



The contribution of the refrigeration, air conditioning and heat pump contracting sector to energy efficiency: an unleashed potential

Background

Europe wastes at least 20% of its energy due to inefficiency¹. Energy efficiency is an issue concerning all aspects of life from a variety of different perspectives and in particular environmental and financial. As the availability of fossil fuels reduces, the price of crude oil has risen dramatically with the knock-on effect of gas and electricity supplies becoming increasingly expensive. The need to address unnecessary energy spending and consumption has therefore become even more urgent. As the reliance on fossil fuels for running the power stations is still substantial, the long term effect of the emissions on the environment cannot be ignored. Energy efficiency is an issue for everybody and everybody has a role to play. The EU can and must lead the way in reducing energy inefficiency, using available policy tools at all different levels of government and society.

AREA (www.AREA-eur.be) is the European organisation of refrigeration, air-conditioning and heat pump (RACHP) contractors. Established in 1988, AREA voices the interests of 21 national members from 19 European countries, representing more than 9,000 companies across Europe (mainly small to medium sized enterprises), employing some 125,000 people and with an annual turnover approaching €20 billion.

AREA members are the designers of RACHP systems, which they design, install, service and maintain. For this purpose, RACHP contractors use every available solution with complete neutrality towards equipments and refrigerants, in the sole aim of ensuring the highest level of reliability, energy efficiency and cost-effectiveness. Energy efficiency thus is a key element included in each facet of the RACHP contractor's work:

- *Proper system design* for new installations enables to maximize the overall energy efficiency level of all the installation's components put together. Design involves key elements, such as the choice of the refrigerant or capacity control;
- *Professional installation* guarantees the efficiency and the reliability of the system;
- *Regular maintenance* and servicing prevents refrigerant's leaks and enables early detection.

Mindful of the fact that RACHP applications are responsible for a sizeable part of the energy consumed globally AREA is fully aware of the significant energy savings achievable through the raising of energy efficiency at all levels but especially in small to medium air conditioning applications. Such savings could be achieved without major investment in capital equipment and plant refurbishment but with education, good maintenance, implementation of good energy saving practices and enforcement of relevant regulations. AREA members therefore feel in the best position to advise European decision-makers on the full implications of using the most energy efficient equipment and the correct use of refrigerants for the various applications in order to minimize the amount of energy required to meet the cooling or heating load.

¹ COM(2006)545 final

The purpose of this paper is to provide an overview of the actions and solutions that can contribute to increasing energy efficiency of RACHP systems in order to diminish the environmental and financial impacts.

1- Choosing the right refrigerant

AREA's primary interest lies with refrigeration, air-conditioning, heat pumps and process chilling. Designing a RACHP system involves a key element: the choice of the "right" refrigerant, i.e. the correct heat exchange media for the cooling or heating application. In the past few years there has been an increased interest in the promotion of non fluorinated refrigerants. Whilst AREA sees the development and promotion of new alternative refrigerants as a natural evolution, it must be pointed out that the energy efficiency level of the "new" refrigerant can only be assessed by comparing it to the existing HFC energy usage on a like for like basis. Manufacturers of split air-conditioners have been producing reverse cycle heat pumps for many years based on a normal packaged air-conditioning system and incorporating a reverse cycle valve that reverses the flow of refrigerant to turn a cooling system into a heating one. The efficiencies have been well documented².

There are numerous applications where alternatives to fluorinated refrigerants are both desirable from a political perspective and preferable from an environmental perspective. For instance, in small systems, such as domestic refrigerators and freezers and point of sale display fridges, it has been demonstrated that hydrocarbon refrigerants (HCs) are very good in terms of energy efficiency compared with the old HCFCs, according to reports by the hydrocarbon industry. On large systems, such as central plant systems serving an office block or a shopping mall, it is normal practice to have a remote plant area either on the roof or besides the building. In these cases again the flammability or toxicological issues are less of a risk to the occupants of the building. However, it is generally accepted that in these cases it is preferable to use either CO₂ or ammonia as the primary heat exchange refrigerant. There are also, however, certain applications where it is beneficial to retain the use of fluorinated gases. In small to medium cooling duty applications, such as room air conditioners and localised process or comfort cooling applications, it has been demonstrated that HFCs are often the most energy efficient refrigerants to use compared with the alternatives:

- For heat pump air-conditioners with cooling duties of 4kW, HFCs prove between 33% and 67% more energy efficient than alternatives.
- For heat pump air-conditioners with cooling duties of 14kW, HFCs prove between 34% and 58% more energy efficient than alternatives. The renewable energy technology of heat pumps falls into the same range of heat exchanger compressor duty.

In 2009, the adoption of the new Directive on the promotion of the use of energy from renewable sources³ saw, for the first time, heat pumps recognised as renewable energy technology. Thanks to their high coefficient of performance, heat pumps enable energy production and recovery at a lower rate of CO₂ emissions. It must however be stressed that most heat pumps are reliant on HFCs to achieve their low carbon potential. This is what one could call the duality of HFCs. Whereas they intrinsically show a high global warming potential (GWP), when leakages are limited their total equivalent warming potential (TEWI) is unequalled on the aforementioned applications.

² See AREA Input Paper "[HFCs vs. alternatives in refrigeration & air conditioning equipment](#)", June 2009

³ Directive [2009/28/EC](#) of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources

2- The impact of the F-Gas Regulation

Historically many stationary refrigerant and air conditioning (SRAC) systems gave rise to significant emissions of fluorinated gases and ozone depleting substances (ODS) through leakage during normal use and venting during maintenance or at end of life. These leakages have a double impact on the environment. First, the release of HFCs in the atmosphere contributes to global warming because of the high global warming potential of these gases. Second, leakages reduce the energy efficiency of the system with both environmental and financial consequences. Mindful of these problems, the EU adopted in 2006 the F-gas Regulation⁴, which is intended to improve refrigerant containment – thus preventing emissions - by ensuring that leakage rates are reduced and that all refrigerant is recovered during regular professional maintenance and at end of plant life. Better plant design, construction and maintenance have enabled emission rates to fall significantly.

The F-Gas Regulation ensures that installation, maintenance, service, (de)commissioning and disassembly of RACHP systems containing or designed to contain HFCs can only be done by duly certified professionals. In addition, the Regulation requires regular leakage checking by appropriately trained personnel. All these obligations are applicable since July 2009.

These regulations need to be enforced as they are not being fully and homogeneously implemented in EU Member States. Many have used their own reduced version of the 842/2006. With the implementation of the F-Gas legislation across the EU there is continued opportunity to communicate energy efficient behaviour and practices.

In the Netherlands, such scheme (known as STEK⁵) has been in application for over 15 years with outstanding results. A report⁶ commissioned by the European Commission DG Environment in 2002 showed that *“STEK has been highly successful in the Netherlands in both minimising average leakage rates and in virtually eliminating ‘rogue traders’ reducing equipment leakage rate to 4.5% p.a. compared to a European average of 25% with the greatest leakages now in the industrial sector. STEK’s own research indicates that 92% of the installations had no emissions at all in the reference year 1999”*. The report adds that *“the potential emission reductions achievable in 2012 through the implementation of STEK on a country by country basis show that that a reduction of around 15M tonnes CO₂ equiv. is achievable against expected emissions of 35.1 M tonnes CO₂ equiv.”*

The implementation of the Regulation has been slow and unequal in the 27 Member States. In many countries, the widespread use of interim certification only enabled RACHP contractors to manipulate F-gases legally after July 2009. The EU F-gas Regulation should ensure that installation and maintenance standards are improved and maintained resulting in better containment of refrigerants and better energy efficiency of the systems. When one looks at the potential emissions and energy savings achievable, AREA finds it of the utmost importance that every Member State commits equally. The upcoming review of the F-Gas Regulation due by July 2011 should provide additional information and pressure on those lagging behind.

⁴ Regulation (EC) [842/2006](#) of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse gases

⁵ www.stek.nl

⁶ See http://ec.europa.eu/environment/climat/pdf/eccc_containment_measures.pdf

3- Energy performance of buildings

Energy efficiency in the building sector is a top priority. Indeed, the energy consumption of houses and buildings taking into account the whole life cycle is responsible for 40% of total EU energy consumption and is the main contributor to greenhouse gas (GHG) emissions⁷. AREA is aware the largest cost-effective savings potential lies in the residential (households) and commercial buildings sector (tertiary sector), where the full potential is estimated to be around a third of energy use⁸. AREA therefore fully supports the overall aim and objectives of the Energy Performance of Buildings Directive.

Air-conditioning systems represent a significant part of the energy consumed by buildings. There are numerous ways and means of improving energy efficiency of RACHP systems: regular maintenance regime carried out by competent engineers, correct refrigerant charge maintained by minimising leaks, good system design avoiding over-specification, use of the best refrigerant for the application, use of inverter drives or variable regulated speed motors, capacity controls or other low energy drives... The requirement for regular inspections of air-conditioning systems can therefore contribute to energy savings thanks to proper maintenance, information about performance and advice on further energy savings and reduction of operating costs.

Most AREA members have their engineers trained to carry out the inspections but in practice there has been little call for these skills because of the relatively limited scope of the Directive. AREA therefore supported the proposed extension of the Directive's scope. Indeed, with a clearer, stronger and larger scope, the Directive will hopefully be applied more extensively. AREA also welcomes the express support given to heat pumps. Now officially recognized as a renewable energy source, heat pumps have already demonstrated their efficiency on numerous occasions. More generally, AREA welcomes the outcome of the Directive's recast, and the stronger commitments taken by Member States with 'nearly zero energy' buildings, the availability of financial incentives or the definition of minimum energy performance requirements. It should however be pointed out that measures to further improve the energy performance of buildings ought to take into account climatic and local conditions as well as indoor climate environment and cost-effectiveness. In this regard, since Europe - and even some Member States internally - show a great variety in climate conditions, AREA believes that minimum energy performance requirements to be set by Member States must be tailored to the local climate.

4- The contribution of heat pumps

Developing production and use of energy from renewable sources is an important means to increase energy efficiency. AREA was therefore very pleased to see the rapid adoption of Directive 2009/28/EC on the promotion of the use of energy from renewable sources⁹ ("RES Directive").

From a general point of view, AREA welcomes the strengthening of RES promotion schemes, an essential aspect of RES development. Indeed, energy-efficient systems are not always the cheapest, quite often the pay back can be 10 years or more. The customer/consumer therefore needs to be steered towards these systems as unfortunately but inevitably cost takes precedence over environmental considerations.

⁷ See http://ec.europa.eu/research/industrial_technologies/lists/energy-efficient-buildings_en.html

⁸ http://ec.europa.eu/energy/action_plan_energy_efficiency/doc/2007_eeap_en.pdf

⁹ Directive [2009/28/EC](#) of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources

From a more specific point of view, AREA welcomes the eventual recognition of heat pumps as a RES. Involved in heat pump's installation and commissioning, and therefore privileged witnesses of their energy performance, RACHP contractors can only hope that this official recognition will further boost heat pumps' use in Europe.

In this regard, it should be reminded that a substantial part of the development of heat pumps' use depends on a proper implementation and application of the F-Gas legislation. Indeed, as indicated above, many heat pumps rely on HFCs to achieve their low carbon potential. A partial or incorrect application of the F-Gas Regulation increases the risk of refrigerant leakage. In the case of heat pumps, such leakage is harmful to the environment both directly (release of greenhouse gases into the atmosphere) and indirectly by reducing the energy efficiency of the system.

The link RES-F-Gas goes even further when one considers qualifications and certification of heat pump's installers. Whereas Member States are in the process of establishing national schemes, AREA wishes to point out that heat pumps' benefits will not materialise in most cases unless the design, installation, and maintenance are executed by trained and competent professionals in RACHP technology. F-Gas guarantees this level of competence. AREA therefore strongly recommends that "RES requirements" closely match those of the F-Gas Regulation in order to avoid duplicate or divergent legislation that would only impede heat pumps' development in Europe¹⁰.

General recommendations

- Coordinated and synchronised implementation of training and certification schemes applicable to RACHP contractors must be ensured to avoid duplicate or divergent requirements (F-Gas, EPBD and RES).
- A holistic approach on heating and cooling applications must be followed to ensure harmony among complementary pieces of legislation. This is particularly important when it comes to the practical implementation of regulations under the responsibility of different authorities, who often act with a complete lack of coordination.
- In view of the role played by RACHP contractors in the field of energy efficiency, training and education must be fostered in order to enable a constant update with technological innovations.
- EU Member States must commit to thorough implementation and application of the existing EU legislation so that energy efficiency gains can be achieved.

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¹⁰ See [AREA recommendations to national authorities for setting up national certification schemes for HP installers](#)