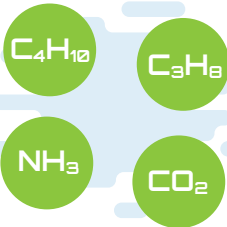


When it comes to the impact of refrigerants on the environment, you can find lots of data but much is used out of context. Here are some of the facts put in perspective.

### NATURAL...

### OR NOT?



Hydrocarbons, such as **Isobutane** ( $C_4H_{10}$ ) and **Propane** ( $C_3H_8$ ), **ammonia** ( $NH_3$ ), and **carbon dioxide** ( $CO_2$ ) are sometimes referred to as "natural refrigerants"

Although they can be found in nature, the gases used are **industrial gases**, just like **HFCs** & **HFOs**, and are produced in **refineries** or other **industrial facilities**

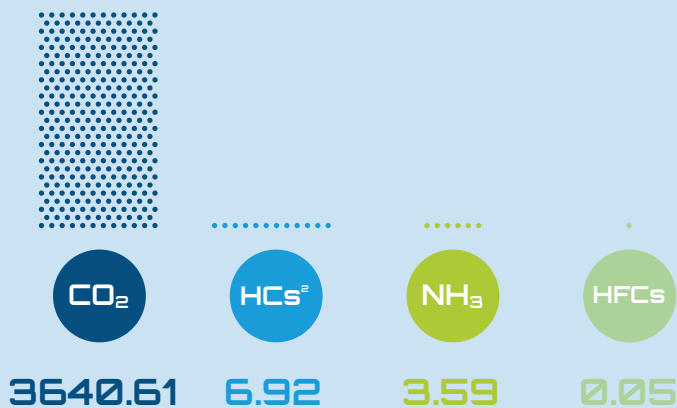


## IT'S ALL ABOUT BALANCE

End-of-Life products of HCs,  $NH_3$ ,  $CO_2$ , HFC and HFO refrigerants occur abundantly in nature. Refrigerant selection should be based upon technical performance and resource efficiency, safety in use, energy efficiency and the lowest GWP compatible with the application, and not an arbitrary and misleading 'natural' label.

### COMPARING ACTUAL EMISSIONS

TOTAL EU EMISSIONS<sup>1</sup> (million tes)



WITH MORE THAN

**69000 X**  
MORE  $CO_2$  EMITTED  
THAN **HFCs**

EMISSIONS OF HFOs ARE MUCH LOWER THAN FOR HFCs

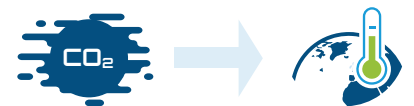
## THE ENVIRONMENTAL IMPACTS OF "NATURAL REFRIGERANT" GASES



**HCs are Volatile Organic Compounds** that cause photochemical smog while breaking down to  $CO_2$  and other compounds.



**$NH_3$  emissions can lead to changes in soil and water quality** and contribute to the formation of particulate aerosols in the atmosphere.



**$CO_2$  emissions are the primary cause of global warming** and persist in the atmosphere for hundreds of years.  $CO_2$  is also a major cause of acidification of the oceans.

<sup>1</sup> Note 1 Total emissions from all sectors including industry and agriculture, reported by Eurostat or EEA. (94% of ammonia emissions are from agriculture in 2010 EEA). HFOs emissions are currently much lower than HFCs.  $CO_2$  and HFCs emissions are for 2015, HCs for 2011, and  $NH_3$  for 2013

<sup>2</sup> Note 2 Hydrocarbons (HCs) are non-methane volatile organic compounds controlled under the Convention on Long-Range Transboundary Air Pollution (LRTAP). Some 80% of the emissions arise from commercial, household and industrial applications (2011 EEA).

## THE ENVIRONMENTAL IMPACT OF HFCs & HFOs BREAKDOWN PRODUCTS

All of the final breakdown products of fluorocarbon refrigerants, already occur in nature in very large quantities and so HFCs & HFOs have little impact.



Fluoride, carbon dioxide and for some refrigerants, **TFA** or formic acid.

**Yes.** Formic acid occurs naturally in the atmosphere. Fluoride is found **all over the globe** and is naturally transported by winds.

Over **200 million tonnes of TFA** are present naturally in both coastal and deep-ocean seawater. HFCs and HFOs will add **only 0.1%** to the amounts already naturally present.

## REFRIGERANT PRODUCTION

Manufacturing all refrigerant gases requires energy due to their production processes.

### COMPARING PRODUCTION



### Other uses



Globally most CO<sub>2</sub> is used for **Enhanced Oil Recovery (EOR, fracking)** mainly in the USA (Global CCS Institute). Other main applications are **beverage carbonisation and food industry usage.**



HCS (LPG) are used mainly as **fuel and also as aerosol propellants and for foam blowing**



NH<sub>3</sub> is mainly used in **industrial production of other chemicals** Including fertilizers



HFCs are used as **propellant in MDIs for asthma treatment** and for foam blowing



HFOs are used for **foam blowing and technical aerosols**

<sup>3</sup> Data sources : McCulloch A. and N.J. Campbell (1998). The Climate Change Implications of Producing Refrigerants, in Natural Working Fluids '98. Proceedings of the IIR-Gustav Lorentzen Conference, June 2-5 1998, Oslo, Norway, pages 191-199, pub. International Institute of Refrigeration, Paris, 1998

<sup>4</sup> CO<sub>2</sub> estimate for Western Europe in 2015, captured from emission streams, fermentation, and natural gas processing plants. Estimated EU refinery production of LPG (2013), Other LPG is produced from natural gas. NH<sub>3</sub> EU production capacity in 2014 (Centre of European Policy Studies)