



***R22 Phase Out  
"Making the right  
decision"***

# R22 Phase Out

## “Making the right decision”

### Introduction

R22 the widely used refrigerant which is harmful to the environment will be phased out according to EU regulation 2037/2000 in the coming years. In addition, alternative synthetic refrigerants will be subject to the so called “F-gas regulations” which will impose additional operating costs associated with their use.

Therefore, finding alternatives for R22 and other synthetic refrigerants (see table below) will be a challenge for many in the industry in the years to come. A complete ban on recharging or topping up existing systems will apply after December 2014. From January 2010 until mentioned date only recycled (non-virgin) R22 can be used for existing installations.

However, there is no guarantee of recycled HCFC’s (synthetic refrigerants containing Chlorine) being available at reasonable costs after 2008. It is expected that supplies of R22 will become limited in the course of 2009.

The circumstances mentioned above may be an opportunity to consider the use of natural refrigerants like NH<sub>3</sub>.

### R22 Phase Out Dates

After December 31st 2009 new virgin R22 refrigerant will no longer be allowed for charging or topping up refrigeration systems.

Reclaimed R22 refrigerant can still be used until 31<sup>st</sup> December 2014.

During this period it will be allowed to continue operating an existing system on R22 refrigerant but it will be illegal to add or charge the system with new R22 refrigerant.

After December 31<sup>st</sup> 2014 a complete ban on all R22 refrigerant for recharging or topping up existing systems will apply.

Should a system operating on R22 require charging or topping up after this date with refrigerant, the system will have to be either converted or replaced with a new system and operated on an alternative refrigerant.

According to EU regulation 2037/2000 there will be a review with respect to the “ban date” 2015 in the course of 2008. In addition, it is expected that during this review process new regulations concerning trading of recycled R22 will be established.

	Substance	Examples	Ozone Depleting	Global Warming	F-Gas
<b>CFC</b>	Chlorofluorocarbon	R11, R21	yes	yes	no
<b>HCFC</b>	Hydrochlorofluorocarbon	R22, R123 (pure fluids)	yes	yes	no
<b>HFC</b>	Hydrofluorocarbon	R134a, R404A, R407C (blends)	no	yes	yes
<b>NH<sub>3</sub></b>	Ammonia		no	no	no

## F-Gas Regulation

The only synthetic refrigerants allowed to be used as an alternative for R22 are the so called HFC's. These substances are subject to the so called "F-Gas Regulation".

The F-gas regulation passed by the European Commission puts the focus on containment and monitoring of emissions. It provides a comprehensive framework for the reporting of data on refrigerant emissions to provide a true picture of HFC's that will enable an informed decision to be made on their future use.

Legislation became law July 4<sup>th</sup> 2006 with a 12 month period of application by member states. This means that the F-Gas regulation has come into force with effect from July 4<sup>th</sup> 2007.

The F-gas regulation has influence on the following aspects:

- Competence and registration of personnel.
- Technical improvement and preventive maintenance.
- Mandatory inspection and registration of leaks and charges
- Refrigerant charging
- Penalties involved for non-compliance
- Responsibility for safety of the installations and operators

A number of member states including Denmark have already taken the step of a total ban on these refrigerants from January 2007 for systems over 3kg charge.

In 2011 the F-gas regulations will be reviewed. It is possible that the regulations will be more restrictive.

## Present Day Alternative Refrigerants Price Comparisons

The prices of alternative refrigerants are depicted below. Prices of most synthetic refrigerants are substantially higher than R22. However, ammonia, a natural refrigerant, is less expensive than R22.

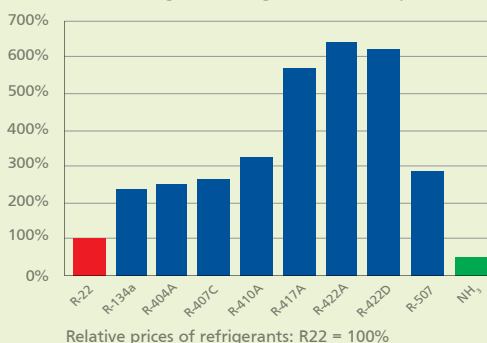
## Impact on installation performance and design

The Global Warming Impact (GWI) should be considered when selecting the type of refrigerant to be used, as the performance is subject to change with some of the above alternative refrigerants.

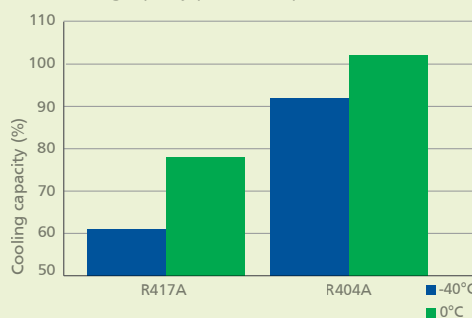
Refrigeration capacity and efficiency can be significantly reduced when replacing with synthetic alternatives to R22 as can be seen from the graphs below. Databased on literature (4).



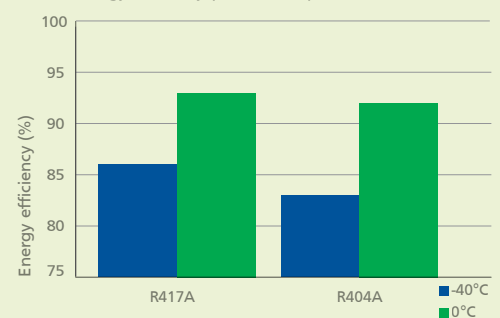
Relative Refrigerant Pricing in Western Europe



Cooling capacity (R22 = 100%)



Energy efficiency (R22 = 100%)



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In addition, replacing the refrigerant in an existing system charged with R22 by another synthetic refrigerant requires the system to be assessed as to the compatibility of the compressor, oil type, sealing materials, pipe work strength and controls.

In summary:

#### Alternative refrigerants may

- Reduce the cooling capacity of the system
- Use more energy
- Require system modifications.

#### Leakage Rates

The fact that synthetic refrigerants are non-toxic, colorless and odorless, leads to the situation that leakages are often not detected. It turns out in practice that about **5 -15%** of all R22 leaks away per year, dependent on materials used and level of maintenance.

In contrast to synthetic refrigerants a small amount of NH<sub>3</sub>, at levels harmless to human beings, would immediately be noticed by the odor. In addition, to ensure compliance with safety regulations, installations containing NH<sub>3</sub> are built leak-tight and are equipped with detection equipment.

Phase out options to be considered	Advantages
<b>1 Do nothing and rely on availability of recycled R22</b>	- Present day low capital cost outlay
<b>2 Replace the R22 charge with an “F-Gas” compliant refrigerant</b>	- Limited investment costs - Planned equipment down time and reduced impact on the site operation - No ozone depletion
<b>3 Replace the R22 charge with a natural refrigerant</b>	- Planned equipment down time and reduced impact on the site operation - Zero global warming (NH <sub>3</sub> ) - More energy efficient than R22
<b>4 Replace individual systems by a central installation using natural refrigerants</b>	- Long term solution: Ready for the future! - Planned equipment down time and reduce the impact on the site operation - Modern energy efficient design, saving energy costs - Low cost of ownership (running, maintenance and refrigerant costs) - No global warming impact (NH <sub>3</sub> ) - Improving your company image with respect to the environment

## Energy and environment

A final passage from the European Partnership for Energy and the Environment reads:

“ Energy efficiency improvements are the key to long term sustainable refrigeration, irrespective of the refrigerant used. On average over 80% of the impact of equipment on the climate comes from the CO<sub>2</sub> generated from producing the power to drive it and for small factory sealed refrigeration systems this is even higher.

By limiting the choice of refrigerants and not taking a holistic approach to all options, there is a risk that overall environment gains will be negated.”

### Disadvantages

- Your company image may be harmed due to your possible contribution to ozone depletion and global warming
- No guarantee of sufficient R22 supplies after 2008 at reasonable cost.
- No functional improvement of your refrigeration equipment
- Probable reduction in efficiency and cooling capacity
- For flooded systems not all HFC's are applicable due to temperature glide
- Some HFC's operate a higher pressures making it necessary to change components (condensers)
- Contributing to global warming
- Additional running and maintenance cost associated with compliance with F-Gas regulations.
- Substantial investment costs may be required
- In case of NH<sub>3</sub> : cannot be used with copper components
- In case of CO<sub>2</sub> :operates at much higher pressures for which special components are required.
- In case of Hydrocarbons: flammable substances that need special safety precautions
- Special regulations for the use of NH<sub>3</sub> and Hydrocarbons are applicable that may vary from country to country
- Significant investments may be required
- Possible site alterations to accommodate new plant.
- Possible larger room evaporators reducing storage space.

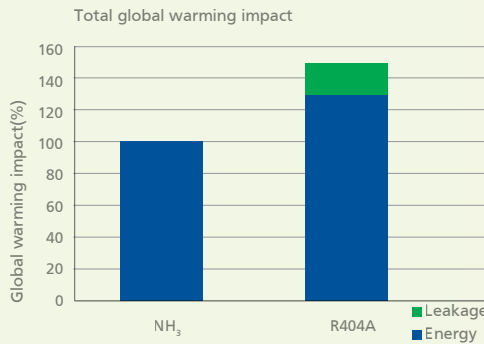


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In view of this let us have a look at the global warming rates associated with the above mentioned aspects.

The graph below shows the dependence of the Global Warming Impact on NH<sub>3</sub> and R404A assuming a leakage rate of 10% per year.



*Total Global Warming Impact of R404A due to leakage and higher energy use compared to NH<sub>3</sub>.*

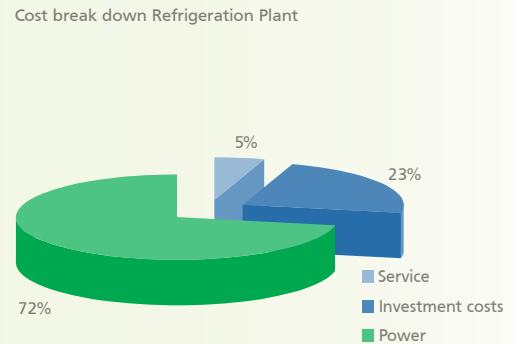
*Data based on:*

*Average cooling capacity: 1000 kW  
 Evaporating temperature: -10°C  
 Refrigerant contents: 1200 kg  
 Grasso screw compressor*

NH<sub>3</sub> shows a much lower impact to global warming than synthetic refrigerants, not only due to the inherent global warming features of the latter, but also due to the fact that synthetic refrigerants are less efficient thus contributing to enhanced CO<sub>2</sub> exhaust levels.

Finally it is interesting to have a look at the cost of energy for refrigeration purposes as a percentage of the total running cost of a typical plant.

In the graph below a typical breakdown of operating cost for a refrigeration plant is depicted.



*Typical cost split over 5 years operation of a Refrigeration Plant*

It is clear that the cost of energy represents the largest part of the total running costs. NH<sub>3</sub>, a natural refrigerant, shows better efficiencies than the chemical alternatives to R22 and will therefore significantly contribute to lower energy costs.

Last but not least, the use of NH<sub>3</sub> does not contribute to global warming and can therefore rightfully be called: “Environmental Friendly”

### How to make the right decision

We have been asked the following question by many clients "I have an R22 system, what shall I do". Unfortunately there is no real straight forward answer to this question.

This question can only truly be answered "accurately" by combining the type of system in use, its operating characteristics and most importantly, the clients own businesses future. One must decide on the features of the business in question and therefore the correct investment approach.

First of all it is important to establish the following **technical** information about each plant:

- Identify all equipment containing HCFC's
- Quantity of refrigerant
- Leakage Rates
- Age of system
- Materials used
- Plant performance
- Life Time expectation

In addition to the technical implications, other aspects to consider are:

#### Financial

- Depreciation level of current installation
- Company policy regarding investment cycles and procedures
- Total Cost of Ownership (initial investment, maintenance, energy use etc.)

#### Company Image

- Environmental: "Green Company"
- Health and Safety requirements in your industry

If one looks into one's business strategy and aspects mentioned above, then based on the current legislative climate and technical data available, a simple piece of advice might be made (see also table "Phase out options to be considered").

#### Long Term:

- Change to Ammonia, Carbondioxide, Propane or any other "Green" high efficiency refrigerant.

#### Medium Term:

- Make appropriate changes to the installation and change to another synthetic refrigerant.

#### Short term:

- Do nothing and rely on availability of recycled R22.

However, those wishing to change to a "drop in" replacement by another synthetic refrigerant will automatically find themselves falling under the new strict F-Gas regulations. In addition there are signs today that F-gas regulations will become more stringent after 2011.

There is only one 100% guaranteed alternative: "Go Green"

### GEA Refrigeration can help

GEA Refrigeration has already helped a number of customers in making the right decision related to their specific R22 exchange issue.

Therefore we suggest that you contact the GEA Refrigeration representatives in your country or region for further information and assistance with your particular needs relating to this subject. For the names and addresses of your local GEA Refrigeration representatives, please refer to the last page of this brochure.

#### Acknowledgements:

- **EPEE**. Preventing Refrigerant Leakage. 21 June 2005. Paper on HFC's.
- **DTI**. Sustainable Development . Global Atmosphere papers
- **Enviros**. Refrigerant Usage in UK. Paper by Climate change group.
- **"Carbon Trust Networks Project"**, January 2007



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