

# *Reduction of the Environmental Impact of Fluorinated Gases in the Sudoe Space using Key Enabling Technologies*

## **KET4F-Gas**



**[www.KET4F-Gas.eu](http://www.KET4F-Gas.eu)**



**Research and Innovation**

**Ana B. Pereiro**

NOVA SCHOOL OF SCIENCE AND TECHNOLOGY | FCT NOVA  
NOVA University of Lisbon  
Campus de Caparica | 2829-516 Caparica | Portugal

**NOVA**  
NOVA SCHOOL OF  
SCIENCE & TECHNOLOGY

 [@SUDOES #KET4FGas](#)

 [@interregsudoe #KET4FGas](#)



**webinar**  
**MEET4GAS\_SOLUTION**  
Hacia la minimización del impacto  
medioambiental de los gases fluorados

Dirigido a gestores de residuos, administración pública y  
entidades relacionadas con el sector del frío.

**25 marzo a las 10:00 h.**

Interreg  
Sudoe

XUNTA  
DE GALICIA

FEUGA  
FUNDACIÓN UNIVERSITARIA  
de Ingeniería y Ciencias

Interreg  
Sudoe  
KET4F-Gas

# *Reduction of the Environmental Impact of Fluorinated Gases in the Sudoe Space using Key Enabling Technologies*

## **KET4F-Gas**

**Execution period:** 01/04/2018 – 31/03/2021

**General objective:** KET4F-Gas will design, test and validate different **Key Enabling Technologies (KET)**, individually and combined. The aim is to implement the most efficient option for the **separation and recovery of fluorinated gases** used in refrigeration and air conditioning equipment. This KET will be based on more efficient treatment systems, designed according to the principles of **green chemistry**.

**SUDOE area:**

Portugal, Spain and France

**Budget:**

1 742 800 Euros - 75% European Regional Development Fund (ERDF)

[www.KET4F-Gas.eu](http://www.KET4F-Gas.eu)





**Interreg Sudoe Programme** supports **regional development** in **Southwestern Europe**, financing **transnational projects** through the **European Regional Development Fund** with a total budget of **141 million euros**.

Promotes transnational cooperation to solve common problems:



Low investment in  
research and  
development



Environment and  
Resource efficiency



Weak  
competitiveness of  
the SMEs



Carbon based  
economy



Reduce climate  
changes



## Beneficiaries

### Academic Institutions



Universidade Nova de  
Lisboa (**FCT NOVA**)  
(PT)



Université de Pau et des Pays  
de l'Adour (**UPPA**)  
(FR)



Universidad de Cantabria -  
Université Clermont Auvergne  
(**UCA/FRE**)  
(ES)

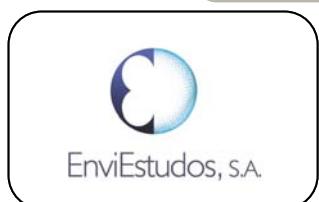


Universidad de Vigo  
(**UVIGO**)  
(ES)



Institut Químic de Sarrià  
CETS Fundació Privada (**IQS**)  
(ES)

### SMEs



EnviEstudos SA  
(**EnviEstudos**) (PT)



APRIA Systems SL (**APRIA**)  
(ES)



Interlun (**Interlun**)  
(ES)



No Waste - Gestão e Recuperação de Resíduos,  
Lda (**No Waste**)  
(PT)



## Beneficiaries

### Public Administration



ConSELLERÍA de Medio Ambiente e Ordenación  
do Territorio (**Xunta de Galicia**)  
(ES)

### Innovation Cluster



Talence Innovation AGCE DEV ECON (**Talence**  
**Innovation**)  
(FR)

### Environmental Federation



Fédération des Recherches en  
Environnement (**FRE**)  
(FR)

### Foundations



Fundación Empresa – Universidad  
Gallega (**FEUGA**)  
(ES)



Fundación Fundecytparque Científico y  
Tecnológico de Extremadura  
(**FUNDECYT-PCTEX**)  
(ES)



## Associate Partners

### Academic Institutions

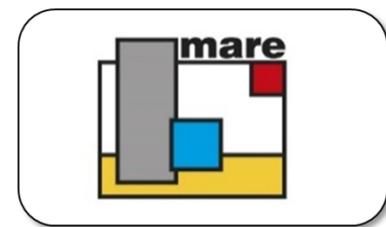


The Petroleum Institute (PI)  
(UEA)

### Industrial Partners



FCC Ambito, SAL (FCC)  
(ES)



Medio Ambiente, Agua, Residuos y  
Energía de Cantabria S.A. (MARE)  
(ES)

### European Platform



European recycling platform (ERP)  
(PT, ES)

### Non-governmental Organization (NGO)



ZERO - Associação Sistema Terrestre Sustentável  
(PT)



## Global Warming and the Greenhouse Effect

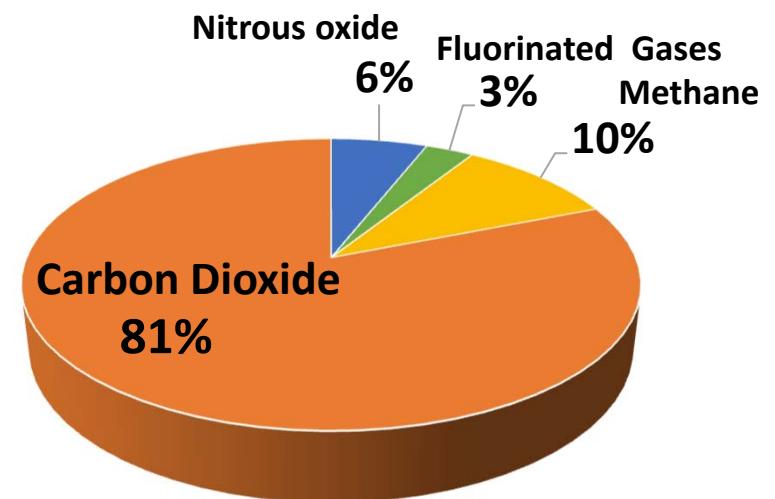


**Global warming** refers to a rise in the temperature of the surface of the earth. An **increase in the concentration of greenhouse gases** leads to an increase in the magnitude of the greenhouse effect (called enhanced greenhouse effect).

Human activities cause the release of greenhouse gases onto the atmosphere.

Since the start of the industrial era, the overall **effect of human activities on climate has been a warming influence**.

## Greenhouse Gas Emissions in 2018



## Effects of Global Warming due to Unbalance of Greenhouse Gases



Sea Level Rise



More severe storms,  
hurricanes and floods



Changes in water supply,  
contamination of fresh water



Habitat damage and  
species extinction



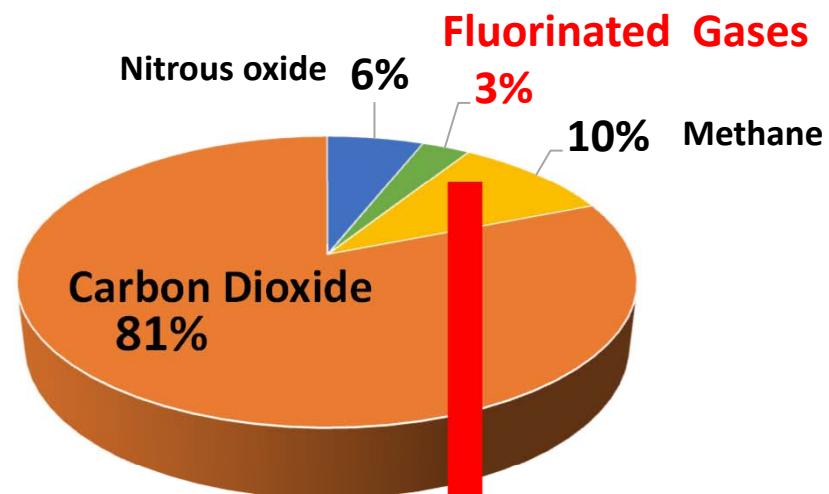
Temperature increase



Droughts, changes in weather  
patterns



## Greenhouse Gas Emissions in 2018



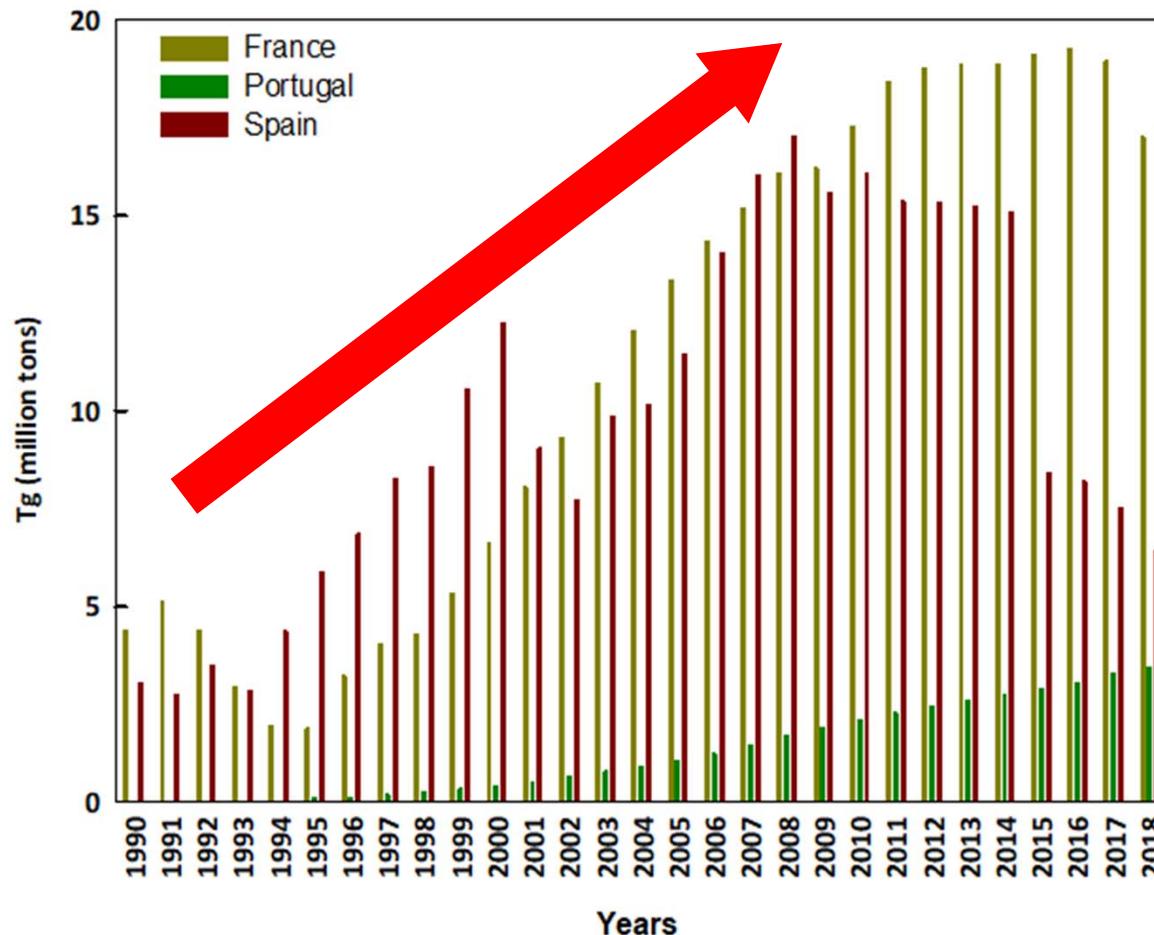
Fluorinated Gases – 3%

Global warming effect up to **23 000 times** greater than carbon dioxide

Will be responsible for **28-45 % of climate change** by 2050

Atmospheric lifetime up to **50 000 years**

## HFC's Gases Emissions in SUDOE Countries



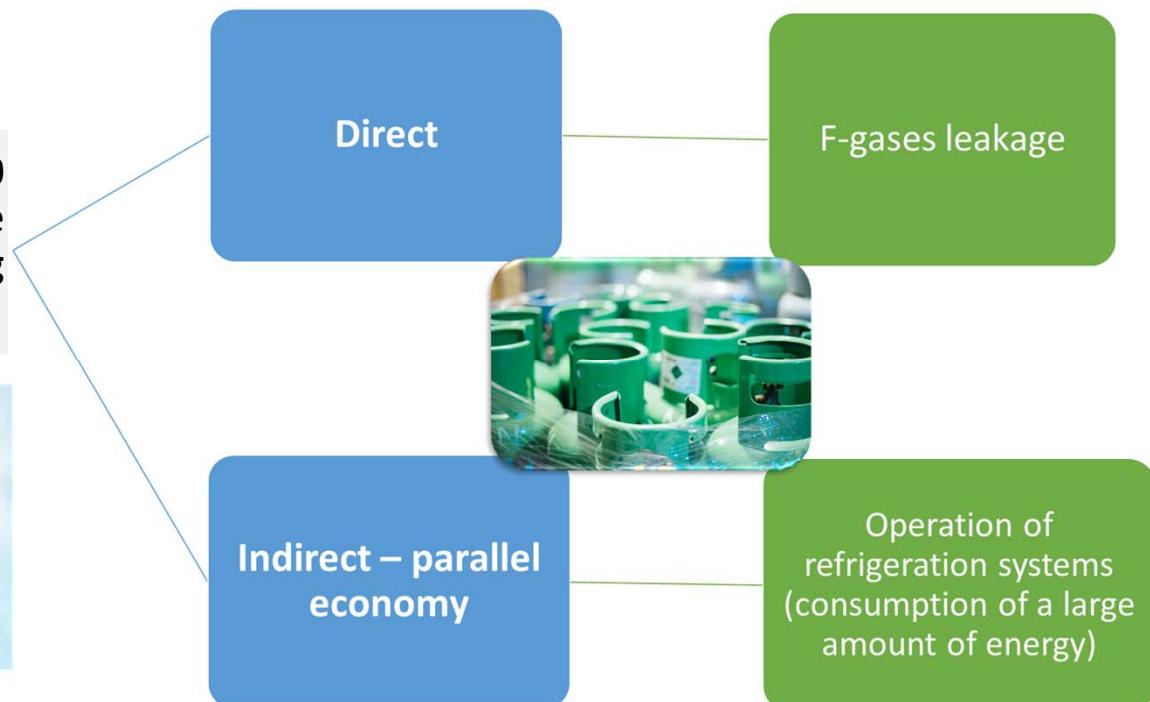
The worldwide production of fluorinated gases is expected to increase for foreseeable future

HFC emissions are projected to grow by nearly **140% between 2005 and 2020**

Refrigerants need proper disposal and recycling procedures

## F-gases are Powerful Greenhouse Gases

Global warming effect up to 23 000 times greater than carbon dioxide (CO<sub>2</sub>), and **their emissions are rising strongly**



## Fluorinated Gases (F-gases) – HFC's

Ozone Depletion Potential (ODP) of approximately zero.



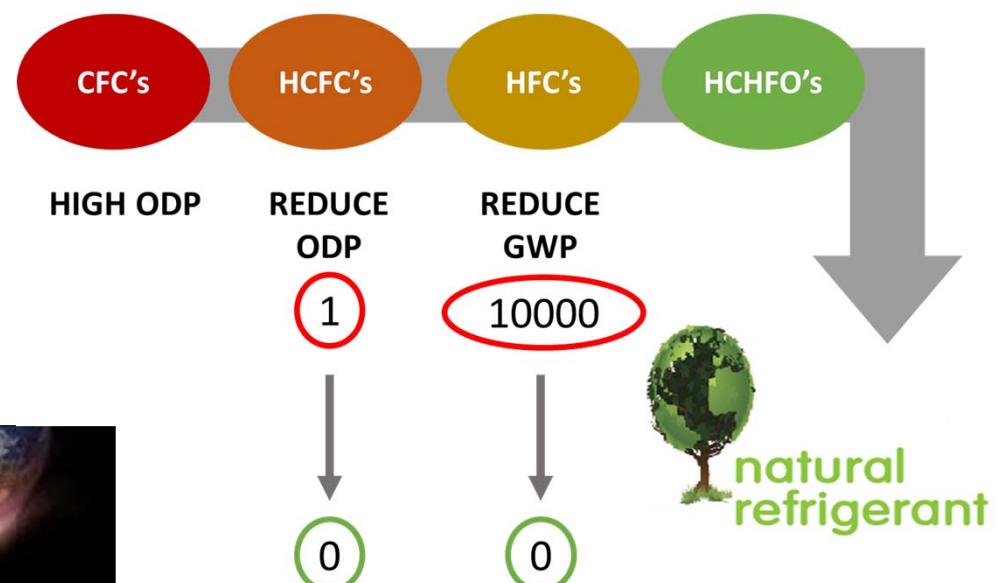
Non-toxic and non-flammable



Present a high Global Warming Potential (GWP)



Synthesized compounds especially designed for different industrial applications such as **refrigeration and air conditioning**.

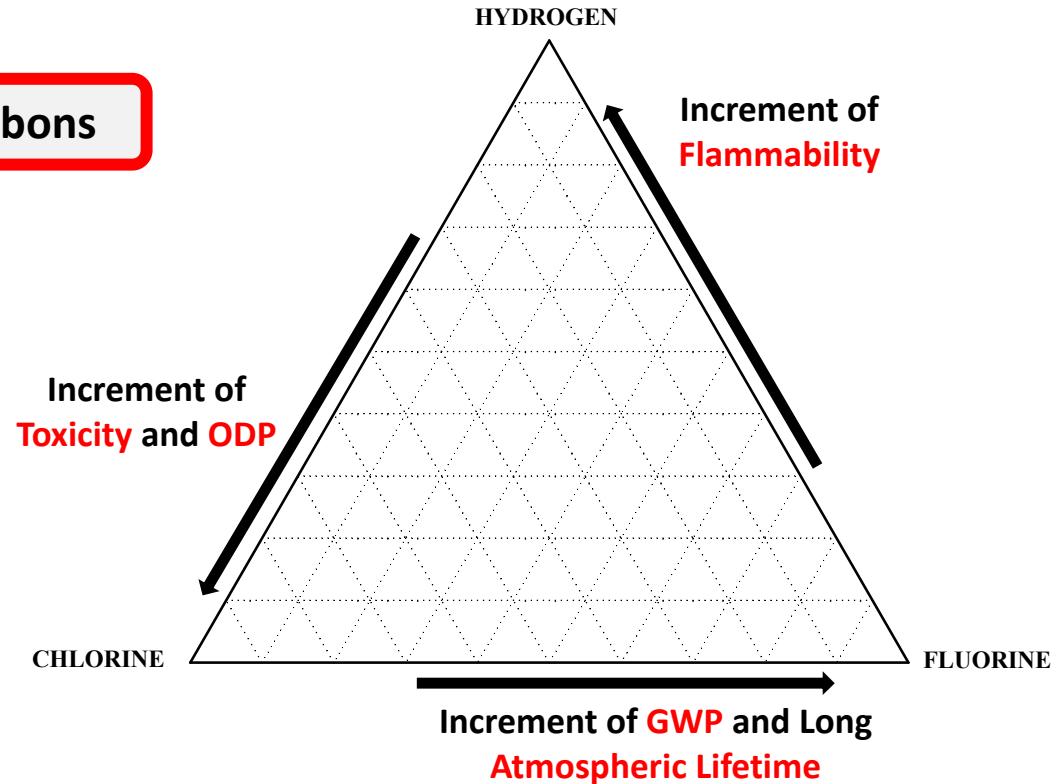


## Refrigerants Chemistry - Fluorocarbons

CFCs, HCFCs, HFCs & HFOs

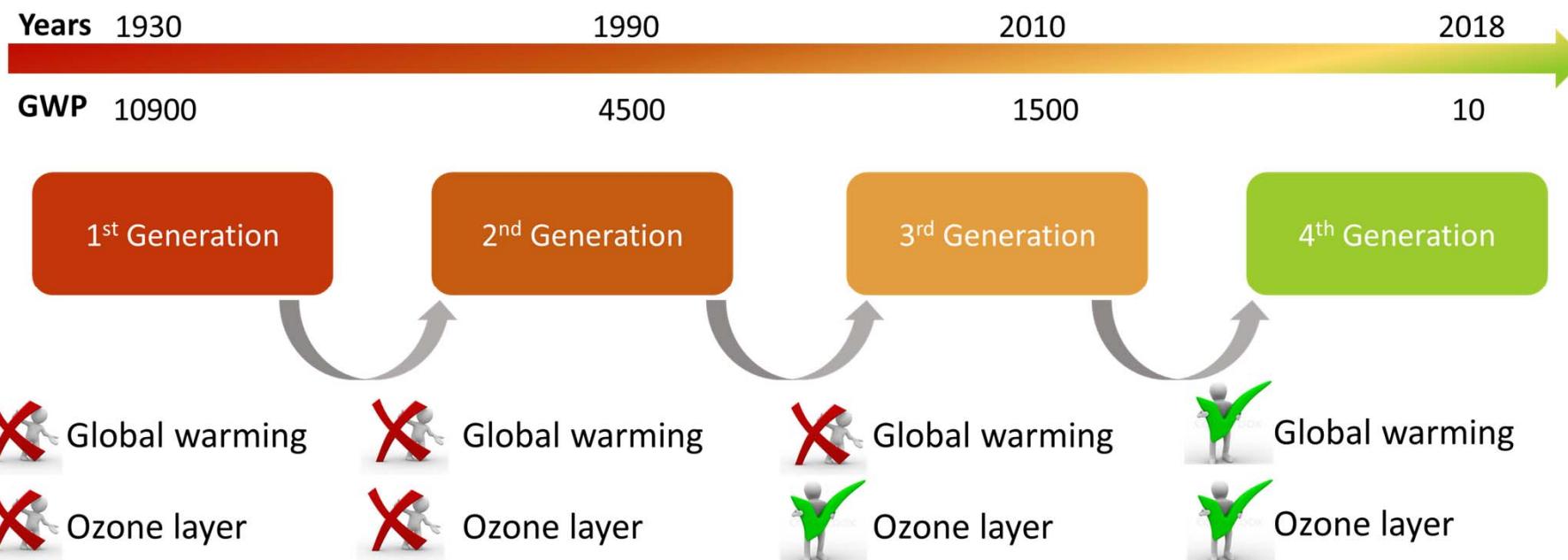
### Limited Combinations

- Adding **Chlorine** or **Bromine** increases Toxicity and ODP
- Adding **Fluorine** increases GWP
- Adding **Hydrogen** increases flammability and lowers atmospheric Lifetime

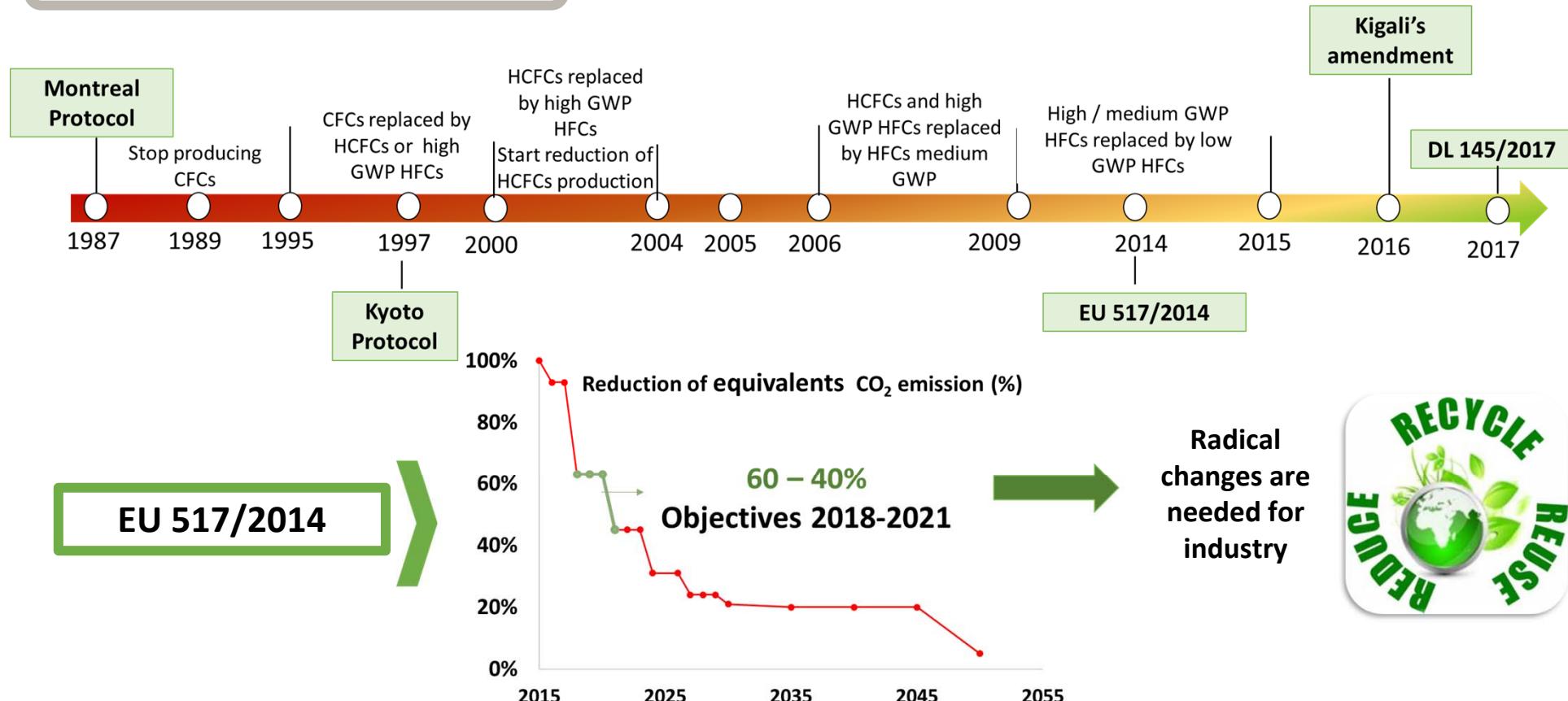


*Trade-off in flammability, toxicity and atmospheric life-time*

## F-gases (Refrigerants 3G & 4G)



## Refrigerants Legislation



## F-gases – economy

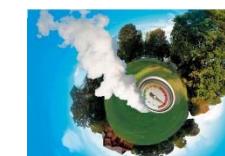
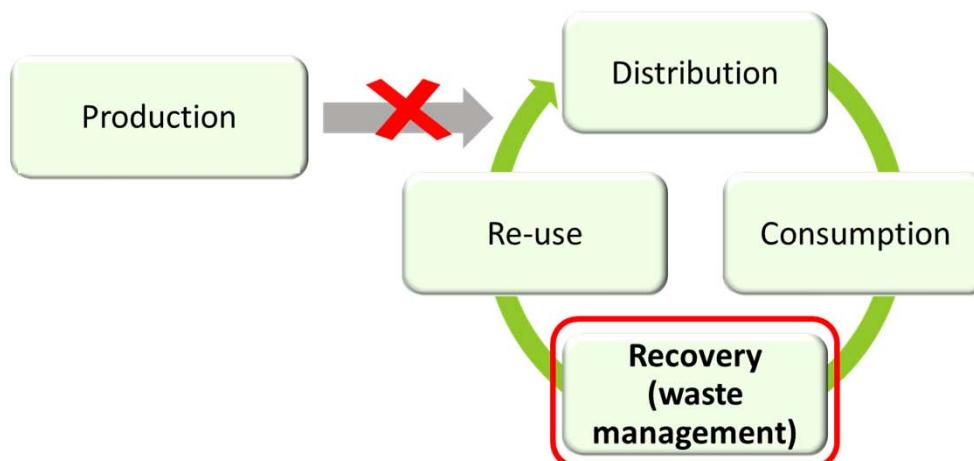
Present → Linear Economy



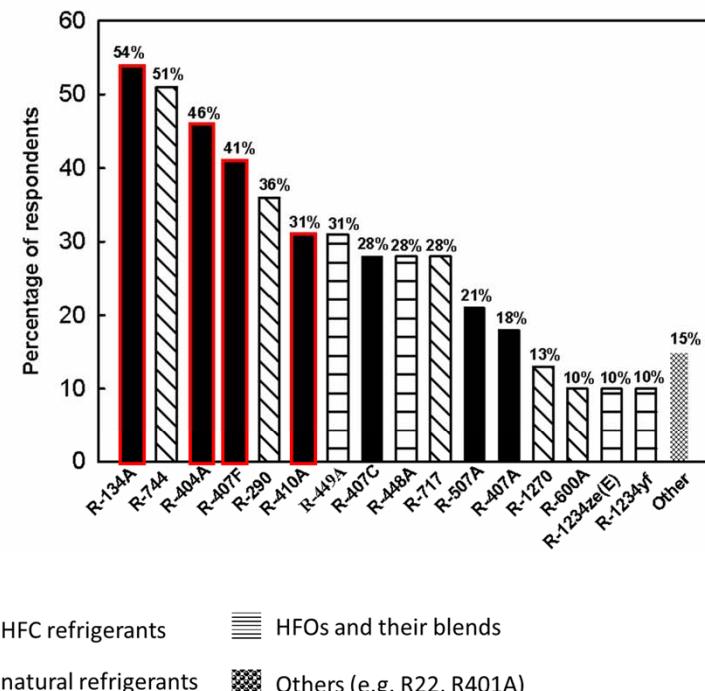
... produce dangerous hydrogen fluoride and transform to trifluoroacetic acid in the atmosphere



KET4F-Gas → Circular Economy



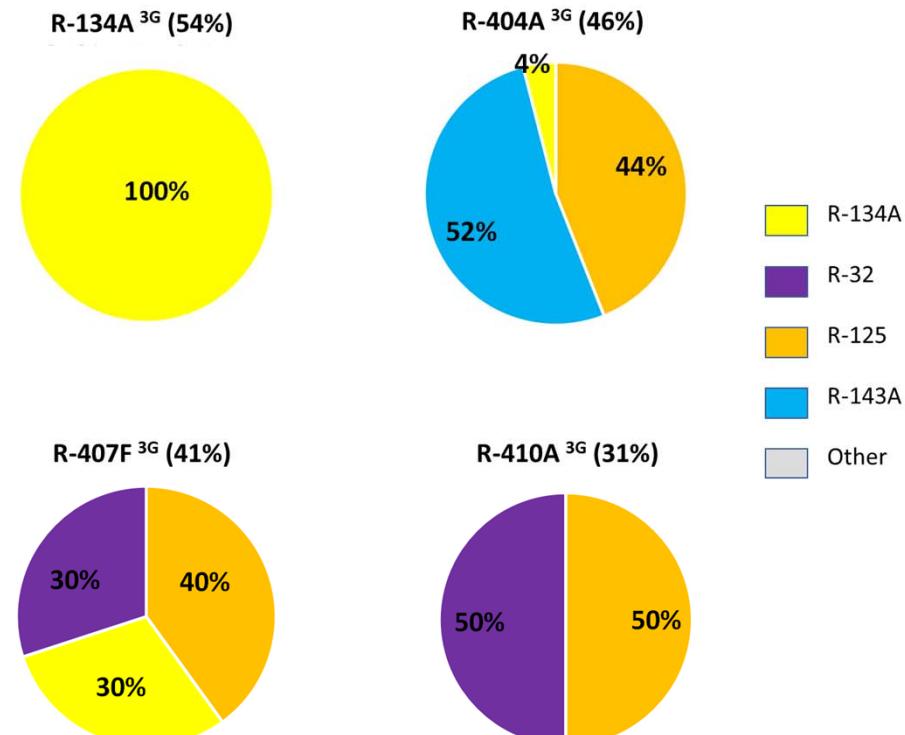
## Refrigerants installed/used for commercial refrigeration – questionnaire EU 2017



Natural refrigerants: R-744 ( $\text{CO}_2$ ); R-290 (Propane)

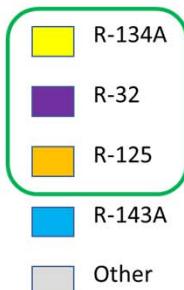
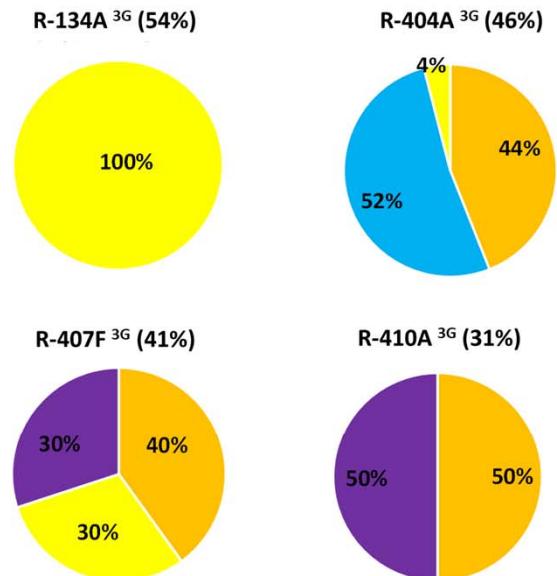
International Journal of Refrigeration 82 (2017) 288–301  
<https://www.oekorecherche.de/en/node/205>

## Refrigerants 3<sup>rd</sup> Generation ( $\uparrow$ GWP)



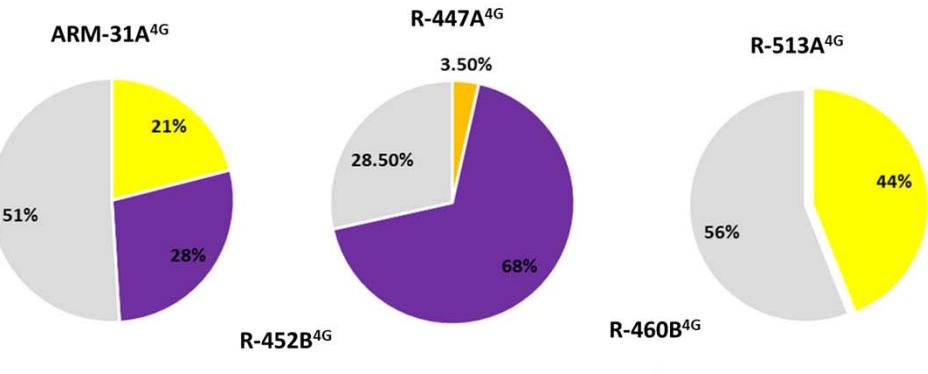
## Circular Economy - “closing the loop”

### Refrigerants 3<sup>rd</sup> Generation (↑ GWP)



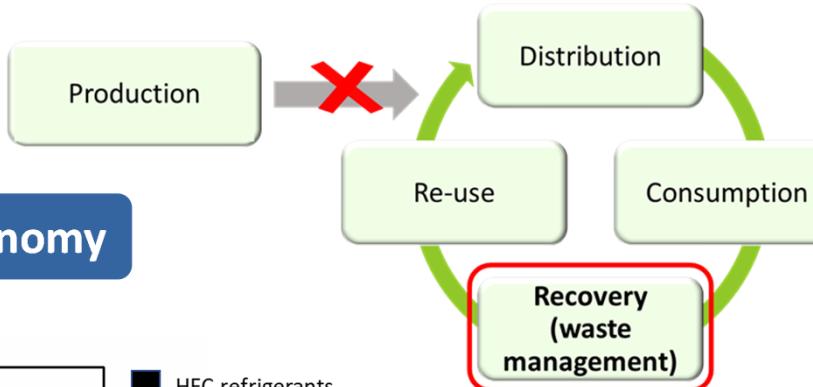
3G	GWP*
R-134A	1430
R-407F	1825
R-410A	2088
R-404A	3922

### Refrigerants 4<sup>th</sup> Generation (↓ GWP)

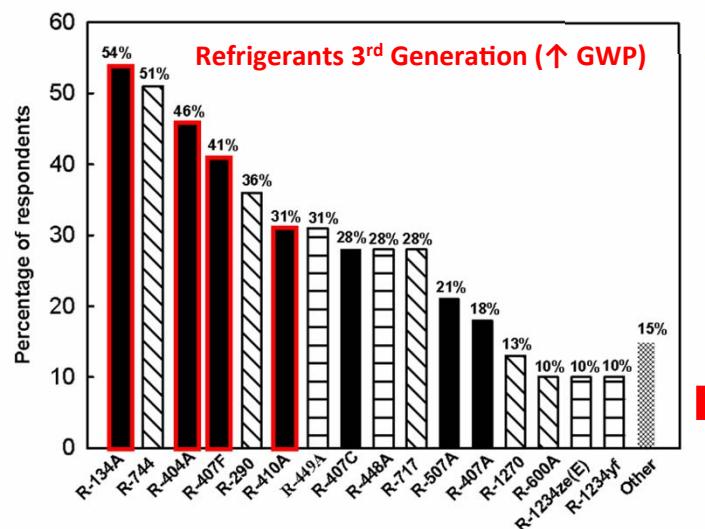


4G	GWP*
ARM-31A	491
R-447A	583
R-513A	631
R-452B	698
R-460B	1352

Recycled F-gases do not have to be declared!!



## KET4F-Gas → Circular Economy



Refrigerants Installed / Used for Commercial  
Refrigeration Questionnaire EU 2017

Recycled F-gases do not have to be declared!!

**FIND OUT MORE**

KEEP UPDATED  
AND PARTICIPATE IN

[www.ket4f-gas.eu](http://www.ket4f-gas.eu)



Research and Innovation



Cooperation depends on you  
[www.interreg-sudoe.eu](http://www.interreg-sudoe.eu)



@SUDOES #KET4FGas



@interregsudoe #KET4FGas



webinar  
MEET4GAS SOLUTION

Hacia la minimización del impacto  
medioambiental de los gases fluorados

 @SUDOE5 #KET4FGas

 @interregsudoe #KET4FGas



Research and Innovation



[www.KET4F-Gas.eu](http://www.KET4F-Gas.eu)

  
Cooperation depends on you  
[www.interreg-sudoe.eu](http://www.interreg-sudoe.eu)



Ana B. Pereiro: [anab@fct.unl.pt](mailto:anab@fct.unl.pt)

NOVA SCHOOL OF SCIENCE AND TECHNOLOGY | FCT NOVA  
NOVA University of Lisbon

NOVA  
NOVA SCHOOL OF  
SCIENCE & TECHNOLOGY

