# CLIMATE CHANGE AND THE OZONE LAYER: THE PHASE DOWN OF HFCS

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## INTRODUCTION

The International Institute of Refrigeration (IIR), an independent intergovernmental science and technology based organisation, promotes refrigeration knowledge and associated technologies that improve quality of life in a cost-effective and environmentally sustainable manner including:

- > Food quality and safety from farm to consumer
- Comfort in homes and commercial buildings
- Health products and services
- Low temperature technology and liquefied gas technology
- Energy efficiency
- Use of non-ozone-depleting and low global warming refrigerants in a safe manner

## It includes:

**58** member countries worldwide over **400** experts More than **500** corporate and private members

#### Its services are:

#### Information resources

- IIR Newsletter
- Books and guides
- Informatory Notes
- International Dictionary of Refrigeration
- Expertise directories
- Statements
- E-alerts

#### Fridoc

The world's most comprehensive refrigeration database with over 100,000 scientific and technical references.

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## > Real alternatives for life

- CryoHub
  - SuperSmart (ended January 2019)
  - ELICiT (ended December 2016)
  - COOL-SAVE (ended April 2015)
  - REAL Alternatives (ended 2015)
  - FRISBEE (ended August 2014)



Food preservation and health, thanks to refrigeration are key issues for a sustainable development. However environmental regulations also are a key driver of refrigeration future.

There are two worldwide challenges and as well as new global regulations which affect refrigeration systems:

#### 1. CLIMATE CHANGE

Climate change became an issue at the Rio convention in 1992, where six greenhouse gases or families of greenhouse gases where identified. There are other ones but these ones are increasing in the atmosphere due to human activities. They are: CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, PFCs, SF6 and hydrofluorocarbons (HFCs).

There were two exemptions from that list: Chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs) since they were already regulated by the Montreal Protocol, since 1987.

After years of negotiations, the Paris agreement in 2015 obliged all the governments, developing as well as developed countries, to reduce their greenhouse gas emissions, provided of course that they ratify the agreement. The commitment was to avoid an increase of the atmospheric temperature lower than 2°C compared to the pre-industrialisation time in the 19<sup>th</sup> century and if possible, lower than 1.5°C in 2100. But there were no other commitment, no general strategy, only "National Determined Contributions" (NDC). The application of the NDCs would only result in an increase of +3 to + 3.5°C. It will thus be necessary to considerably increase these national commitments in the near future. Currently, the European Union (EU) is the only region in the world which really reduced its greenhouse gas emissions since the 90s thanks to the Kyoto Protocol and the Paris agreement. But even if it only represents about 10% of the worldwide greenhouse gas emissions, the EU shall continue to build regulations to reduce its emissions.

There are thus two objectives in the refrigeration field: reducing the emissions of HFCs (direct emissions) and reducing the CO<sub>2</sub> emissions (indirect emissions). It is not possible to run an equipment without an energy input, generally electricity. Electricity is generally produced by fossil fuels and is thus an important source of CO<sub>2</sub> emissions. Currently, according to IIR estimations<sup>1</sup>, the refrigeration sector, including air conditioning, cryogenics and heat pumps, represents 7.8 % of global greenhouse gas emissions. 37% are due to CFCs, HCFCs and HFCs and 63% to energy consumption.

<sup>&</sup>lt;sup>1</sup> IIR Informatory Note « The impact of the refrigeration sector on climate change" (November 2017)

# 2. THE STRATOSPHERIC OZONE LAYER

Chlorine can destroy the stratospheric ozone layer and thus, chlorinated products bromides....) such as Chlorofluorocarbons (CFCs) (as well as and Hydrochlorofluorocarbons (HCFCs) were included in the Montreal Protocol to protect the ozone layer. It was adopted in 1987. CFCs are already forbidden. HCFCs are also now forbidden in the EU and will soon (2020) be forbidden in all HCFCs production and consumption will similarly be developed countries. forbidden by 2030 in all countries. The stratospheric ozone layer is thus now recovering, despite of some illegal manufacturers. HFCs are similar to HCFCs (same uses, same stakeholders) and, at an average, have a similar Global Warming Potential. The European Union has thus decided to phase down HFCs thanks to two successive regulations; one in 2006 on Mobile Air Conditioning (MAC) and on certification of persons and companies handling HFCs; the other in 2014 on bans and quotas of HFCs with a phase down schedule ending in 2030. A reduction of 79% compared to the initial production and consumption of HCFCs and HFCs was planned.

## 3. THE KIGALI AMENDMENT

In October 2016, the Kigali amendment to the Montreal Protocol was adopted. Despite of the fact that HFCs are not destroying the ozone layer, it was decided to use the tools of the Montreal Protocol to phase down HFCs because of its success regarding the ozone layer. However, HFCs are still included in each country NDC concerning the Paris agreement.

Reductions of HFCs production and consumption shall start in 2019 for developed countries, in 2024-2029 for most developing countries and 2028-2032 for the other ones. The end of the phase down will take place in 2036 for developed countries at a level of 85% and in 2045-2047 for developing countries at a level of 80-85%: see the table below. Currently 71 countries have already ratified the agreement and the Kigali amendment entered into force on January 2019.

	A2 countries	A5 countries (Group 1)**	A5 countries (Group 2)***
Baseline	2011-2013	2020-2022	2024-2026
Formula	Average HFC consumption	Average HFC consumption	Average HFC consumption
HCFC	15% or 25% baseline*	65% baseline	65% baseline
Freeze	-	2024	2028
1 <sup>st</sup> step	2019 – 10%	2029 – 10%	2032 – 10%
2 <sup>nd</sup> step	2024 – 40%	2035 – 30%	2037 – 20%
3 <sup>rd</sup> step	2029 – 70%	2040 – 50%	2042 – 30%
4 <sup>th</sup> step	2034 – 80%		
Plateau	2036 – 85%	2045 – 80%	2047 – 85%

The European Union and its member countries have approved and thanks to the F-gas regulation starting in 2014, will respect the Kigali amendment until 2030. They will only now have to complete the F-gas regulation for the years 2031-2036. The EU is ahead compared to all other countries which can give it some advantages such as preparing its companies earlier to new markets. But it can also come with some drawbacks such as immediate costs and illegal trade.

# 4. COMMENTS ON THE CURRENT SITUATION

- a. Countries are progressively ratifying the amendment. Even if the USA currently are "reluctant" to ratify, the trend is clear: the phase down of HFCs will take place.
- b. National agendas and solutions are and will be adapted differently depending on the contexts: safety issues, industrial issues, climate issues... and will differ according to the application.
- c. Very high GWP refrigerants will be progressively more rare and costly. This was the case until mid-2018 in Europe. Illegal trade has developed and will continue to exist for years. But it will not stop the evolution.
- d. Before changing the refrigerant, it would be best to first explore other potentially effective solutions such as reducing leakage and refrigerant charge, refrigerant recovery etc. But for new equipment, moving to the refrigerant with the lowest GWP while improving the energy efficiency and considering safety issues is necessary.
- e. There is a competition among the various refrigerants, especially between natural refrigerants (ammoniac, CO<sub>2</sub>, hydrocarbons) and fluorinated refrigerants (HFOs and relatively low GWP HFCs (such as R32).
- f. It is impossible during such a conference to present all refrigerant solutions and kinds of applications. Each month a new refrigerant appears, apparently adapted to a certain application, either as a transitory solution (moderate GWP) or as a long-term solution (low GWP).
- g. The refrigerating equipment and its energy efficiency are linked to the refrigerant used. The presentations in session 1 and 2 are thus completing each other. It will allow the conference to be more balanced between natural refrigerants and HFCs/HFOs solutions.
- h. It is generally difficult to compare the various solutions. All parameters must be taken into account: energy efficiency in similar conditions, in similar applications, additional costs due to safety equipment, old equipment versus new equipment etc.

#### **CONCLUSION:**

Discussions on the various new solutions must take place and debates are important. It is impossible to exhaustively present these solutions. Moreover, many innovations regularly appear and constantly updated information is needed.

Other occasions will take place, such as IIR congresses and conferences, new researches and developments will be regularly published. Please keep informed!