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APPLiA's comment paper on a document called "*Report summary F-Gas uses*" accompanying the a call-for-evidence process concerning an upcoming PFAS REACH restriction proposal.

APPLiA, the EU Association representing manufacturers of home appliances, including residential refrigeration, heating, ventilating and air conditioning equipment, would like to inform competent authorities of its stance regarding a document called "*Report summary F-Gas uses: Heating, ventilation, and air-conditioning and refrigeration (HVACR), foam-blowing agents, solvents, propellants, cover gases and fire suppressants*"[1] ('*summary report*'), within the context of an upcoming per- and polyfluoroalkyl substances (PFAS) REACH restriction proposal from five Member States.

As a reminder, APPLiA participated in the first Call-for-Evidence (CfE) process from the Member States, back in July 2020. We also provided a contribution to the Exponent consulting company as mandated by the competent authorities, nevertheless, we fail to see the home appliance sector's input being taken into consideration in the summary report, and further in the CfE process.

As a CfE exercise[2] has been launched by these Member States back in July 2021, APPLiA would like to provide specific input and feedback to some sections of a summary report accompanying such a CfE. Our particular comments would thus follow the structure of the summary report with the following key messages:

This paper reflects the home appliance sectorial comments and further recommendations with regards to a published document called "Report summary F-gas uses", which accompanies a new CfE exercise. The content of this comment paper is to be considered within the context of the products' scope that the Association covers, which is domestic equipment, including domestic refrigerators and freezers, domestic thermodynamic water heaters, domestic heat pump tumble driers and domestic fixed single/multi split air-conditioners with a power range below 12kW.

APPLiA key messages:

- *According to its chemical formula, R-32 should neither be identified, nor be covered by the scope of the RoI and its further related new CfE exercise;*
- *Misalignment between the collected quantitative data, and related estimations, with the information available in the Inventory that should be rectified;*
- *The use of F-Gases in heat pumps incorporated in white goods to decrease in the future and it should be highlighted in the Summary Report;*
- *Data on market prices to be clarified and rectified;*
- *We recommend placing home appliance sector's insulation-application in balance with other foam blowing agents applications and their related (estimated) emissions data on F-Gases;*
- *Concerning recycling/reclaiming of F-Gases sites, these need to be in full compliance with the Atmospheric Explosive (ATEX) Directive and related codes, in view of preventing and protecting workers against explosions;*

[1] Report summary F-Gas uses, published online 19.07.2020 (here).
[2] Direct link to the CfE exercise available online here.

- *Reminder of several key pieces of legislations still missing from this report' section: Ecodesign Directive 2009/125/EC and the Energy Labelling Regulation (EU) 2017/1369 with the followed key requirements Directive amending the Energy Performance of buildings (EU) 2018/844 and Directive amending the Energy Efficiency (EU) 2018/2002;*
- *We would suggest an EU-wide approach, i.e. further developing a uniform and consistent approach to set requirements on HVACR equipment using F-Gases across all Member States;*
- *R-32 as a non-PFAS alternative and R-290 as non-viable alternative for all equipment, especially split A2A heat pumps;*
- *Need for the reference quantitative data used to develop such a summary report and its accompanying Appendixes.*

APPLiA products' scope is constituted of the following residential equipment using refrigerants or foam blowing insulation gases:

- Refrigerators and freezers;
- Heat pump water heaters (without space heating function);
- Ice cream makers;
- Dehumidifiers;
- Heat pump tumble dryers;
- Washer dryers;
- Fixed single/multi split air conditioners (<12kW);
- Double duct air conditioners;
- Dishwashers with heat pump technology.

The natural refrigerants regularly used in our industry include R-600, R-600a and R-290, while the synthetic ones cover R-134a, R-410A, R-407C, R-32, HFO-1234yf, HFO-1234ze, as well as blends of such F-Gases.

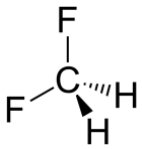
The first point of this comment paper discusses the situation of R-32, as this latter does not meet the definition of PFAS statement, which we support. As such, we would like to highlight some important messages around this refrigerant, and its crucial role in the well-functioning of certain HVACR equipment and the non-necessity to address it under the Registry of Intention (RoI) and further to include such a substance in a REACH Annex XV dossier proposal.

1. The situation of difluoromethane (R-32) (Point 2 "*Main PFAS substances*", p.3)

According to our assessment, **R-32 should neither be identified, nor be covered by the scope of the RoI and its further related new CfE exercise**. The definition used by the five Member States to identify PFAS is as follows:

"X-(-CF2-)n-X' with n ≥ 1 and X, X' not being H (thus including X-CF3) meaning fluorinated substances that contain at least one aliphatic carbon atom that is both, saturated and fully fluorinated, i.e. any chemical with at least one perfluorinated methyl group (-CF3) or at least one perfluorinated methylene group (-CF2-), including branched fluoroalkyl groups and substances containing ether linkages, fluoropolymers and side chain fluorinated polymers."

The chemical formula of R-32 is CH2F2, and its 2-D chemical structure is as follows:



R-32 should not be identified as a PFAS throughout the summary report as published by the five Member States. There is no presence of a fully fluorinated aliphatic carbon atom.

We would recommend the competent authorities to update the summary report accordingly, by further **removing R-32 from the list of substances found under Appendix I, and further including this substance within the list of non-PFAS alternatives as found under Appendix VII**, specifically for the HVACR Market and Foam-blowing applications Tables (p.24-25).

R-32 should be considered as a viable non-PFAS alternative throughout the summary report, during the CfE process, with a view of proposing a PFAS REACH restriction proposal which would be fully in-line with both the OECD-recommendations[3], and the identified definition for PFAS as proposed by the five Member States' competent authorities in July 2021 via the publication of their RoI.

In Annex I of this comment paper, we provide some insightful information on the **tropospheric degradation of R-32**.

As a more general observation from our side, we believe it is essential to promptly determine the RoI scope, and further the Annex XV dossier scope, as regularly changing those would create legal uncertainty and be detrimental to relevant stakeholders within the context of this dossier.

2. General comment on the data-source from which stems the data-collection exercise (Point 3 "Tonnage band", p.3)

The chosen EU reference for the data-collection to gather specific information on PFAS, including tonnages and emissions, i.e. the Greenhouse Gas (GHG) Inventory of data, is the appropriate source. As such, we fully support keeping consideration on this Inventory during any future work of the competent authorities to build their PFAS REACH restriction proposal.

Nevertheless, we would strongly recommend to fully align the collected quantitative data, and related estimations, with the information available in the Inventory.

For instance, regarding Table 1 of page 4, and its next explanatory paragraph:

*"In 2018 in total, **30,671 tonnes/a F-gases are filled into new products** for the first time during their manufacturing process, while 492,173 tonnes/a are found in operating systems (Annual stocks in operating systems refers to products that already contain F-gases and are in operation) used in EU-27 & the United Kingdom (UK) & Iceland (IS) & Norway (NO) (EU, 2020a). Remaining in products at decommissioning is 19,724 tonnes/a F-gases. From the GHG Inventory data for 2018, refrigeration and air conditioning account for 78% (24,093 tonnes/a) of the total amount of these F-gases filled into new manufactured products and 82% (404,315 tonnes/a) of the F-gases in stocks."*

The (bold) highlighted above-tonnage figure cannot be retrieved from the GHG Inventory data. Also, a comparison with the most recent and for industry reliable EEA Report 15/2020 on Fluorinated greenhouse gases 2020 and more specifically with table A5.23 on intended applications of EU bulk supply of F-Gases is not possible in a realistic manner.

[3] *Reconciling Terminology of the Universe of Per- and Polyfluoroalkyl Substances: Recommendations and Practical Guidance*, OECD Series on Risk Management No. 61, July 2021, available online here.

On a general note, **we would appreciate receiving** from the Consultant and/or from the competent authority liable for the F-Gases summary report, **the reference quantitative data** used to develop such a summary report and its accompanying Appendixes. Indeed, the current content of the summary report, the information gathered in such a document, does not allow to fully understand, and corroborate the outputs of the summary report and the figures of its related Appendixes.

Also, please note that not all HFCs are meeting the definition of PFAS (e.g. R-32), therefore, it may be that the (estimated) figures provided in the summary report would need to be reviewed and modified (i.e. deducted) accordingly.

3. Figure 2: Trends of F-Gases supplied for use in products and equipment in EU-28 (2007-2019) (Point 5 "Manufacturing & market price + market development", p.6)

Firstly, we would like to kindly point out that a spelling mistake exists in the summary report, as it should read "Trends in the supply in EU-28 of data 2007-2019 have been reported in the table in Appendix II and illustrated in the figure 3 (and not 2 as currently found in the document).

We would like to provide comments on the next paragraphs, particularly regarding the underlined part:

"Change in demand for refrigeration specifically (leaving aside air conditioning and the use of heat pumps) is likely to follow a mix of population and economic growth over time. However, continued growth of 2.77% has been forecast for refrigeration in Europe over the period 2021-2025 (Statista, 2021). Forecasts beyond 2025 have not been identified relative to units sold, and information on changes in demand for refrigeration as a consequence of climate change is available but does not relate directly to the number of units sold, which is a better proxy for demand for F-gases. The baseline for the use of F-gases in this sector, covering refrigeration, air conditioning and heat pumps, is anticipated to grow strongly up to 2025 and beyond."

We expect the use of F-Gases in heat pumps incorporated in white goods to decrease in the future, i.e. for instance no anticipated growth expectations with regards to heat pumps for tumble dryers, but rather the opposite. It is forecasted that the stock of heat pumps used to decarbonise the building stock will grow in the coming years in order to allow the EU to reach its decarbonisation targets.

We would appreciate it if this difference could be clearly highlighted in the summary report, as well as taken into consideration during the development of the Annex XV dossier proposal from the competent authorities.

"*As for insulation, it has been forecast that growth of 8%/year globally will occur in the insulation market over the period 2020 to 2024 (Global Insulation, 2020). However, a lower estimate of growth in the sector has been quantified for Europe of 3.48% annually over the period 2015-2027 (Pavel, 2018), with wool minerals, and plastic foams (EPS, XPR and PUR) being the dominant materials for insulation. Increased use of PFAS-bearing foams for building insulation where the service life of materials is long will take decades to feed through to the waste sector."*

Concerning "insulation", the forecasted growth as mentioned herein above concerns building insulation, not HVACR equipment insulation covered by the scope of APPLiA.

4. Data regarding market prices or number of production sites for F-Gases used in different applications (Point 6 "Market price & No. of production sites", p.7)

Regarding the next statement as found in the summary report:

"Detailed information on the market price or number of production sites is not given for the F-gases used in different applications."

We would like to recommend the authorities to further check the latest information as gathered by Oeko-Recherche, mandated by DG CLIMA, with regards to the monitoring of refrigerant prices against the background of Regulation (EU) No 517/2014 (Q1 of July 2021)[4]. You will find the pdf-document accompanying this comment paper.

5. Data and estimations on "emissions" (Point 7 "Emissions", p.7)

Regarding the next statement as found in the summary report:

"From the GHG Inventory data (2018) and UN Methodology, it is apparent that the implied emissions during the manufacturing of products and equipment is generally between 0 – 3 % of the F-gases used and mainly from foam blowing agents (closed-cell). By contrast emissions from stocks are significantly higher as would generally be expected and are in the range 0 – 13%. Commercial and industrial refrigeration, mobile and stationary air conditioning accounting for 83% of the total emissions from stocks.

In total, the emissions of F-gases in 2018 from the different uses were as follows:

Manufacturing of products and equipment: 1,696 tonnes /a

Stocks (i.e. service-life): 38,806 tonnes /a"

As already mentioned above, concerning the underlined part, we believe that it is important to breakdown the application "insulation" into different sub-categories of application per sector, including the building sector (i.e. foam blowing agents using F-Gases for insulation purposes), and the home appliance sector (i.e. where for instance very limited quantities of HFOs can be used for insulation materials of refrigerators). On the estimated emissions data for "insulation" as mentioned throughout the summary report, we strongly believe that the F-Gases emissions are primarily stemming from building insulation, not from the home appliance sector. As such, we would highly recommend placing our insulation-application in balance with other foam blowing agents applications and their related (estimated) emissions data on F-Gases.

On another note, we would also like to provide further explanations and clarifications with regards to the importance, for the home appliance sector, of hydrofluoroolefins (HFOs).

As correctly highlighted in the summary report through this next paragraph:

"*Industry stakeholders have underlined the importance of Hydrofluoroolefins (HFOs) and fluoroketone (FK) alternatives during the development of this dossier. Primarily this is because in a number of applications they can substitute the function provided by other F-gases alone or in blends, whilst at the same time having significantly lower global warming potential (GWP). The relative proportion of HFOs compared to other F-gases has been increasing from 2016 – 2019 from 6 to 24%."*

HFOs are already and will continue to be essential F-Gases with regards to certain applications/equipment covered by APPLiA' scope.

[4] Monitoring of refrigerant prices against the background of Regulation (EU) No 517/2014, Q1 July 2021, cfr. accompanying pdf-document to this comment paper.

As a general message on **heat pump technology**, to reach the new climate targets as laid down in the provisional agreement by both the Parliament and the Council on the European Climate Law[5], this type of new and more advanced technology will need to be deployed on a large scale, instead of pursuing with the more conventional technology. As such, it is important to understand that, for some applications (like heating of buildings), F-Gases, including HFOs, are and will continue to play a central role with a view of reaching those climate targets by 2030, and later on by 2050.

Furthermore, we should also keep in mind that 80% of GHG emissions today are related to energy production and energy consumption. The heating and cooling sector represents almost 50% out of the total and final energy consumption. On this latter, 80% out of those 50% is allocated to fossil fuels being used for heating purposes. Therefore, it is important to emphasise that heat pump-based technologies' deployment is highly necessary to mitigate GHG emissions in the EU and achieving the climate targets, as well as for the decarbonisation of buildings under the Green Deal, and the decarbonisation of the energy-infrastructures (e.g. demand side flexibility) as put forward in the Energy System Integration Strategy.

We highly recommend the five Member States competent authorities to fully take into account this latter goal, i.e. **decarbonisation of buildings and energy-infrastructure**, whenever working on their future PFAS REACH restriction proposal.

To conclude under this point, we would like to provide a general comment on the waste-treatment of refrigerants under the WEEE Directive 2012/19/EU. Annex VII, on the selective treatment for materials and components of WEEE equipment referred to in Article 8(2), requires that as a minimum a range of substances, mixtures and components have to be removed from any separately collected WEEE. This includes chlorofluorocarbons (CFC), hydrochlorofluorocarbons (HCFC) or HFCs, and hydrocarbons (HC). In addition, for equipment containing gases that are ozone depleting or have a GWP > 15, such as those contained in foams and refrigeration circuits, the gases must be properly extracted and properly treated. Ozone-depleting gases must be treated in accordance with Regulation (EC) No 1005/2009.

The collection, logistics and treatment requirements for WEEE can be found in the WEEE standard FprEN 50625-1.

As such, the industry and infrastructure in place in the EU for the recollection chain of those substances at the end of life for home appliances is well-established. Hence, industry is able to properly contain the dispersion of those substances in the environment.

6. Workers exposures (Point 8 "Worker exposures", p.8)

Concerning the next paragraph of the summary report, particularly the underlined part:

"Worker exposures to F-gases in plant manufacturing equipment or putting the gases into product should be small, given the need to use closed systems (mentioned by many respondents to the call for evidence). Outside of the manufacturing plant, however, there may be greater exposure of workers, for example at sites reclaiming refrigeration equipment at the end of its service life."

We would like to highlight that, concerning recycling/reclaiming of F-Gases sites, these need to be in full compliance with the Atmospheric Explosive (ATEX) Directive and related codes, in view of preventing and protecting workers against explosions. Indeed, the ATEX Directive describes what type of equipment and environment is allowed for work in an explosive atmosphere. Its codes apply to all equipment intended for use in explosive atmospheres.

[5] Provisional agreement on the European Climate Law, available online here.

Also, these sites must be compliant with several other pieces of legislations stemming from the F-Gas Regulation, i.e. accompanying implementing acts, including:

- Commission Regulation (EC) No 306/2008 of 2 April 2008 (available online here).
- Commission Implementing Regulation (EU) 2015/2066 of 17 November 2015 (available online here).
- Commission Implementing Regulation (EU) 2015/2067 of 17 November 2015 (available online here).

7. Missing legal requirements under the list of legal texts of the summary report (Point 9 "Summary of existing legal requirements", p.8)

We would like to highlight that there are several key pieces of legislations still missing from this report' section: **Ecodesign Directive 2009/125/EC and the Energy Labelling Regulation (EU) 2017/1369**:

- Air conditioners and comfort fans: (EU) No 206/2012 & (EU) No 626/2011
- Water heaters and hot water storage tanks: (EU) No 814/2013 & (EU) No 812/2013
- Air heating products, cooling products, high temperature process chillers and fan coil units: (EU) No 2016/2281 & N/A
- Household Refrigerating appliances: (EC) No 643/2009 & (EC) No 1060/2010
- Household Tumble driers: (EU) No 932/2012 & (EU) No 392/2012
- Household combined Washer driers: N/A & 96/60/EC
- Household Washing machines: (EU) No 1015/2010 & (EU) No 1061/2010
- Space heaters and combination heaters: (EU) No 813/2013 & (EU) No 811/2013

These legislations and their specific requirements apply to HVACR equipment using F-Gases and should thus be carefully considered whenever developing the Annex XV dossier proposal. Also, the next pieces of law should be taken into account:

- Directive amending the Energy Performance of buildings (EU) 2018/844

- Directive amending the Energy Efficiency (EU) 2018/2002

As a general comment, we would like to highlight that there is a certain accretion of diverging requirements on HVACR equipment using F-Gases, particularly at national levels, which further create a challenging environment for manufacturers of household products using such substances. In order to tackle this issue, we would recommend settling an EU-wide approach, i.e. further **developing a uniform and consistent approach to set requirements on HVACR equipment using F-Gases across all Member States**.

The list highlights indeed the main legal texts applying to both F-Gases and the applications/equipment using such substances. Nevertheless, several existing national rules are missing from the list, and we would like to highlight them below, specifically concerning three different Member States: France, Italy and Spain.

1 France: Etablissements Recevant du Public, ERP, Article CH35;

2 Italy: The Presidential Decree No 151 of 1 August 2011 identifying the activities subject to fire prevention controls and regulating the authorisation procedures and controls;

3 Spain: Royal Decree 138/2011;

These pieces of **national legislations should be fully taken into consideration** throughout the work of the Member States in developing a PFAS REACH restriction proposal, within the context of the F-Gases policy area. Indeed, they specifically limit, or even restrict, the use of flammable refrigerants (A2L and A3) in some public and high-rise buildings, including propane (R-290). Thank you for further referring to our comments under point 8 of this comment document, to understand our views on R-290, and the fact that this substance has been inappropriately identified as one of the viable non-PFAS alternatives for use in all applications/equipment covered by APPLiA's scope.

8. R-32 as a non-PFAS alternative and our views regarding the alternatives as suggested in the summary report

As already mentioned, and further recommended under point 1 of this comment document, R-32 should neither be identified, nor be covered by the scope of the RoI and its related new CfE exercise.

The summary report should be modified and updated accordingly, by further removing R-32 from the list of substances found under Appendix I, and further including this substance within the list of non-PFAS alternative-substances as found under Appendix VII, specifically for the HVACR Market and Foam-blowing applications Tables (p.24-25).

Regarding the next wording used to describe the Table of Appendix VII "*Assessment of the availability of fluorine-free alternatives (…)*", we would recommend deleting the underlined part of the explanatory phrase, and replacing with this next more appropriate wording:

"*Assessment of the availability of non-PFAS alternatives for each use disaggregated into subapplication level.*"

Indeed, we believe it is important to recognise and consider that some specific fluorine-based substances such as R-32, are viable alternatives for the proper functioning of certain HVACR applications/equipment, without meeting the definition of PFAS (neither the RoI definition, nor the OECD recommended one). As such, the Tables of Appendix VII should be updated accordingly, fully aligning with the objectives of the PFAS REACH restriction process, i.e. reducing the use and emissions of recognised/identified persistent substances meeting the PFAS definition).

We would also appreciate receiving some clarification on the different reference sources of information from which the list of non-PFAS alternatives is stemming from.

Last but not least, concerning the herein below statement as found in the summary report, on the underlined part:

"Review of the properties of these options (alternatives) indicates a variety of issues. The major constraints relate to safety, technical factors and legislation. However, in many cases the technical issues may be solved in the design of equipment."

We would like to point out that **CE conformity is absolutely necessary whenever placing on the market any HVACR equipment**. As such, CE marking indicates that a product has been assessed by the manufacturer and deemed to meet EU safety, health and environmental protection requirements. It is required for products manufactured anywhere in the world that are then marketed in the EU.

Concerning the choice of a refrigerant by a manufacturer, we would like to inform that it relies on several aspects, such as (i) technical feasibility, (ii) safety, (iii) energy- efficiency (and further improvements potential of such refrigerant), (iv) cost-effectiveness, etc. Therefore, considering and identifying a refrigerant as a "real" alternative for HVACR equipment should not be solely based on the fact that it would be technically possible to build-up an appliance to use such gas in such equipment.

In addition to the choice of refrigerants (and their related GWP impact), reducing their charge in equipment, avoiding leakage, and increasing their recovery and reuse will also contribute in mitigating climate change and reaching the (reduced) CO_2 emissions targets.

The barriers to perform the switch towards non-PFAS alternative refrigerants need to be primarily addressed. It should not be forgotten that **transition towards new refrigerants takes time**, this is a parameter that cannot be forgotten whatever the application considered. Any upcoming REACH restriction on F-Gases would also need to be fully in line with the Ecodesign and energy label specific product rules and studies, as well as with Circular Economy objectives.

Specifically, on highly flammable refrigerants (A3 refrigerants), including R-290, there is currently a low level of training of service personnel and certification. Thorough training on A3 refrigerants is not yet part of any EU certification scheme with regards to installers and service companies, since the refrigerant does not fall under the requirements of Regulations (EU) 517/2014 and (EU) 2067/2015.

For equipment that is not factory sealed a safety-risk currently exists for the installation and servicing if R-290 would be used as a refrigerant. Therefore, training on flammable refrigerant use for installers and service companies and an EU-wide qualification/verification programme is essential. R-290 needs a certification scheme for installers and service companies at the EU-level, prior it is considered as being a "real" non-PFAS alternative.

Safety of use, installation, servicing, maintenance cannot be guaranteed with A3 refrigerants for equipment that needs a large amount of refrigerant, such as split air conditioners. Using R-290 needs specific technical and legal requirements to be fulfilled, such as safety-classified stores (i.e. warehouses) to stock the charged units with the refrigerant, strict transport-measures, etc. All the points mentioned before should be considered whenever discussing R-290 as a refrigerant, regardless of the amount used in an appliance.

To conclude, **R-290 cannot, at this moment, be considered as a generically viable non-PFAS alternative for all equipment, especially split A2A heat pumps or HVACR or other applications that would need more than 150gram of R-290.** Several applications such as household refrigerators and freezers, and gradually also heat pump tumble driers, however already safely use less than 150 grams of flammable refrigerants since many years.. This latter statement should be carefully considered by the Member States competent authorities during the development process of the future Annex XV dossier proposal on PFAS under REACH. We attach our position paper on small single-split air-conditioners and R-290 as an accompanying document to this comment paper.

On another note, **Energy efficiency is an important factor to consider** during the development of the PFAS Annex XV dossier proposal. Care should be taken that any upcoming PFAS REACH restriction does not conflict with that principle, e.g. any upcoming PFAS REACH restriction proposal does not jeopardize the possibility to fulfill the appliance minimum energy efficiency requirements of the EU Ecodesign legislation.

9. Methods used & uncertainties (Point 13, p.14)

As also mentioned at the beginning of this comment paper, **we would appreciate receiving the reference quantitative data** used to develop such a summary report and its accompanying Appendixes. For instance, we would be keen in acknowledging the data used to calculate the IEF factors, as well as the values of the IEF factors used to calculate and provide the output figures (e.g. estimated emissions data) as found throughout this summary report and its Appendixes.

This latter would enable us to understand the methodology used, as well as the equation used to estimate the emissions data: *Emissions = activity data x emissions factors*.

In addition, regarding this next specific question from the summary report:

- *It is unclear if the application stationary air conditioning includes F-gases used in heat pumps*

We would like to understand whether the competent authorities in charge of this summary report are referring to their own classification, or other? In any case, we would prefer to have a separate classification and further assessment regarding stationary air-conditioning and heat pump equipment.

10. Appendixes – APPLiA general comments

Once again, we would like to highlight that the figures found under the Summary Report Appendix cannot be aligned with the information found in the EEA Report 15/2020 on Fluorinated greenhouse gases 2020 and more specifically with table 15.23 on intended applications of EU bulk supply of F-Gases.

With regards to these unclarities, **we would appreciate receiving the reference quantitative data** used to develop such a summary report and its accompanying Appendixes. For instance, we would be keen in acknowledging the data used to calculate and provide the **output figures as found in Appendixes IV and V.**

We invite the five Member States to consider our input as laid down in this comment paper. We further kindly recommend those EU competent authorities to take into account and consider our arguments, as well as address our concerns and recommendations throughout their work to propose an upcoming PFAS REACH restriction dossier.

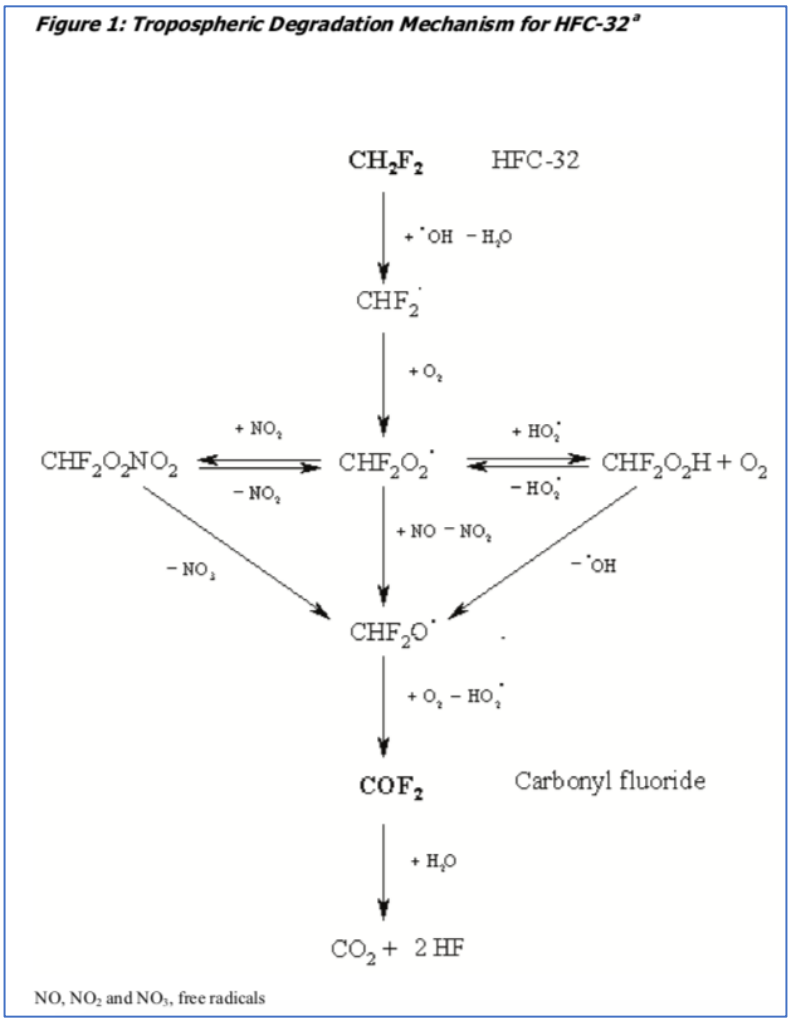
APPLiA and its members remain fully available to discuss the points raised in this comment paper.

ANNEX I – TROPOSPHERIC DEGRADATION OF R-32

The breakdown of R-32 will occur (almost) exclusively in the troposphere and will be initiated by the diatomic molecule ·OH, i.e. the hydroxyl radical.

As seen in Figure 1 herein below, the degradation scheme will proceed via various free-radical or short-lived molecular intermediates, more particularly, to give the intermediate product carbonyl fluoride (COF_2).

Figure 1: Tropospheric Degradation Mechanism for HFC-32[a]



In the troposphere COF_2 has a lifetime measured in days and is predominantly removed by incorporation in water droplets followed by hydrolysis (reacts instantly) and rain out. Reaction with OH radical or photolysis are too slow to be of any significance.[6] It is converted to hydrogen fluoride (HF) and carbon dioxide (CO_2) by hydrolysis[7]. The tropospheric lifetime of COF_2 by physical (wet) removal is estimated at 7 days and its GWP is < 1. [8]. Further, the intermediates peroxynitrate ($CHF_2O_2NO_2$) and hydroperoxide

[6] IPCC/TEAP Special Report Safeguarding the Ozone Layer and the Global Climate System: Issues Related to Hydrofluorocarbons and Perfluorocarbons Chapter 2 pages 152 and 153

[7] Difluoromethane (HFC-32) CAS No. 75-10-5 (Second Edition) JACC No. 54, June 2008, available online here (link to be added)

[8]WMO (World Meteorological Organization), Scientific Assessment of Ozone Depletion: 2018, Global Ozone Research and Monitoring Project–Report No. 58, 2018. Appendix A .

(CHF_2O_2H) that may be formed along the degradation process of R-32 are extremely short-lived.

It is equally as important to highlight that, since R-32 contains neither chlorine nor bromine, it has no effect on stratospheric ozone. Also, as a result of R-32' low reactivity with ·OH, the **refrigerant would not contribute significantly to the formation of ground-level ozone**.
The atmospheric lifetime of R-32 is 5.4 years[9] which means that it is well-mixed in the atmosphere and HF from its degradation would be widely dispersed at extremely low atmospheric and rainwater concentrations. Further, the HF formed from R-32 and scavenged in rainwater would represent a negligible-acidity, at least 25,000 times less than the acidity arising from the global natural and anthropogenic emissions of sulfur dioxide (SO_2) and nitrogen oxide (NOx). As such, **the contribution of R-32 to acid rain would be negligible**[10].

Fluorides are naturally released into the environment through the weathering and dissolution of minerals, and in emissions from volcanoes and in marine aerosols. The major natural source of hydrogen fluoride emissions to the atmosphere is volcanoes. These emissions are estimated to range from 0.6 to 6 million metric tons per year[11]. On average, <10% of these emissions are a result of large eruptions that are efficiently ejected into the stratosphere. Passive degassing is a major source of tropospheric hydrogen fluoride. Soil naturally contains fluoride, and resuspension of soil by wind also contributes to the atmospheric burden of fluorides in the form of soil minerals[12]. Another source is sea salt aerosol, which releases small amounts of gaseous hydrogen fluoride and fluoride salts into the air. The marine aerosol is potentially a major source of tropospheric hydrogen fluoride[13]. However, these releases would be confined to the air over the oceans. Human exposure to fluoride is well understood and includes from the addition of fluorides to dental products[14].

Concerning HF, particularly, the toxicological profile of such a substance as found in the European Chemicals Agency (ECHA) database does not provide any information on its PBT assessment, as this latter does not apply, i.e. it is neither relevant, nor required for inorganic substances[15].

HF is a colourless, corrosive gas that may fume in air. This substance is also highly soluble in water. HF and its aqueous solutions present an acute hazard by inhalation or dermal exposure. Data on this substance were available for developing acute exposure guideline levels (AEGL). As such, marked sensory irritation can occur at exposures greater than

[9] AR6 IPCC Working Group I- Climate Change 2021, The Physical Science Basis- 7.SM Chapter 7: The Earth's 2 energy budget, climate feedbacks and climate sensitivity - Supplementary Material
[10] Difluoromethane (HFC-32) CAS No. 75-10-5 (Second Edition) JACC No. 54, June 2008, available online here.
[11] Symonds RB, Rose WJ, Reed MH. 1988. Contribution of Cl- and F-bearing gases to the atmosphere by volcanoes. Nature 334:415-418.

[12] Biologic effects of atmospheric pollutants: Fluorides. Washington, DC: National Academy of Sciences, National Research Council, Committee on Biologic Effects of Atmospheric Pollutants, 239.

[13] Friend JP. 1989. Natural chlorine and fluorine in the atmosphere, water and precipitation. United Nations Environmental Programme/World Meteorological Association. Scientific Assessment of Stratospheric Ozone: 1989. Alternative Fluorocarbon Environmental Acceptability Study Report.

[14] 2006 World Health Organization (WHO). Fluoride in Drinking-water by J. Fawell, K. Bailey, J. Chilton, E. Dahi, L. Fewtrell and Y. Magara. ISBN: 1900222965. Published by IWA Publishing, London, UK.

[15] ECHA database, Registration dossier of Hydrogen fluoride, CAS number: 7664-39-3, available online here.

3ppm for 1 hour[16]. However, these hazards are not relevant to the extremely low rainwater concentrations from the atmospheric degradation of R-32.

Our HVACR applications using R-32 cannot provide such concentration levels of HF in the atmosphere, which would in turn cause adverse health effects on organisms. Thus, as these HF conditions cannot be found in any type of natural environment due to potential emissions of R-32, we further recommend taking into consideration this aspect during the development of the Annex XV dossier proposal.

Finally, PFAS are defined as a group of organic substances containing a strong carbon-fluorine bond. Due to the R-32 boiling point of -51.7C, when released to the environment it will enter almost exclusively into the ambient air and have little tendency to partition to the hydrosphere, biota, sediment or soil. It has low potential for adsorption (low log K_{ow}) and is expected to rapidly volatilise. R-32 breaks down completely in the atmosphere to inorganic substances that are naturally occurring.

[16] Acute Exposure Guideline Levels for Selected Airborne Chemicals: Volume 4, 2004, available online here.