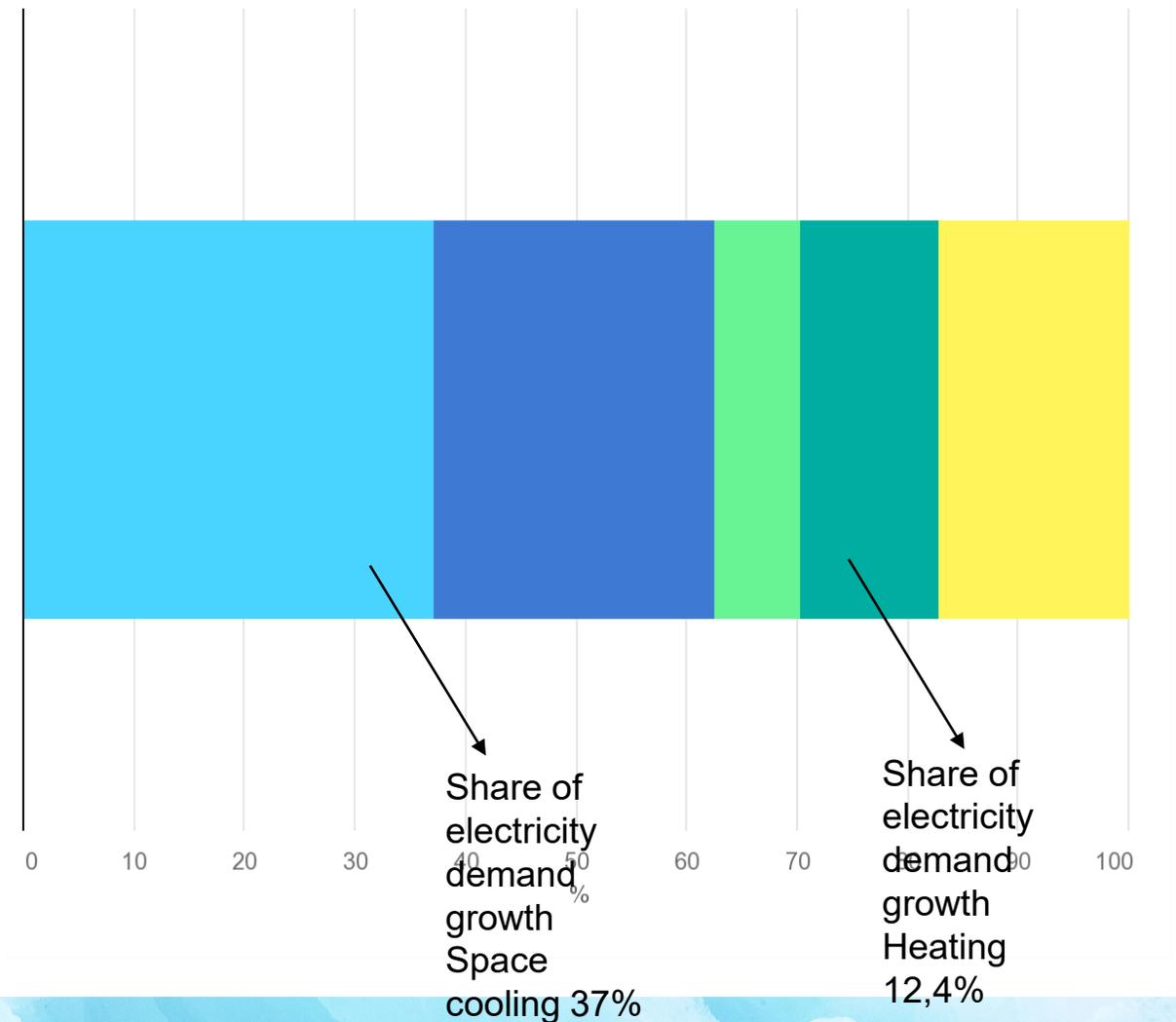
Opportunities for energy-efficient air conditioning

- By 2050, around 2/3 of the world's households could have an air conditioner. China, India and Indonesia will together account for half of the total number.
- IEA, Global air conditioner stock, 1990-2050, IEA, Paris <https://www.iea.org/data-and-statistics/charts/global-air-conditioner-stock-1990-2050>



Cooling is the fastest growing use of energy in buildings

- Without action to address energy efficiency, energy demand for space cooling will more than triple by 2050 – consuming as much electricity as all of China and India today.
- IEA, Share of global electricity demand growth to 2050, IEA, Paris <https://www.iea.org/data-and-statistics/charts/share-of-global-electricity-demand-growth-to-2050>
- The problem is, today's consumers are not buying the most efficient ACs
- The average efficiency of air conditioners sold today is less than half of what is typically available on the shelves – and one third of best available technology.



The world faces a 'cold crunch'

- Our sector has been increasingly important globally in the last decade
 - Wealthier countries (China, India, South-East, Middle East, Africa, South America...) and emerging middle class in developing countries
 - Environmental and energy issues
 - Cold chain in Africa (and other developing countries...)
 - Heat Pumps
 - Global warming is getting cool appliances more needed (paradox)
- and even more this year
 - Cold chain for the supply of food during the pandemic and the lockdown
 - Air ventilation, air recirculation, fresh air and heat recovery
 - Cold chain for the supply of the vaccines (Ultra Low temperatures freezers and dry ice)

Refrigerant leakage and its impact on energy efficiency

Making a case for reducing leakage

- 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 Alternative refrigerants, which are mainly flammables, leakage are potentially dangerous and a source of fire ignition and propagation**

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

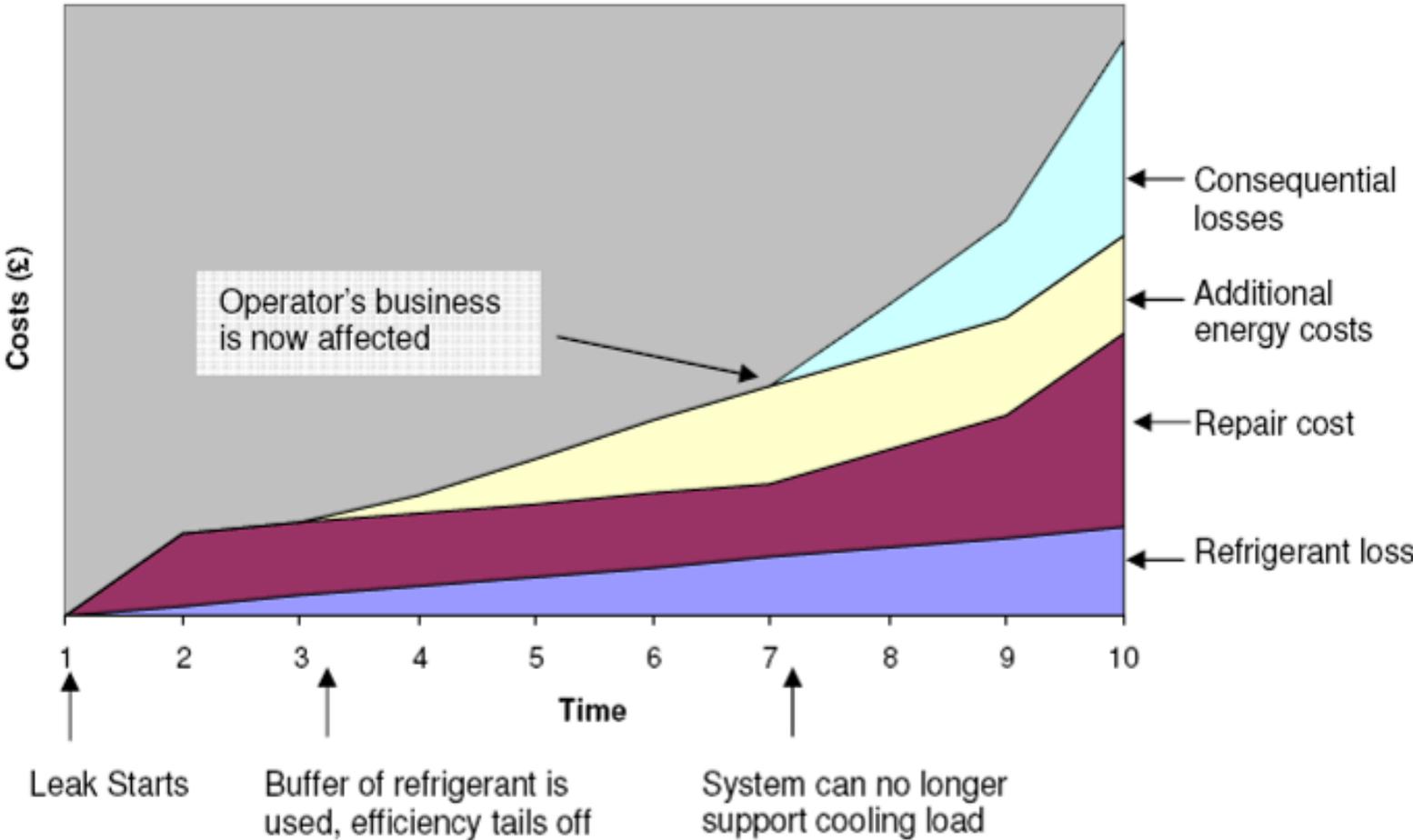
Table: Range of values for charge and emission factors for RACHP systems¹

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

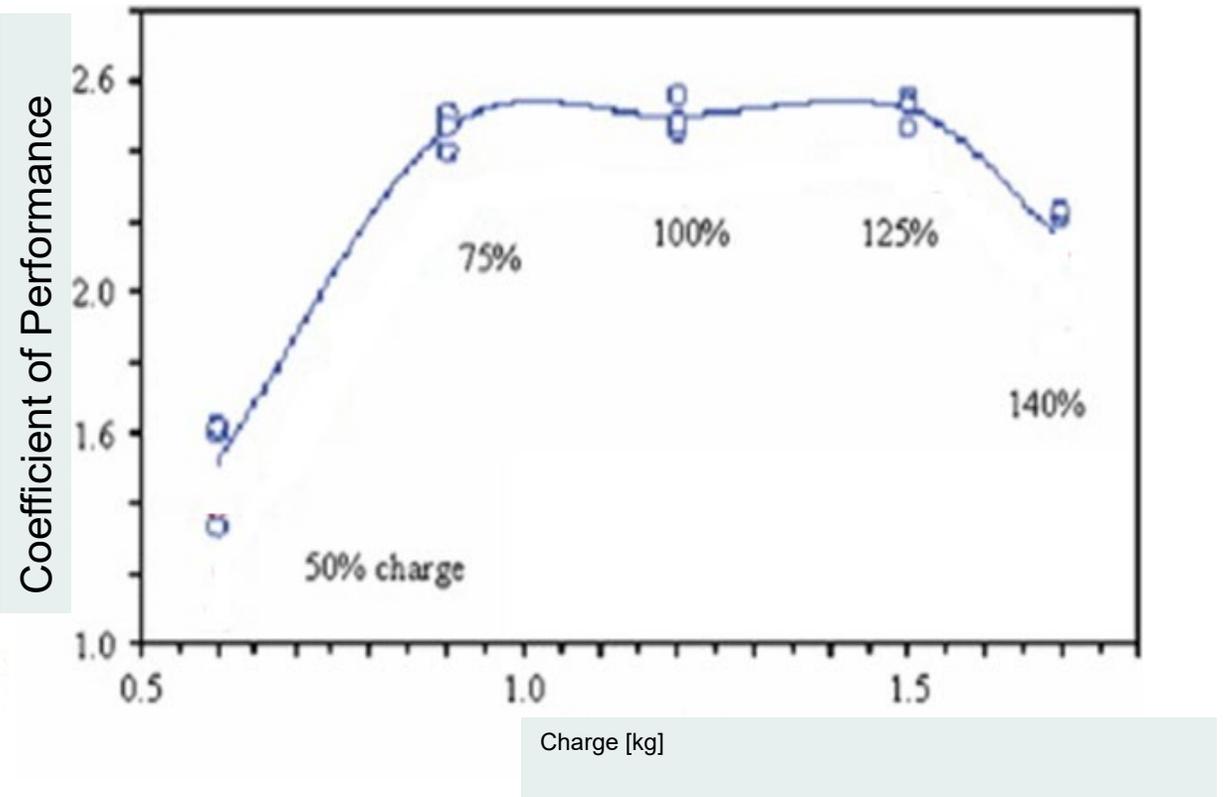
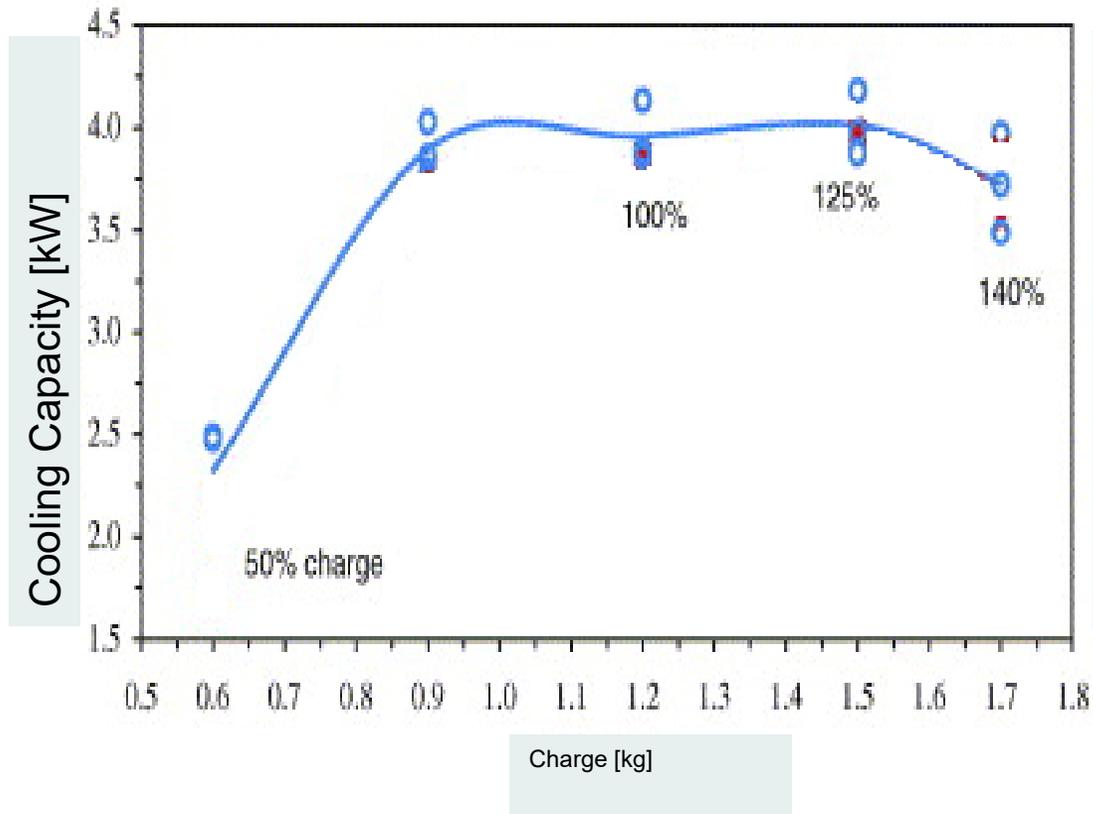
Financial and Energetic cost

Cost of a Refrigerant leak



Source: IIR informative notes

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),

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

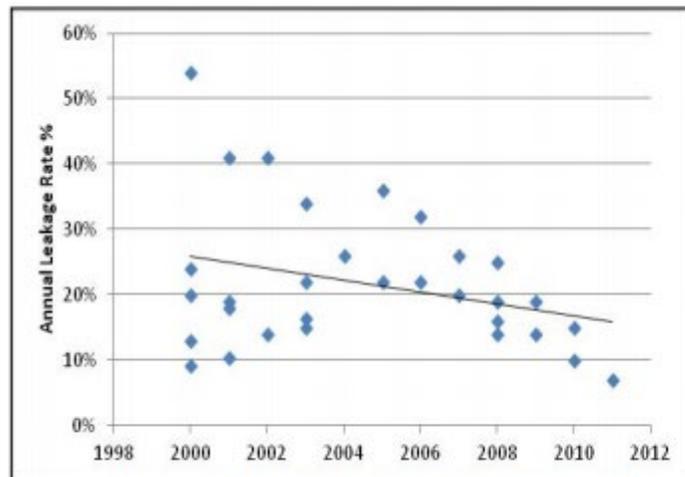


Figure 1. Reported leakage rates from studies²

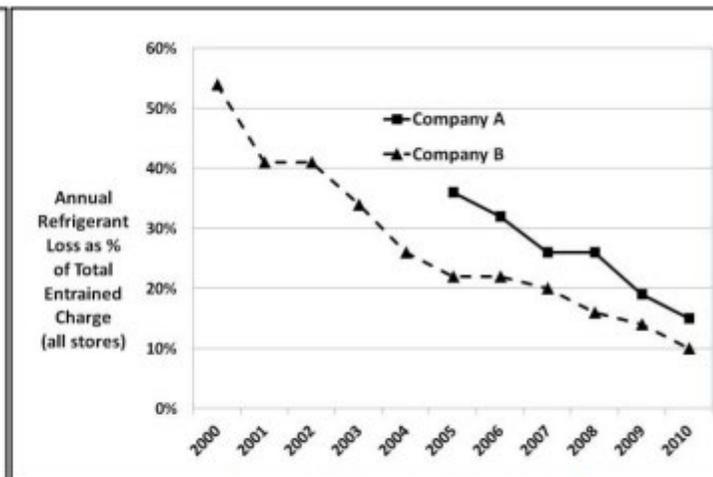


Figure 2. Leakage rates reported by two end users (supermarkets)³

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.

Importance of regular maintenance of buildings

(credit IRI Ireland)

- **Benefits of Deep Cleaning and Maintenance**

- Improved IAQ. A/C units act as filters of dust, filters must be cleaned.
- Minimized odors and micro-organisms. By cleaning an A/C unit, we kill odor causing bacteria and prevent growth of micro-organisms.
- Lower energy use. HVAC uses significant % of energy. Cleaning and maintenance of indoor and outdoor HVAC equipment greatly reduces the amount of energy consumed. 3% per every °C of increasing of condensing temperature.
- Longer equipment life expectancy.

- **Health and IAQ**

- Low IAQ can lead to negative health effects: Short term and long term.
- Studies show People perform better in better work environments.

Changing refrigerants: Fgas reduction, moving to alternatives

- Fgas regulation (and revision)
 - Phase down
 - Bans
- Incentives
- National legislation
- Future proof (Natural Refrigerants)

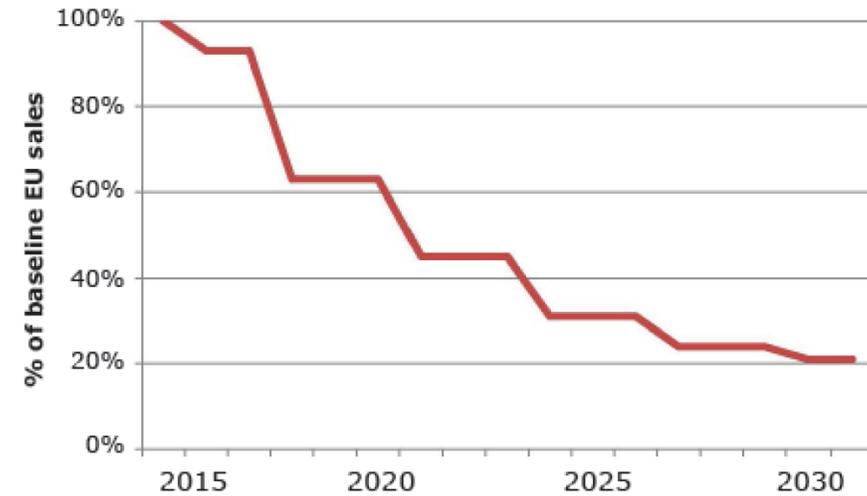


Table 8: Phase down steps until 2030

2009-12	2015	2016-17	2018-20	2021-23	2024-26	2027-29	2030
Baseline (100 %)	100 %	93 %	63 %	45 %	31 %	24 %	21 %

Training and certification

AREA's proposed extension of the F-gas certification scheme to alternative



The Voice of European Air-Conditioning, Refrigeration and Heat Pumps Contractors

Proposal for the extension of the F-Gas training and certification scheme to alternative refrigerant greenhouse gases

March 2021

Introduction

As the European association of refrigeration, air conditioning and heat pump (RACHP) contractors, AREA is pleased with this opportunity to present its views on the current review of Regulation (EU) No 517/2014 (F-gas Regulation). AREA supports the ambitions and goals of the Regulation in view of the high Global Warming Potential (GWP) of many fluorinated greenhouse gases and their effects on global warming.

The contractors whom, through their membership of AREA's constituent associations, we represent, provide services which are absolutely indispensable in many industries. AREA is fully aware of its responsibility to provide information, based on many decades of combined experience, which contributes to both sensible European policies focusing on combating climate change, as well as to the assurance of continued safe and effective work by our respective members, thereby ensuring the continuity of RACHP services.

In this light, we raise the issue of the importance of proper training and certification regarding the use of alternative low GWP refrigerants. As a result of the phase-down, the availability of F-gases will continue to wane, while the demand for refrigeration and related services will remain strong. Consequently, the use of alternative refrigerants will continue to grow, compensating for a decrease in availability of F-gases on the market. Natural refrigerants, such as carbon dioxide, certain hydrocarbons and ammonia, as well as others such as HFOs, have the characteristics required to efficiently transport heat energy. Although alternative refrigerants do not contribute significantly to climate change, there are other issues which present safety-related challenges.

Different alternative refrigerants pose different challenges. Some are highly flammable, others are toxic when inhaled or exposed to skin, or are employed in systems which operate at high pressures. These characteristics are mostly absent in HFCs, which, considering their current prevalence, means that many contractors are less familiar with them. This unfamiliarity, combined with growing use, leads to an increasing level of risk.

The successful achievement of the F-gas Regulation's objectives greatly depends on a large uptake of alternative low GWP refrigerants. Such an uptake relies itself on sufficient knowledge and competence from the RACHP contracting sector on these alternative low GWP refrigerants. Currently, the proportion of F-Gas certified personnel trained on alternative refrigerants ranges from 3.5% to 7% depending on the type of alternative refrigerant¹. This is far below market potential, creating a gap that limits alternative refrigerants uptake.

¹ AREA Internal survey, January 2021

Rationale

- Competent technicians are essential to the success of the F-gas regulation's objectives
- Lack of enough trained technicians on alternatives identified as an obstacle to further take-up of alternatives
- Need to ensure safe and reliable installation and operation of equipment

Justification for an extension of the existing scheme

- A stand-alone regulation would take several years to come about
- Fluorinated greenhouse gases and alternative refrigerants are intrinsically connected (same market)
- Existing F-gas certification scheme already established – only needs to be complemented

AREA proposals

- amendments to the F-Gas Regulation 517/2014
- Amendments to Implementing Regulation 2067/2015
- Updated set of minimum competence requirements (Implementing Regulation 2067/2015, Annex I) based on state-of-the-art standards EN 13313 and ISO/DIS22712

Revision of the F-Gas Regulation

AREA's proposed extension of the F-gas certification scheme to alternative

Proposed amendment to the F-gas Regulation 517-2014

Inclusion of alternative refrigerants within the scope of F-gas certifications scheme by introducing a new definition of:

'Alternative refrigerant greenhouse gases' means refrigerating substances with a greenhouse effect used as alternatives to fluorinated greenhouse gases. They include hydrocarbons, ethers, carbon dioxide and unsaturated hydro(chloro)fluorocarbons ;

- ⇒ Enables inclusion of most alternative refrigerants within the F-gas scope (except ammonia)
- ⇒ Reflected in the body of Implementing Regulation 2015/2067

Ideally, should be coupled with the introduction of mandatory leak checking requirements and sales conditions similar to those applicable to fluorinated greenhouse gases

ANNEX I

Draft amendment to the F-Gas Regulation 517/2014

Proposed changes are highlighted in yellow.

Recital (7)

Certification and training programmes, covering both fluorinated greenhouse gases and their alternatives, should be established or adapted taking account of those established under Regulation (EC) No 517/2014 and may be integrated into the vocational training systems.

Article 2 – Definitions

'Alternative refrigerant greenhouse gases' means refrigerating substances with a greenhouse effect used as alternatives to fluorinated greenhouse gases. They include hydrocarbons, ethers, carbon dioxide and unsaturated hydro(chloro)fluorocarbons ;

Article 10 – Training and certification

(...)

2. Member States shall ensure that training programmes for natural persons recovering fluorinated and alternative refrigerant greenhouse gases from air-conditioning equipment in motor vehicles falling within the scope of Directive 2006/40/EC are available, on the basis of the minimum requirements referred to in paragraph 5.

3. The certification programmes and training provided for in paragraphs 1 and 2 shall cover the following:

(a) applicable regulations and technical standards;

(b) emission prevention;

(c) recovery of fluorinated greenhouse gases;

(d) safe handling of equipment of the type and size covered by the certificate;

(e) information on relevant technologies to replace or to reduce the use of fluorinated greenhouse gases and their safe handling.

(...)

6. Member States shall establish or adapt certification programmes on the basis of the minimum requirements referred to in paragraph 5 for undertakings carrying out installation, servicing, maintenance, repair or decommissioning of the equipment listed in points (a) to (d) of Article 4(2), and of the equipment listed in the points (a), (b), (c) and (e) of article 4(2) that contains alternative refrigerant greenhouse gases, for other parties.

Revision of the F-Gas Regulation

AREA's proposed extension of the F-gas certification scheme to alternative

Minimum requirements as to the skills and knowledge to be covered by the evaluation bodies							
SKILLS AND KNOWLEDGE	CATEGORIES						
	FG I	FG II	FG III	FG IV	FLAM II small	FLAM I big	CO2
1.00 Basic thermodynamics							
1.01 Know the basic ISO standard units as for temperature, pressure, mass, density, energy	T	T					
1.02 Understand basic theory of refrigeration systems: basic thermodynamics (key terms, parameters and processes such as Superheat, High Side, Heat of Compression, Enthalpy, Refrigeration Effect, Low Side, Sub-cooling), properties and thermodynamic transformations of refrigerants including identification of zeotropic blends and fluid states	T	T					
1.03 Use relevant tables and diagrams and interpret them in the context of indirect leakage checking (including checking of the good operation of the system): log p/h diagram, saturation tables of a refrigerant, diagram of a single compression refrigeration cycle	T	T					
1.04 Describe the function of the main components in the system (compressor, evaporator, condenser, thermostatic expansion valves) and the thermodynamic transformations of the refrigerant	T	T					
1.05 Know the basic operation of the following components used in a refrigeration system and their role and importance for refrigerant leakage prevention and identification: (a) valves (ball valves, diaphragms, globe valves, relief valves), (b) temperature and pressure controls, (c) sight glasses and moisture indicators, (d) defrost controls, (e) system protectors, (f) measuring devices as manifold thermometer, (g) oil control systems, (h) receivers, (i) liquid and oil separators	T						
1.06 Know about the specific behaviour, physical parameters, solutions, systems, deviances of alternative refrigerants in the refrigeration cycle and components for their use	T	T	T				
1.07 Know the differences between low GWP refrigerants and HFCs	T	T	T				
1.08 Know the toxicity characteristics, grades and limits of CO2 for the human body							T
1.09 Know the characteristic of flammability of refrigerants, velocity of flame propagation, LFL, UFL, occupancy limits					T	T	
2.00 Environmental impact of refrigerants and corresponding environmental regulations							

Updated set of minimum competence requirements (Implementing Regulation 2067/2015, Annex I)

- ⇒ based on state-of-the-art standards EN 13313 and ISO/DIS22712
- ⇒ 3 new categories: flammable small, flammable large, and CO2
- ⇒ Includes requirements on safe handling and operations, as well as components and system design for the different types of alternative refrigerants

Revision of the F-Gas Regulation

AREA's actions post F-gas consultation meeting



The Voice of European Air-Conditioning, Refrigeration and Heat Pumps Contractors

Revision of the F-gas Regulation

AREA comments further to the consultation meeting

24th May 2021

AREA would like to comment on the F-Gas review and impact assessment's preliminary results presented at the consultation meeting on 6th May. These comments follow on from the proposals we put forward in March. They are also complementary to the joint industry statement co-signed by AREA and several other RACHP industries.

1- The costs of extending the F-gas training and certification requirements scheme to alternatives

We welcome the proposals currently under evaluation and take note of the broad support expressed by the majority of stakeholders, whether in their reply to the consultation questionnaire or during the consultation meeting.

Some concerns were raised on the costs associated with such an option.

First, we firmly believe that **administrative costs** would be marginal since the extension would add modules to an already established certification scheme and structure. The situation is therefore very different to 10 years ago, when such frameworks were originally being set up.

Second, although we are not in a position to give precise estimates, we do not deny that an extension of the certification to alternatives would generate **operational costs** which would have to be borne by our contractors. For companies working with flammables daily, such training and certification costs would overall be marginal. Moreover, we see these costs as a worthwhile upskilling investment given the market position that alternative refrigerants are to take and mindful of their safety issues. Training and certification costs will be largely compensated by the higher safety standards provided which will imply with a lower cost to keep the unit running safely and efficiently. The same logic applies from the users' point of view, as they will certainly gain from more highly qualified technicians in terms of installation and maintenance costs.

Overall, we are convinced that the benefits in terms of competence, safety, efficiency and ultimately facilitation, largely outweigh the costs.

Worries were also expressed that compulsory installation and maintenance of alternative refrigerants equipment by certified technicians would act as a deterrent. This would imply that the current absence of such an obligation acts as an incentive. However, if that was indeed the case, then surely by now we would see a much higher share of F-gas certified technicians competent on alternatives and the insufficient number of competent technicians would not have been identified as an obstacle to the

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AREA's individual comments

Complementary to a joint industry statement (below)

Further explanations and justifications on the costs of extending the F-gas certification scheme to alternative refrigerants:

- Low administrative cost since framework already in place
- Limited operational cost in favour of upskilling

⇒ overall, benefits in terms of competence, safety, efficiency and ultimately facilitation, largely outweigh the costs

Importance of maintaining refrigerant's choice in support of energy efficiency

Evaluation and Impact Assessment for amending Regulation (EU) No 517/2014 on fluorinated greenhouse gases (F-Gas Regulation)

Joint comments following the 6 May 2021 Stakeholder Workshop
25 May 2021

Representing the full value chain of the refrigeration, air-conditioning and heat pump sector (RACHP) in Europe, the signatories of this joint statement support the European Green Deal and its objectives to reduce greenhouse gas emissions by at least 55% by 2030 and to reach climate neutrality by 2050. Accounting for half of the total final energy consumption in Europe, the RACHP sector offers a large cost-effective potential to facilitate decarbonisation through energy efficiency improvements, the electrification of heating via heat pumps and by facilitating a more circular approach to energy, including the integration of renewables into the energy system.

Revision of the F-Gas Regulation

Quick survey among National positions on extension of F-gas certification to alternatives

EU

Country	Contact	Position	Comments
Austria			
Belgium			
Czech Republic	Y		National certification in place
Denmark	N		National certification in place
Estonia			
Finland	Y		National certification coming up
France			
Germany	Y		Adequacy of F-gas Regulation?
Greece	Y		
Ireland			
Italy	Y		
Netherlands	N		National certification in place
Poland			
Portugal			
Slovakia	Y		National certification in place
Spain	Y		National certification in place
Sweden	Y		Adequacy of F-gas Regulation?
Norway	Y		
Turkey	N		
UK	Y		

AREA internal survey
(May 2021)

What?

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SECRETARIAT

Working Group Refrigerants

Synthetic refrigerants

- F-gases
- Ozone depleting substances
- HFOs

Natural refrigerants

- Ammonia
- Hydrocarbons
- CO₂

Working Group Sustainable Innovation

Energy & decarbonisation

- Renewable energy
- Energy efficiency
- EPBD

Environment & circular economy

- Ecodesign
- WEEE
- Resource efficiency

Working Group Human Capital

Promotion

- Inclusive workforce
- Societal purpose
- Career development

Skills

- Projects
 1. REAL Alternatives,
 2. Refrigerant Driving Licence RDL,
 3. UT-KAR... Universal Training Kit for Alternative Refrigerants
- Standards (EN 13313...)
- Upskilling
- Education schemes
- Certification of personnel

WG Legislation & standards

Standards

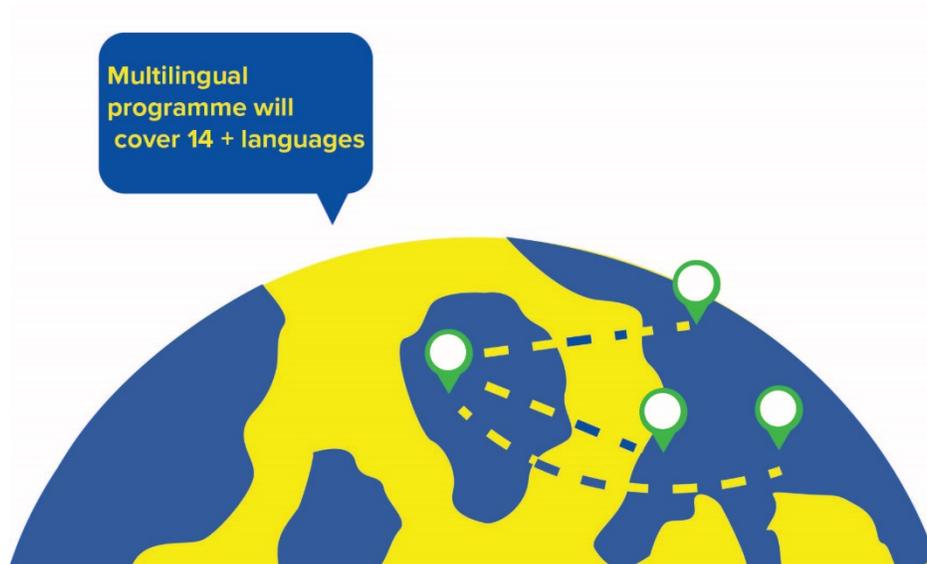
- EN378
- IEC product standards
- ISO 22712

Legislation

- Pressure equipment directive
- ATEX for workers
- Occupational safety
- National developments

1. Real Alternatives

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



International scope of our training and certification programme



RA4LIFE: National Leads
& Training Providers



15 languages..

Croatian
Czech
Dutch
English
Finnish
French
German
Italian
Polish
Portuguese
Romanian
Russian
Slovakian
Spanish
Turkish

Example: REAL Alternatives Flammables Course



With contribution of
the LIFE programme
of the European Union

Official Training Provider

Issue REAL Alternatives 4 LIFE Certificates

- Only available to those who passed assessments by a licensed training provider
- Options for certification:
 - I. Flammable refrigerant (HC, HFO & R32): theory and practice
 - II. Flammable refrigerant (HC, HFO & R32): theory only
 - III. Carbon Dioxide: theory and practice
 - IV. Carbon Dioxide: theory only



2. Refrigerant Driving License



- Italy, Casale Monferrato - on 10th -11th June 2019, an international **delegation of 10 worldwide leading HVACR experts and Associations representatives** gathered for the first ever meeting aimed at complete implementation of the pilot training and assessment sessions under the RDL project.
- **Centro Studi Galileo** hosted the meeting in its headquarters, with the role of consultant involved in the development of the **Refrigerant Driving License (RDL)**, which will be a globally recognized and acceptable qualification program that sets minimum requirements for the proper and safe management of refrigerants in air conditioning and refrigeration equipment.



3. Universal Training Kit on Alternative Refrigerants” UT-KAR

- for the use of training institutes and centres in developing countries with the aim of offering state-of-art information and knowledge on the best practices and techniques in managing and handling future, mainly flammable, refrigerants in sound and safe manners by different stakeholders of the RSS sectors.



Full package of material for each module: for the training centres

- Pre-Assessment test (to be taken before the training start) – Post training assessment
- Venue requirements for training
 - Venue equipment as Computer, projector, WhiteBoard, Microphone, Number of seats, spaces, chair. Requirments
- Teacher minimum qualification
 - Education Level, Year of Experience, Hold of Certificate, Teaching skills
- Guide for the instructor
 - Checklists and Proceedures to start and hold a training course
- Equipment needed
 - Minimum Equipment: i.e. Test Rig equipped with Pressure Gauges, sight glasses in key points, service valves for connections, temperature well
- Text book, manuals, tables, charts
 - Material for the attendees to learn in a perfect manner during and after the training course
- Syllabus
 - List of teaching materials subjects and programme for the developing countrie 's institutes to start a training course on future alternative refrigerants
- Powerpoint Presentations
 - Material for the trainer to explain in a perfect and inclusive manner the syllabus for a perfect comprehension

Importance of Training & Certification



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Example of international support: (in many countries, such as The Gambia, Kuwait, Bahrain, Argentina, Rwanda, Ghana, Benin, Eritrea, Saudi Arabia, Sri Lanka, Montenegro, The Caribbean's, China, etc...)

- Training Sessions and material
- Certification Sessions and material
- Drafting Certification schemes for handling refrigerants



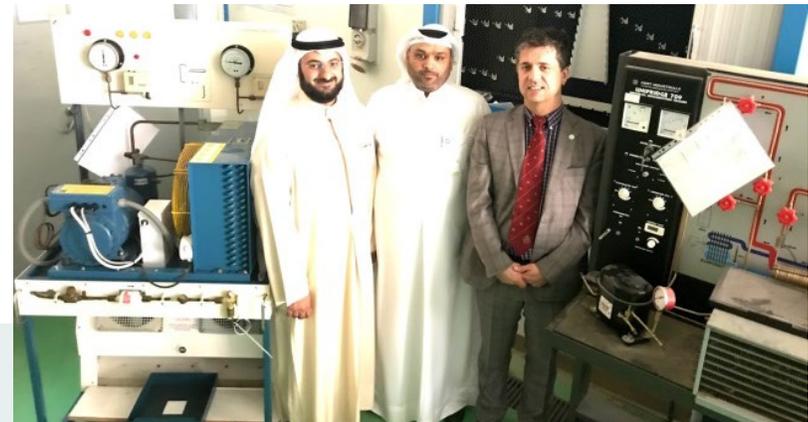
Italy
Turkey
Bahrain



Assessing training centers

- Kuwait, Bahrain, Qatar
- Maldives
- Grenada (Caribbean) ...

→ Propose a package, tools, training and certification (including in the legislation) to make it sustainable



Assessing training centers

- Armenia
- Belarus, Ukraine, Uzbekistan, Tajikistan



→ Propose a package, tools, training and certification (including in the legislation) to make it sustainable



eurammon e. V. is always available as a sparring partner for questions on refrigeration with natural refrigerants.

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eurammon

refrigerants delivered by mother nature