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PFAS emissions to air:
The forgotten pathway?

Various regulatory developments and growing appreciation of the potential impacts through different environmental pathways has seen global attention placed on PFAS compounds. However, the importance of the emissions to air pathway is now becoming recognised as an important component of the overall risk assessment framework for PFAS. Yet the complex behaviour of these compounds in the atmosphere can present significant challenges to their robust assessment.

In this briefing note, we explore what PFAS are, why they are considered an environmental risk, and why their unique physicochemical properties increase the complexity of environmental impact assessments for this group of compounds in the context of this pathway. We explain how Logika Group is taking a leading role in the development of new procedures for supporting more robust assessment of PFAS emissions to air on behalf of operators who may be subject to future regulatory action on the use of these compounds, or policy makers considering emission limits.

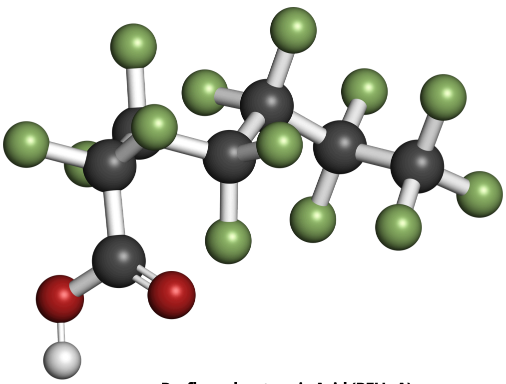
What are PFAS?

PFAS is a generic term used to represent a large family of synthetic organic compounds that contain fluorine. There is no universally accepted definition as to what counts as a PFAS but the Organisation for Economic Co-operation and Development (OECD) definition is perhaps the most widely used internationally:

"Fluorinated substances that contain at least one fully fluorinated methyl or methylene carbon atom (without any H/Cl/Br/I atom attached to it), i.e. with a few noted exceptions, any chemical with at least a perfluorinated methyl group (–CF_3) or a perfluorinated methylene group (–CF_2–) is a PFAS."

The OECD estimates there are approximately 4,700 unique PFAS compounds with CAS registration numbers that make up the PFAS family. However, there are potentially more than 10,000 unique compounds that could exist.

The PFAS family can be divided into two classes – polymers and non-polymer PFAS. The non-polymer class can be further divided into two sub-classes – perfluorinated alkyl substances and polyfluorinated alkyl substances. It is also possible to define many other groups and sub-groups within these sub-classes including, for example, perfluoroalkyl acids (PFAAs), perfluoroalkyl ether acids (PFEAs), fluorotelomers etc.



Perfluoroheptanoic Acid (PFHpA)

Whilst there are a larger number of PFAS compounds, one aspect they all share is a carbon-fluorine bond, and it is this bond that provides PFAS with their unique properties. As the most electronegative element, when fluorine forms a covalent bond with carbon, it pulls electrons in that bond towards it providing partial ionic character to that bond. The fluorine atom adopts a partial negative charge and the carbon atom a partial positive charge. As a result, the carbon-fluorine bond is the strongest bond in organic chemistry.

Consequently, as a result of the carbon-fluorine bond, PFAS retain unique physical and chemical properties which make them valuable compounds for use in a wide variety of everyday applications. These properties include:

- Oil, water, stain and soil repellence
- Thermal stability
- Low chemical reactivity
- Low flammability
- Low co-efficient of friction
- Some PFAS, such as PFAAs, have an amphiphilic structure with a hydrophobic fluorinated alkyl chain "tail" and a hydrophilic functional group (e.g., carboxylic acid) "head". This makes them excellent surfactants, exceeding the performance of other hydrocarbon-based surfactants.

These unique properties have resulted in PFAS becoming ubiquitous in everyday life since their discovery in the 1930s and first mass commercialisation in the 1950s, with use in applications as diverse as construction materials, aqueous film forming firefighting foams, food wrappers, non-stick coating appliances, waterproof clothing, stain repellent finishes on furniture etc.

Health and environmental concerns of PFAS

The specific properties of PFAS which make them an important component of modern life also present certain risks. The strength of the carbon-fluorine bond means that they do not degrade easily in the environment which can lead to their persistence.

Some PFAS, particularly the shorter chain length compounds, are highly mobile and easily transported in groundwater, surface water and soil. Other PFAS have potential negative health impacts and can be bioaccumulative, with longer chain compounds exhibiting greater bioaccumulative properties than the shorter chain compounds.

Of the many non-polymeric PFAS compounds forming the PFAA sub-class, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), are, perhaps, the most widely known and studied, with PFOA recently classified as a Group 1 (carcinogenic to humans) compound, and PFOS a Group 2B (possibly carcinogenic to humans) compound by the International Agency for Research on Cancer (IARC). However, not all PFAS pose health risks. Polymeric PFAS, such as polytetrafluoroethylene (PTFE), for example, are not typically associated with health risks and classed as polymers of low concern (PLC).

Awareness of the potential health risks of certain PFAS was first identified in the 1970s when several employees working with PFOA and PFOS became ill and the compounds were detected in their blood. However, it was not until the early 2000s when improvements in analytical methods began to detect PFOA and PFAS more widely in a range of different environmental media.

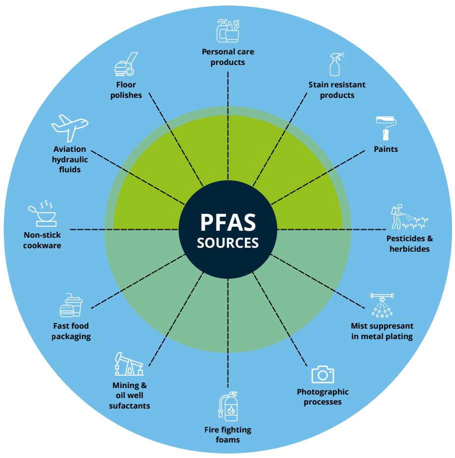
The potential health implications of certain PFAS, plus further improvements in our understanding of their behaviour, and ever decreasing analytical limits of detection, has recently expanded focus to all other PFAS.

Human exposure to PFAS occurs through a wide variety of pathways including inhalation, ingestion and dermal absorption. To date, most focus has concerned exposure through consumer products and industrial discharges to water and ground, including associated ingestion of contaminated water and foodstuffs grown on land contaminated with PFAS. Until recently, little attention had been given to environmental exposure through the inhalation pathway, but this is now starting to be recognised as a potentially key exposure route.

Recent regulatory developments in Europe and the UK

In 2023, five European countries submitted a proposal to the European Chemicals Agency (ECHA) that would provide dramatic, wide-ranging restrictions on the use of PFAS in Europe. The proposed restriction would prohibit both the manufacture and use of PFAS in Europe after a transition period, with the length of the transition period lasting between six and a half and thirteen and a half years dependent on sector and application after the entry into force of the restriction. Following an initial consultation in 2023, the five proposal-submitters updated the restriction proposal in 2025 to include assessments for eight sectors not named in the initial proposal, and to explore alternative restriction options for certain applications. In mid-March 2026, ECHA launched a 60-day consultation on the draft opinion for the proposed universal PFAS restriction. This consultation is a critical point in the restriction process: it will directly inform the final opinion and, ultimately, the shape, scope and conditions of any adopted restriction. Logika Group has provided further detail on this consultation separately, here.

Under the Industrial Emissions Portal Regulation (IEPR), industrial installations in Europe are required to report on their emissions to air and water of a suite of specific pollutants. These are made publicly accessible via the Industrial Emissions Portal (IEP). Based on analysis conducted by Logika Group and partners for the European Commission, discussions are currently ongoing with respect to incorporating new pollutants within the IEP. Among these potential new pollutants are PFAS, which would require operators to start reporting emissions to air of PFAS from 2028.



In March 2024, the Flemish authorities published the very first Best Available Techniques (BAT) guidance for PFAS emissions to air in Europe in recognition of the role PFAS emissions to air has on the overall risk assessment framework. In addition to establishing control techniques, this guidance introduces a specific impact assessment methodology for PFAS emissions to air. At present, the method only considers the inhalation pathway but stresses the importance of effects to soil, groundwater and surface water receptors from deposition.

In the UK, the Health and Safety Executive (HSE) and Environment Agency (EA) published a regulatory management options appraisal (RMOA) for PFAS in March 2023. Supported by a series of environmental risk evaluation reports, this analysis concluded that, although there are measures in place within the existing UK regulatory framework, there are gaps in regulation for both consumer exposure and environmental control, with emissions from source only controlled for certain installations, and an environmental quality standard only in place for one PFAS compound (PFOS in water).

Following on from the RMOA, in February 2026, the UK Government published its PFAS Plan. Several of the proposed actions of this plan specifically target industry and emissions to air as part of a wider framework which seeks to better understand the variety of PFAS sources, tackle exposure pathways and to reduce exposure. In the context of emissions to air, one proposal includes adding PFAS to the UK Pollutant and Release Transfer Register (PRTR), the UK equivalent of the IEPR, which would require UK operators to report their emissions to air of PFAS. Other actions include the development of cross-sector guidance for regulators, operators, and industry regulated through environmental permits to reduce emissions of PFAS and improve their handling, monitoring, and disposal. This guidance would then be used to identify how best to ensure appropriate measures are in place to control PFAS, which could include reviews of relevant environmental permits and development of new BAT guidance. The UK Government is proposing to develop scientifically robust and defensible environmental thresholds and standards for emissions to air, land and water for PFAS which are hazardous or have other properties of concern.

Where and how can PFAS be emitted to air from industrial activities

Recent Logika Group research has identified that numerous industrial processes regulated under the Environmental Permitting (England and Wales) Regulations 2016 (EPR) have the potential to emit PFAS to the atmosphere. These emissions can originate directly from PFAS being used as an ingredient in raw materials or intermediates, or as a result of formation during the industrial process itself. The types of emission sources include both point source (stack) and fugitive (diffuse) emissions. It is also possible for other PFAS to form in the atmosphere as a result of secondary transformation of precursors emitted from industrial activities.

Whilst the nature and type of PFAS emitted to air differs by individual sectors, there are common uses of PFAS, and associated emissions to air, which are cross-cutting and applicable to multiple sectors. These cross-sectoral emissions are associated with the use of fluoropolymers in industrial equipment, the use of refrigerants incorporating hydrofluorocarbons (HFCs), and the use of firefighting foams.

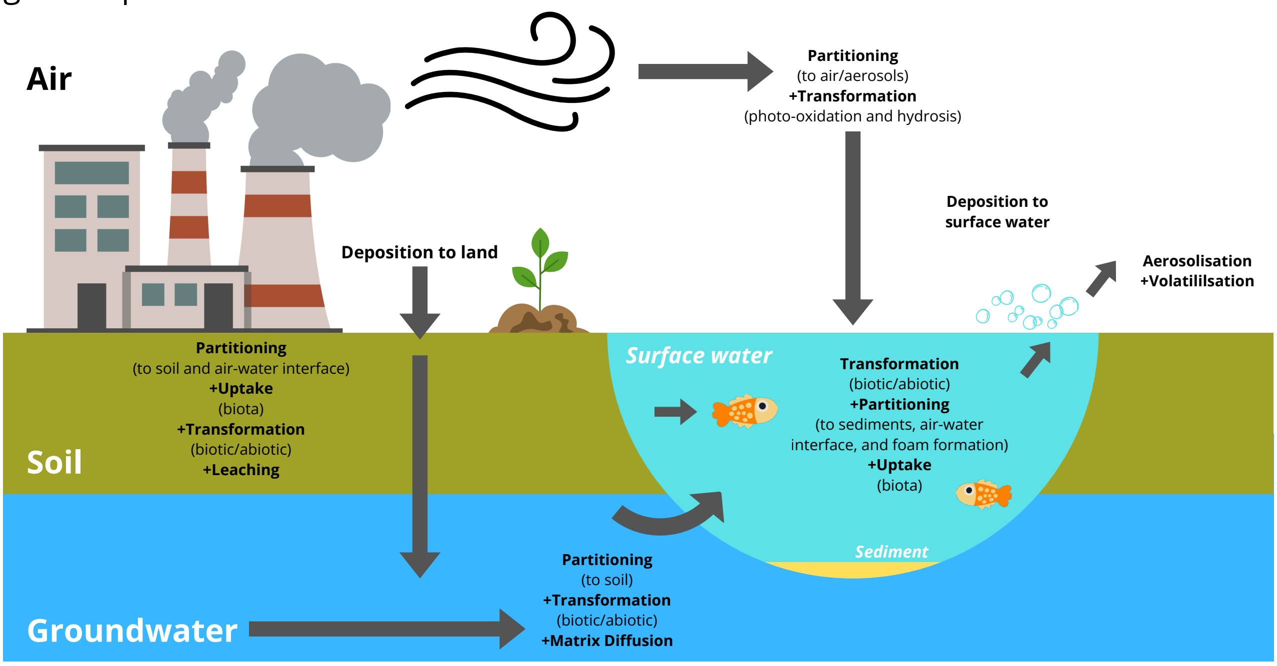
In general, “neutral” PFAS i.e., those which do not have a charged functional group or dissociate in the environment, are more relevant to the emission to air pathway due to their greater volatility, meaning that they are often found in the vapour phase at typical environmental conditions. This group includes fluorotelomer alcohols (FTOHs) and shorter chain perfluorocarbons (PFCs). Sectors of particular relevance for these types of emissions include metal production and plating; fluorocarbon production; semiconductors; landfill; wastewater treatment; paper and board manufacturing; the production of textiles, upholstery, leather, apparel and carpets; and the manufacture of paints and coatings and application to surfaces.

Although less volatile, processes that involve agitation of aqueous media containing ionic PFAS, including PFAAs, can result in fugitive emissions to air through aerosolisation. Similarly, fugitive emissions of dust from the storage and handling of solid materials or residues containing PFAS is an important pathway for this group of compounds. Processes involving the application of heat also increase the potential for PFAAs and related compounds to be found in point source emissions. This is a consequence either of increased volatilisation at higher temperatures or the thermal degradation of precursors. Relevant sectors include wastewater treatment; fluoropolymer manufacturing; waste incineration; composting; ash recycling; and battery recycling amongst others.

Complexity of assessing the environmental impacts of PFAS

The complexity of assessing the environmental impacts of PFAS emissions relates to the wide variety of compounds that form this group and their vastly different physicochemical properties which affects their behaviour (fate and transport) in the environment, combined with the large number and different uses of these compounds. Due to this significant variability, detailed exposure assessments for PFAS should consider both compound and site/location characteristics. It is difficult to perform such assessments for PFAS as an overall group using a proxy compound in the same way that is possible for groups of other organic compounds e.g., polycyclic aromatic hydrocarbons (PAHs). As emerging pollutants, there are also no Environmental Assessment Levels (EALs) in the UK for PFAS in air, whether that be as a group or individual compounds.

Exposure assessments focusing on the emissions to air pathway can be particularly challenging. The wide variety of PFAS compounds and associated chemical and physical properties means they are often emitted to air in different phases (for some emission sources, it is possible for the same compound to be emitted in multiple phases). Once emitted to the atmosphere, PFAS can further partition between these phases. This has important implications for PFAS deposition to the surface, with recent research from scientists at the US EPA demonstrating partitioning plays a crucial role in both the magnitude and spatial distribution of PFAS deposition due to the enhanced deposition in the particle phase compared to the gaseous phase.



Although chemical stability is inherent to all groups of PFAS, there are certain PFAS, including the polyfluorinated alkyl substances, that are less stable or more subject to transformation than others. In polyfluorinated substances, the other types of bond on the main alkyl chain, for example the carbon-hydrogen bond, can allow transformation through abiotic and biotic degradation. This generally results in transformation to the more stable PFAAs.

For example, it is possible for fluorotelomer alcohols to degrade to their associated perfluorocarboxylic acid e.g., 8:2 fluorotelomer alcohol (8:2 FTOH) can degrade to PFOA, whilst certain HFCs can degrade to trifluoroacetic acid, an ultra-short-chain PFAA. It is possible for these precursors to be emitted with their equivalent PFAA itself, so any assessment focussing on the PFAA would need to consider additional contribution from the secondary transformation of the precursor.

Due to their persistence and bioaccumulative properties, long-range transport and deposition to soil and surface waters, with subsequent biotransformation, are also important aspects to support a complete risk assessment. The US EPA, for example, assessed that more than 95% of one particular PFAS compound was expected to be transported more than 150 km from an emission to air source. The unique behaviour of PFAS compounds in the atmosphere means that current 'off-the-shelf' regulatory approved dispersion models are unlikely to be suitable for providing a robust, complete risk assessment of PFAS emissions, as they are not typically complex enough to sufficiently represent PFAS partitioning and transformation, or for modelling long-range transport.

How is Logika Group addressing PFAS impact assessments and regulatory developments?

Logika Group is one of the UK's leading independent environmental consultancies, underpinned by a growing team of more than 150 experts in environmental policy, strategy, design and assessment. We have significant expertise in the development, implementation and evaluation of environmental policies focussed on PFAS, in addition to PFAS impact and exposure assessment.

Logika Group's industrial emissions and permitting team is investing in the development of new procedures and tools for supporting more robust environmental risk assessments of PFAS. This includes pioneering work using more detailed chemical transformation models (CTMs) to account for the dynamic partitioning of PFAS compounds within the atmosphere, enabling more accurate assessment of PFAS deposition and long-range transport. We have led emissions to air and water monitoring surveys for one of the larger emitters of PFAS in the UK and supported the development of new stack emissions monitoring methods for novel PFAS compounds. Our team of permitting experts have detailed knowledge of techniques to reduce PFAS emissions to air and water, including studies to identify the Best Available Technique (BAT) and support subsequent permit variations to allow the installation of new control techniques. Through collaboration with partners, we are also leading the way in the development of Environmental Assessment Levels for PFAS in ambient air. Most recently, our policy team has been commissioned by the European Commission to draft technical guidelines for methods facilitating monitoring and reporting of PFAS as part of the revision to the Industrial Emissions Directive (IED) and Industrial Emissions Portal Regulation (IEPR).

Our water management and flood risk/drainage team have been commissioned to provide design and regulatory advice in support of Regulation 61 notices relating to the potential presence of PFAS. This includes liaison with the Environment Agency, sampling of the associated outfalls and watercourses, testing for potential pollutants, monitoring flows, and preparation of technical reports.

Our environmental policy and economics team includes members of ECHA's network of REACH socio-economic analysis and analysis of alternatives practitioner (NeRSAP) group, members of the UK REACH Independent Scientific Expert Pool (RISEP), and members of the UK Office of Environmental Protection (OEP) College of Experts. We are working to offer bespoke, rapid-turnaround, support to help companies and associations participate effectively and credibly in the ECHA universal PFAS restriction consultation. Several of these studies involved socio-economic analysis including the development of market data for substance identity, uses, emissions and fate, assessment of alternatives, risk management measures, preliminary identification of potential critical uses, and economic cost evaluation.

If you would like to discuss how Logika Group can support you in this important and emerging area of research, please contact:

Adam Clegg
Industrial Emissions and Permitting Lead
adamclegg@aqconsultants.co.uk

David Tyrer
Chemicals Policy Lead
davidtyrer@logikagroup.com

Ben Grebot
Industrial Emissions Policy Lead
bengrebot@logikagroup.com

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