PFAS exemption application for HFO-1234yf

2,3,3,3-Tetrafluoropropene (HFO-1234yf), CAS No. 754-12-1, without ozone layer damage, with a GWP of 4, low toxicity, good flammability, stability, and compatibility, is an effective substitute for R134a. Currently, it has been promoted and used in the automotive markets of developed countries such as Europe, the United States, and Japan. I believe that HFO-1234yf should not be included in the PFAS restrictions of the five EU countries. Mainly based on the following four explanations.

1. New environmentally friendly vehicle air conditioning refrigerant

HFO-1234yf, as a typical representative of the fourth generation refrigerant, has no ozone-destroying effect, extremely low greenhouse effect, and fully meets the environmental requirements of the United Nations Framework Convention on Climate Change (UNFCCC) to limit greenhouse gas emissions.

By the end of 2021, more than 100 million vehicles worldwide have used HFO-1234yf as a refrigerant. HFO-1234yf has been used as a standard refrigerant in the automotive air conditioning industry in Europe and America, and is in the process of being fully adopted. HFO-1234yf has become the development direction of the global automotive air conditioning application refrigerant. In the European Union, starting from January 2017, vehicles produced and sold must use refrigerants with a GWP lower than 150. HFO-1234yf is the only new type of automotive refrigerant that has been accepted and used by the industry. In China, in May 2022, Honeywell announced the provision of HFO-1234yf refrigerant for NIO Motor ET7. In July of the same year, Volvo Cars announced that they would use HFO-1234yf as a car refrigerant in the Chinese market. In North America, the United States and Canada have passed legislation to ban the use of HFC-134a in new passenger models and light trucks from 2021, and will adopt HFO-1234yf. In Japan, HFO-1234yf will be used as the refrigerant for new passenger models in 2019, and by 2023, the transfer upgrade will be completed and all HFO-1234yf will be used as the refrigerant.

HFO-1234yf, as a new type of green and environmentally friendly refrigerant, is widely promoted and used worldwide. As a fourth generation refrigerant, HFOs are continuously researched, developed, and promoted on the basis of the first three generations of refrigerants such as CFCs, HCFCs, and HFCs. I believe that including HFO-1234yf in the PFAS restriction case is unacceptable and does not comply with the actual development of automotive air conditioning refrigerants. Even if exemptions are granted for 5 or 12 years, it is not possible to develop and prepare an effective alternative to the relevant HFO-1234yf, let alone effectively promote and apply it on a global scale. It is hard to imagine how we feel when we sit in a car with no air conditioning and a temperature of more than 50 ° C on a hot summer day.

2. Overlap with the EU F-Gas Act

I believe that the PFAS restrictions proposed by the EU overlap with the EU F-gas regulation that came into effect in 2006. From the perspective of dual regulations, I believe that fluorine-containing gases are more suitable for F-gas regulations and should not be included in the PFAS restrictions. In order to ensure the smooth

implementation of the Kigali Amendment to the Montreal Protocol, the European Commission announced a new F-gas regulatory proposal in April 2022, which plans to implement stricter controls on hydrofluorocarbons (HFCs). In March 2023, the European Parliament passed a decision on amending the EU F-Gas Act, which aims to better achieve the full phase-out of HFCs by 2050, and raise the phase-out target of 80% to 85% between 2036 and 2047 in the Kigali Amendment to the Montreal Protocol to a higher level. As we all know, HFCs, as third-generation refrigerants, are substitutes for ODS. Although they do not have any ozone layer damaging effects, HFCs are greenhouse gases with high GWP values. After the adoption of the Kigali Amendment, the Montreal Protocol opened a new chapter in the collaborative response to ozone layer depletion and climate change. I believe that this step-by-step reduction and differentiated reduction in different regions with different levels of economic development are more in line with the historical process of refrigerant development and the objective laws of things' development. We believe that the inclusion of fluorinated gases in the PFAS restriction measures proposed by the alliance is unnecessary and objective.

The development of refrigerants originated in the 1830s, from the first generation of NH_3, CO_2 and other less safe natural working substances to the second generation of fluorochloroalkanes (CFCs) and hydrofluorochloroalkanes (HCFCs), Until now, the third generation of hydrofluoroalkanes (HFCs), which is still widely used, and the fourth generation of hydrofluoroolefin (HFOs), which is being developed and promoted, have been around 200 years. In order to protect the ozone layer, the international community took active action and concluded the Vienna Convention for the Protection of the Ozone Layer in 1985. In 1987, the Montreal Protocol on Substances that Deplete the Ozone Layer was concluded, proposing deadlines for limiting and replacing CFCs. In order to strengthen the control of non carbon dioxide greenhouse gases such as hydrofluoroalkanes (HFCs), the international community passed the Kigali Amendment in 2016. The concept of green, environmental protection, and sustainable development runs through the entire historical development process of refrigerants. It is no exaggeration to say that the development of refrigerants is a firm practitioner of the concept of green, environmentally friendly, and sustainable development. If we follow the PFAS restriction measures proposed by the European Union, the transitional period of the bill is only 18 months (1.5 years), and even if we can obtain an extended exemption, it will only be 5 or 12 years. I believe this is likely to be far from enough. This does not fully consider the historical facts of the development of refrigerants mentioned above, and is also contrary to the internationally agreed development concept and implementation method of UNFCCC refrigerants.

3. Degradation of HFOs and the Harmfulness of Trifluoroacetic Acid (TFA)

Fluorinated olefins (HFOs), under ultraviolet light irradiation in the atmosphere, combine with hydroxyl radicals (OH) and degrade to produce trifluoroacetic acid (TFA). Fluorinated gas itself is not a persistent substance proposed in the PFAS restriction case, but a precursor of TFA.

On page 1 of the proposed restriction proposal, it is mentioned that “When these substances and their degradation products continue to be released to the environment, the concentration in the environment will increase as mineralization under natural conditions does not take place for the PFASs in the scope of this restriction proposal. Once present in the environment, the removal of PFASs from surface water, groundwater, soil, sediment and biota is technically extremely difficult and very costly, if at all possible. ”（page 1）

From Reference 1, we can conclude that TFA is formed as an acid in the atmosphere, and when it reaches the surface (soil or water), it can undergo low-temperature mineralization and form salts with alkali metals (such as sodium, potassium, calcium, etc.). TFA salts lack reactivity and are relatively persistent in the environment, with an estimated half-life ranging from hundreds to thousands of years. Therefore, fluorinated gases as TFA precursors should not be included in PFAS. Meanwhile, through reference 1, we can also learn that PFCAs can be mineralized at low temperatures to generate corresponding salts, which can be extended from PFCAs to other perfluorinated and polyfluoroalkyl substances. The degradation rate is fast, and the reaction conditions are mild, providing a new pathway for the degradation of perfluorinated or polyfluoroalkyl substances.

At the same time, regarding the toxicity of the degradation product of HFO-1234yf, trifluoroacetic acid (TFA), by reference to 2, the report submitted by the Norwegian Environment Agency, the summary mentions:“A systematic review of the literature alongside consultation identified a number of knowledge gaps which need to be addressed to conclude whether HFOs and their degradation products, namely TFA（trifluoroacetic acid）（）will have negligible effecton the environment and human health. The risk assessment performed indicated the toxicity risk of TFA to organisms and human health appears to be low.”（Summary）

We can conclude that the toxicity of TFA to biological and human compositions is very low. Since TFA, the degradation product of HFOs, is of little harm, and TFA is mineralized and decomposed at low temperature, it is meaningless to include HFOs in the PFAS restriction case.

4. Serious hindrance to international economy and trade

The first item mentioned above has pointed out that HFO-1234yf, as a new type of environmentally friendly refrigerant, has begun to be promoted and used globally in automotive air conditioning. If HFO-1234yf is directly included in the PFAS proposed restriction case, the trade of this product will be greatly restricted, and supply chains around the world will be severely disrupted. I believe that even if alternative substances are currently being developed, they still need to undergo repeated experiments and evaluations, so it will take a considerable amount of time to be implemented. Moreover, HFO-1234yf is the latest environmentally friendly refrigerant that has been developed and successfully applied. The description of refrigerants in Annex XV of the proposed restrictions (page 93), it is also mentioned that“The lack of availability of alternatives would be problematic for both producers and consumers. RO1 would cause loss of producer surplus from the likely withdrawal

of some product lines with some risk of business closure and loss of consumer surplus through the lack of availability of alternatives that are either safe to use or provide the necessary level of performance.”

The lack of substitutes can cause problems for both producers and users. For producers, the withdrawal of product lines will lead to a decrease in product profits and a risk of bankruptcy for the enterprise. Similarly, whether the safety and performance of substitutes meet the standards can also pose risks to users.

Refer to attachment

1. Trang B, Li Y, Xue X S, et al. Low-temperature mineralization of perfluorocarboxylic acids[J]. Science, 2022, 377(6608): 839-845.

2. Fleet, David, et al. "Study on environmental and health effects of HFO refrigerants." Report Prepared for the Norwegian Environment Agency M-917/2017 (2017).