

We should use fluorine-containing gases as a refrigerant

Answer to specific info request 1:

Applications of fluorinated gases: Refrigeration, Air conditioning, Heat Pump

Answer to specific info request 2:

Applications of fluorinated gases in the use phase: Refrigeration: the application of refrigeration can be organized in the following sections: 1 - Plug-in commercial refrigeration systems > The emission of fluorinated refrigerant is under 0,5% of the charge per year during the life of appliances. 2 - Non Plug-in commercial refrigeration systems > The emission of fluorinated refrigerant is drastically decreasing year per year because of the controls requested by F-Gas Regulation. In 2022 we can estimate the medium emission equal to 8% of the charge per year , decreasing at least 1% every 2 years. 3 - Non Plug-in industrial refrigeration systems > The emission of fluorinated refrigerant is drastically decreasing year per year because of the controls requested by F-Gas Regulation. In 2022 we can estimate the medium emission equal to 4% of the charge per year , decreasing at least 1% every 3 years. Air Conditioning & Heat Pump (AC & HP) in the use phase: 1 - Plug-in AC&HP systems > The emission of fluorinated refrigerant is under 0,5% of the charge per year during the life of appliances. 2 - Non Plug-in AC&HP systems > The emission of fluorinated refrigerant is drastically decreasing year per year because of the controls requested by F-Gas Regulation. In 2022 we can estimate the medium emission equal to 4% of the charge per year , decreasing at least 1% every 2 years. Both Refrigeration Systems and Air Conditioning / Heat Pump are wasted as appliances in RAE center, recovering the refrigerant contained in the appliances. In this end of life phase a good estimation of the medium recovery ratio can be 90% of the refrigerant contained in the systems. All the RAE center are working to improve the efficiency of the recover process increasing the recovery ratio. If the system is not easily transported in RAE center, they are evacuated by contractor using recovery machine and vacuum pump used in the field. In this case 98% of the refrigerant is recovered and recycled using some portable recycling machine (80%) or sent to reclaim center made of company authorized for the reclaiming of the refrigerant (20%). All these value are well estimated inside our industrial association exchanging information also with the Italian association of contractors.

Answer to specific info request 4:

I have information on the hypothesis that it will be necessary to reclaim the recovered refrigerant discharged from systems that must be wasted. To reclaim the recovered refrigerant from the system at end of life of them or under the necessity to waste the same system, it is necessary to have the availability of the contractors in wasting the system and recover the refrigerant + the availability of the reclaiming facility or incineration site + the availability of the contractors to install the new systems not using fluorinated refrigerant (CO2 and R290 in refrigeration equipment + R290 in air conditioning and heat pump). We remember that the R290 systems require qualified contractors that are able to install and maintenance the system. The number of contractors that have this

know how is actually less than 1% of the total number. Discussing with the association of the contractors, they affirm that it is necessary to have the time to certify a sufficient number of contractors to avoid to use refrigeration and air conditioning systems that can cause very dangerous incident with the risk of hundred of death. So al we know that the capacity of reclaiming or the capacity of incineration of the recovered refrigerant could be increased in 3/5 years, but the whole process that require the wasting of the refrigeration and air conditioning systems require at least 15/20 years to be completed guaranteeing a safe use of the R290 equipment or systems. A different consideration must be done to waste the refrigeration system working with fluorinated refrigerant with CO2 system. The critical issue is the energy efficiency of the refrigeration equipment working with CO2; it is much lower if compared vs the energy efficiency of systems working with HFO refrigerant (-25%/-35%) generating and increase of the electricity used by the systems working with CO2 (+25% / +35% if compared vs the systems working with fluorinated refrigerants). The operating cost of the CO2 system are much more higher that the operating cost of the equipment working with HFO. Also the CO2 emitted in atmosphere is 25%/35/ more compared with the technology using HFO); so the adoption of the CO2 technology will produce much more CO2 emitted in the atmosfere. Also in this case it is necessary time for the industries to find the way to increase the energy efficiency of CO2 refrigeration system with acceptable cost. we think that 15/20 years could give the possibility to the industries to find the right solutions to guarantee good energy efficiency.

Answer to specific info request 5:

There are 2 main application of fluorinated refrigerant that should be derogated:

A - All the time the flammability and explosively of R290 (or other hydrocarbon) produce a risk that is too high to be managed. For example: A.1 - Air Conditioning systems in school, hospital, public space, houses, public transportation, exhibition centers where the charge of R290 or hydrocarbon is more than 1 kg > A charge equal to 1 kg has an explosion capacity that can generate many death > This application use in Italy roughly 1'000 ton of refrigerant; in many cases the refrigerant used could be R1234ze or blend of it that do not have PBT characteristics as the other substances and that are not flammable (NOT explosive) or as happen for R1234ze has very low flammability with NO risk of explosion. A2 -Refrigeration systems in supermarket, cold rooms and production equipment where the charge of R290 or hydrocarbon is more than 1 kg > A charge equal to 1 kg has an explosion capacity that can generate many death > This application use in Italy roughly 800 ton of refrigerant; in many cases the refrigerant used could be blends of R1234ze and R32 ; R32 is not PFAS substance; R1234ze do not have PBT characteristics as the other substances. Both are A2L with very low flammability with NO risk of explosion. There are also some blends of R1234ze that are NOT flammable and not explosive. For the same application using these products it could be possible to avoid the use of CO2

systems avoiding the increase of +25%/+35% of electricity used and of CO₂ emitted in the atmosphere.