



BUILD ELECTRONICS BETTER

Raising Awareness: Steps the Electronics Industry Can Take to Prepare for Emerging PFAS Policies

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Key Messages

Existing and upcoming PFAS policies can have a significant impact on the electronics industry

- *Question: What exactly is PFAS?*
- *Consider: Where is PFAS used in our industry?*

Preparation can moderate these impacts and enable supply chain transparency and compliance.

- *We will talk about emerging environmental policies and drivers regarding PFAS uses.*

What are Per- and Polyfluoroalkyl Substances (PFAS)?

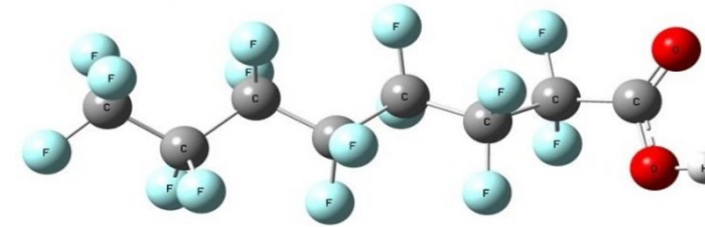
Basics on PFAS

U.S. Environmental Protection Agency @
<https://www.epa.gov/pfas/pfas-explained>

European Chemicals Agency @
<https://echa.europa.eu/hot-topics/perfluoroalkyl-chemicals-pfas>

Organisation for Economic Cooperation and Development @
<https://www.oecd.org/chemicalsafety/portal-perfluorinated-chemicals/>

U.S. National Institute of Environmental Health Sciences @
<https://www.niehs.nih.gov/health/topics/agents/pfc/index.cfm>



- > Per- and polyfluoroalkyl substances (PFAS) are a group of man-made chemicals. PFAS are a large, complex group of manufactured chemicals widely used to make various types of products
- > PFAS molecules are made up of a chain of linked carbon and fluorine atoms; because the carbon-fluorine bond is one of the strongest, these chemicals do not readily degrade in the environment (persistent, bioaccumulative, toxic)
- > Complications in defining PFAS
- > Complications in understanding the chemistry of PFAS

PFAS Definitions (in development)

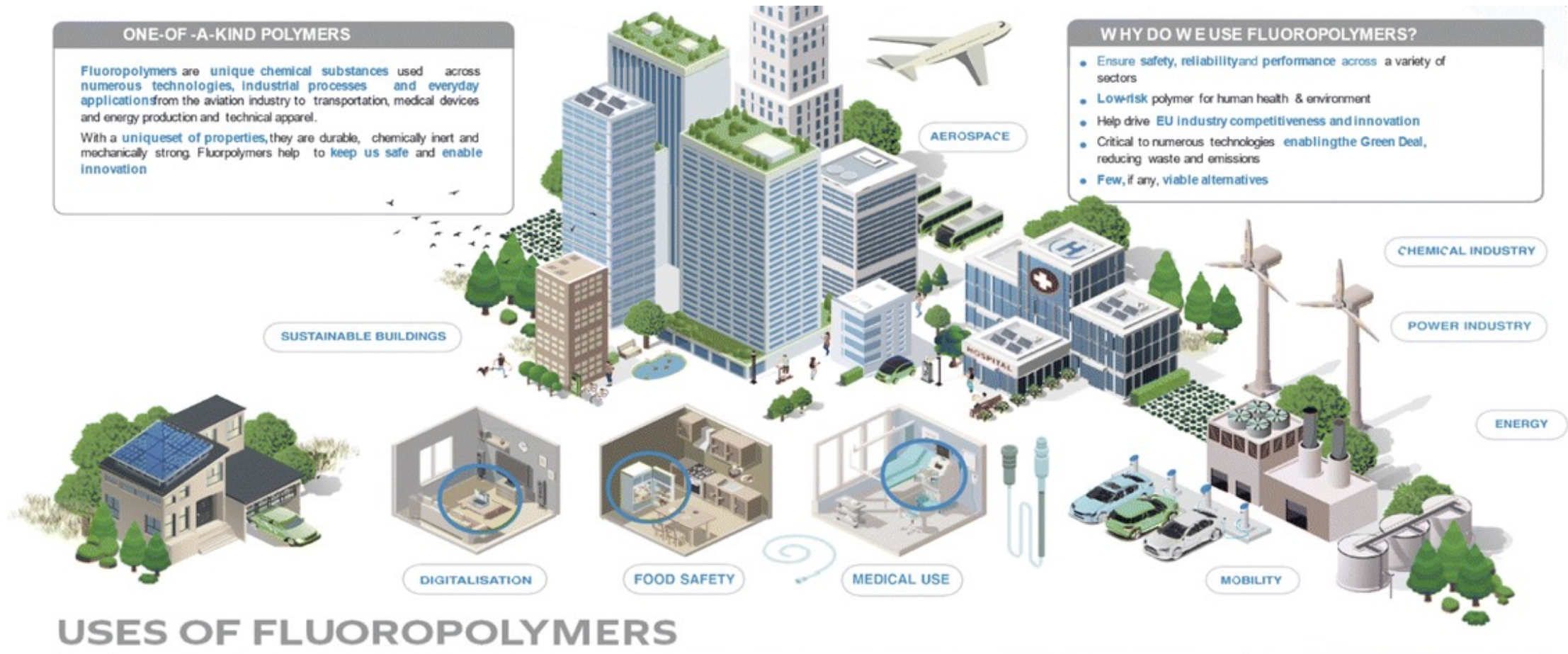


OECD: PFAS are defined as fluorinated substances that contain at least one fully fluorinated methyl or methylene carbon atom (without any H/Cl/Br/I atom attached to it), i.e., with a few noted exceptions, any chemical with at least a perfluorinated methyl group ($-\text{CF}_3$) or a perfluorinated methylene group ($-\text{CF}_2-$) is a PFAS.” [Source: OECD, Series on Risk Management No. 61, 2021].

European Chemicals Agency (ECHA): PFAS are defined as substances that contain at least one fully fluorinated methyl (CF_3-) or methylene ($-\text{CF}_2-$) carbon atom (without any H/Cl/Br/I atom attached to it).

U.S. Environmental Protection Agency (EPA): PFAS means any chemical substance or mixture that structurally contains the unit $\text{R}-(\text{CF}_2)-\text{C}(\text{F})(\text{R}')\text{R}''$. Both the CF_2 and CF moieties are saturated carbons. None of the R groups (R, R' or R'') can be hydrogen.

How and where are PFAS Used?



- Promoting sustainable and smart mobility through electric vehicles.
- Extending the lifespan of medical equipment and devices, reducing the need for replacements, risk of failure and cross infections.
- Enabling a data driven economy through the manufacturing of microprocessors and semi-conductors.
- Facilitating the Renovation Wave and the construction of energy efficient buildings.

- Driving innovation and helping decarbonise the aviation industry.
- Assisting the chemicals industry in preventing corrosion in harsh environments.
- Ensuring food and pharmaceuticals remain fresh and uncontaminated.
- Protecting workers in professional protective and high-performance clothing.

Why are we concerned about PFAS?



- > People are most likely exposed to these chemicals by consuming PFAS-contaminated water or food, using products made with PFAS, or breathing air containing PFAS
 - More research is needed to understand all sources of exposure and env/health-related impacts
- > Why be concerned about PFAS? Legacy uses and emissions, widespread use and occurrence, numerous opportunities for exposures, persistence and bioaccumulation
- > PFAS are often referred to as “forever chemicals” due to their persistence.
- > PFAS is used **widely**: drinking water, soil and water, waste sites, fire-fighting foam, manufacturing, food, food packaging, household products, personal care products, biosolids

What do we know about PFAS uses in electronics?

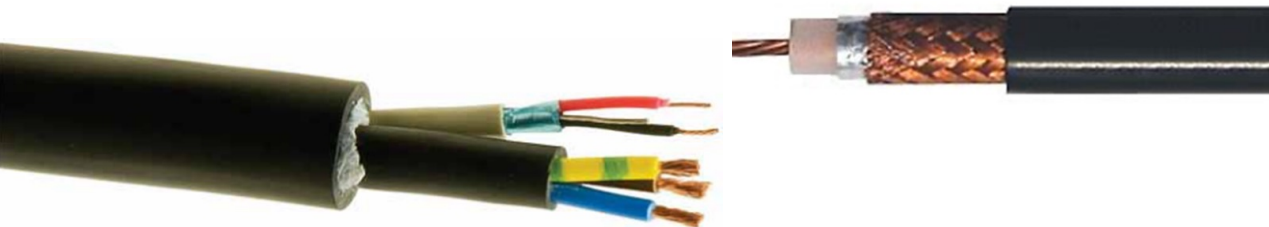
- > With thousands PFAS identified, the potential use in electronics can be extensive.
- > PFAS uses are indicated in:
 - Semiconductors
 - Wire and cables (insulation) and cable assemblies
 - Printed Circuit Boards (PCBs)
- > PFAS are selected for use because of their unique properties:
 - Temperature resistant: able to function at high temperatures
 - Chemical resistant: inert
 - Water and oil repellant: protect against moisture and corrosion
 - Low coefficient of friction: good wear prevention
 - Low dielectric constant: excellent electrical insulator
 - Manufacturability, compressibility, flexible, high stress crack resistance, flame retardant



Likely PFAS Applications in Electronics

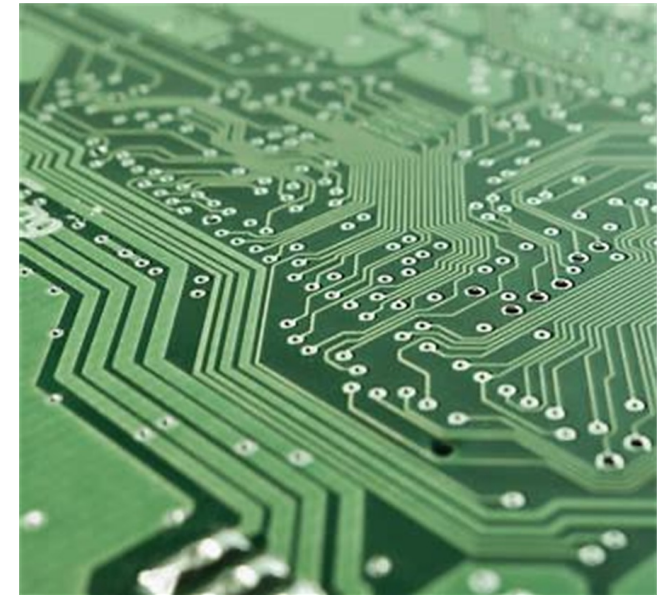
Wires and Cables

- > Fluoropolymers are used in materials for insulating cables in a variety of electrical and electronic applications
 - Examples include PTFE, PFA, ETFE, FEP
- > Fluoropolymer insulated wire and cables can be used in harsh environments and where high-volume data transmission is required e.g., automotive, medical equipment, data centers
- > PFAS is used in wires and cables for several properties:
 - Heat resistance, resistance to corrosion, water and oil resistant
 - Flame retardant, flexibility/ crack- resistance



Printed Circuit Boards (PCBs)

- > Some PFAS are used as a fiber-reinforced fluoropolymer layer in printed circuit boards (PCBs)
 - Examples include PTFE and PFA
 - PCBs can be Rigid, Flexible and Hybrid
- > Fluoropolymer use is preferable over traditional FR-4 laminate material for high frequency and microwave applications



Likely PFAS Applications in Electronics: Mixed Bag



Non-exhaustive list

- > Etching fluids
- > F-Gases, some used to manufacture liquid crystal displays**
- > Fluoropolymers used in:
 - > Lithium (Li) ion batteries***
 - > Renewable Energy – photovoltaic panels
 - > Fuel cell membrane electrode assemblies****
- > Hard disk drives
- > Heat transfer and thermal test fluids
- > High temperature film capacitors
- > Inks, toners, coatings
- > Light management films in flat panel displays*
- > Liquid crystal displays*
- > Lubricants and vacuum pump fluids
- > Semiconductor manufacturing equipment
- > Seals, O-rings, gaskets, hoses, tubing

* An overview of the uses of per- and polyfluoroalkyl substances (PFAS), 2020, Glüge et al., <https://pubs.rsc.org/en/content/articlelanding/2020/em/d0em00291g>

** https://www.epa.gov/sites/production/files/2015-07/documents/supplier_profiles_2013.pdf

*** <https://onlinelibrary.wiley.com/doi/10.1002/pola.28551>

**** <https://www.energy.gov/eere/fuelcells/parts-fuel-cell>

PFAS policy activities are happening locally, nationally, and globally

- > Policies aim to address remediation of PFAS contamination, prevention of future contamination, and research to increase understanding of PFAS risks to environmental and human health
- > Policymakers are considering science and engineering (and politics) in how/what is regulated
 - PFAS addressed as a group versus by individual chemical, chain-length, class, or product type
 - PFAS included in policy based on CAS registry number, chemical structure
 - Restrictions across product sectors versus exemptions for essential uses
 - > The role of the "essential use concept" and who/what/how/when the term is defined
 - Requirements for data and information on current and legacy uses

PFAS restriction under the REACH Regulation

- > The Netherlands, Denmark, Germany, Norway, and Sweden have published their intention to prepare a restriction dossier
 - First Call for Evidence: Jul – Oct 2021
 - Expected Date of Pre-Publication of the dossier: Jan 2023
 - Consultation period will open following a conformity check: March 2023 (6 months)
- > Restriction would be on the manufacture, placing on the market (EU regulation), and use of PFAS
- > Stakeholders are requested to provide relevant information to the Dossier Submitter.
 - If justified based on robust risk and socio-economic information the Dossier Submitter may propose **derogations (exemptions)** from the proposed restriction.
 - If a derogation is not proposed by the Dossier Submitter then it will be incumbent on the relevant stakeholders to do so during any consultation process with a full risk and socio-economic justification accompanying it.
 - > Stakeholders from both inside and outside the EU are invited to submit comments.

PFAS recordkeeping and reporting under TSCA Section 8(a)(7)

- > Proposed rule issued: Jun 2021
 - Proposed rule addresses at least 1,300 PFAS and includes requirements to collect information on PFAS manufactured since 2011, includes PFAS-containing articles
 - > Could apply to all importers of articles and other commonly excluded entities such as manufacturers of impurities and byproducts; Reporting of information "known to or reasonably ascertainable by" manufacturers
 - Comments were submitted in 2021:
 - > Electronics industry concerns: Ability to connect with and obligate supply chain partners to collect data on potentially thousands of PFAS chemistries, most unregulated, with a look-back of more than 10 years for all finished electronic articles manufactured (or imported) in the U.S.
- > [Small business advocacy review panel](#) completed: Aug 2022
- > Final rule expected, TBD (statutorily: Jan 2023)
 - > Compliance against final rule: Six-month submission period beginning six months after the effective date of the final rule (i.e., allows one year to collect and submit all required information to EPA)

What can my company do right now?

Preparation will moderate impacts to the supply chain and enable compliance. Responsibility to act rests with all supply chain members.

First, recognize the complexity of electronics manufacturing processes and products, the multi-layered supply chains, and difficulty in obtaining accurate information about PFAS content across the supply chain

Then, put forward realistic actions that will improve the likelihood that you can obtain data and information about current uses of PFAS, the quantities and types used and the purpose/function of the PFAS, byproducts, the risks associated with the uses, and alternatives

- Prepare your company, prepare your supply chain
- Document your actions: surveys, mapping, consultation agreements, partnerships, contractual improvements, phase-out timelines



What can my company do right now?



- > Work with quality assurance personnel, compliance personnel, or those with access to supply chain suppliers and customers, bills of material (BOMs), full material disclosure/declarations
 - Search for CAS numbers and, if possible, structural chemical composition data
 - Consider function and properties of PFAS in the processes or products, look for performance requirements or standards
 - Identify alternative processes or chemicals that are already in use or that can be implemented
 - Determine availability of information for current uses and legacy uses

What can my company do right now?

Consider the types of data and information necessary to answer questions asked by ECHA during Annex XV Restriction Report Consultation Guidance

- > While we don't yet know what questions will be put forward, we have guidance from ECHA on the consultation phase of an [Annex XV restriction report and SEAC draft opinion](#) under REACH
 - Guidance aimed at stakeholders who wish to submit substantiated information in either of the consultations on a restriction proposal (i.e., six months consultation on the Annex XV restriction report and two months consultation on SEACs draft opinion on the restriction proposal); Includes what information can be submitted and the level of information needed, for example:
 - > Scope or restriction options analysis
 - > Hazard, exposure
 - > Environmental emissions
 - > Description of analytical methods
 - > Information on alternatives
 - > Information on costs
 - > Information on benefits
 - > Transitional period/deferred entry into force
 - > Exemptions

What can my company do right now?



Call to Action!

- > Consider **partnering with supply chain members** to work together to ensure electronics manufacturing processes and products are represented across the supply chain and with policy makers.
- > **Get involved.** There are several formal and informal collaborative efforts by industry regarding PFAS uses by downstream users, including electronics-specific partnerships.
 - Collaborations prompt industry to obtain supply chain insights, including function of PFAS, specific types of PFAS, uses in processes or products, information on alternatives.
- > **Preparation now** will ensure better supply chain communication and stakeholder engagement with policy makers.
 - Gathering information on function, types, uses, and alternatives will prepare companies for a multitude or evolving regulatory obligations.



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