

The concept of essential use of Per- and Poly-fluoroalkyl Substances (PFAS)

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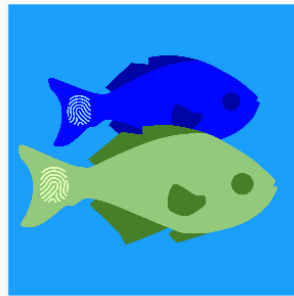
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Sources, Transport, Exposure & Effects of PFASs
UNIVERSITY OF RHODE ISLAND SUPERFUND RESEARCH PROGRAM

Connecting science and people



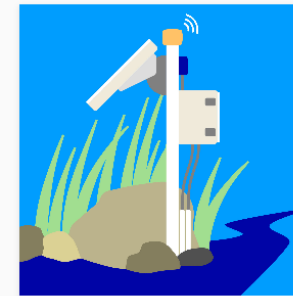
STEEP Research:
Environmental Fate
& Transport



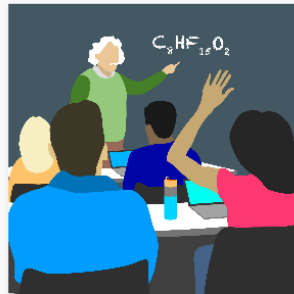
STEEP Research:
Childhood Risk



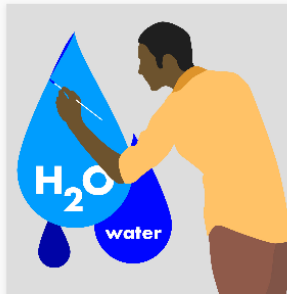
STEEP Research:
Metabolic Effects



STEEP Research:
Detection Tools



**STEEP Core: Next
Generation**



STEEP Core:
Research
Translation

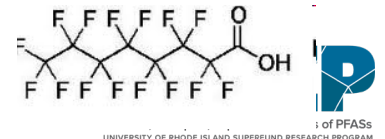
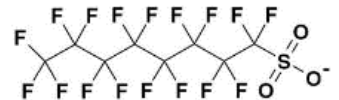


STEEP Core:
Community
Engagement



STEEP Core:
Administrative

-



1000s of PFAS
100s produced *
10s monitored
2 targeted (EPA)

• Categories:

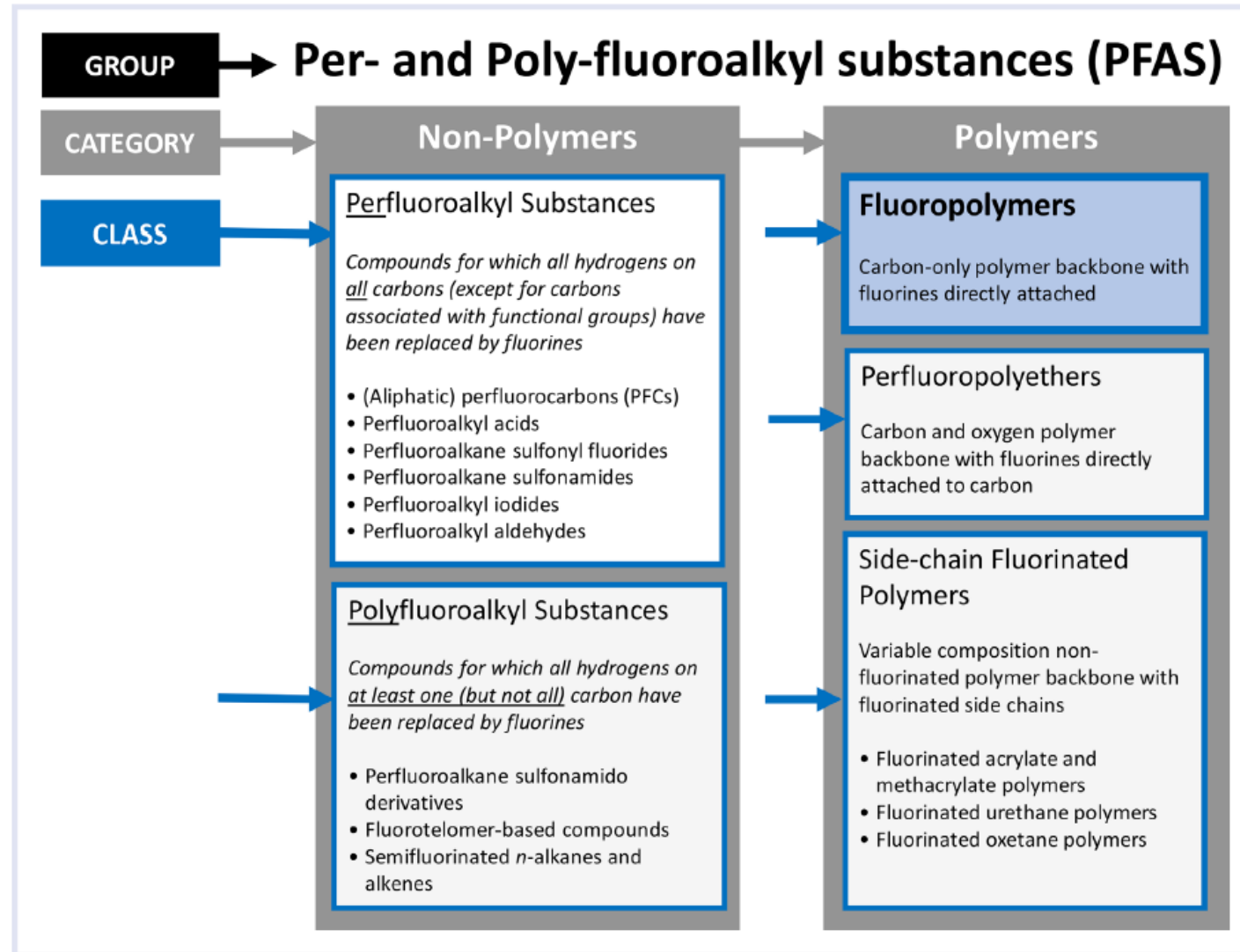


Figure 1. Per- and polyfluoroalkyl substances (PFAS).

The known unknowns are getting us

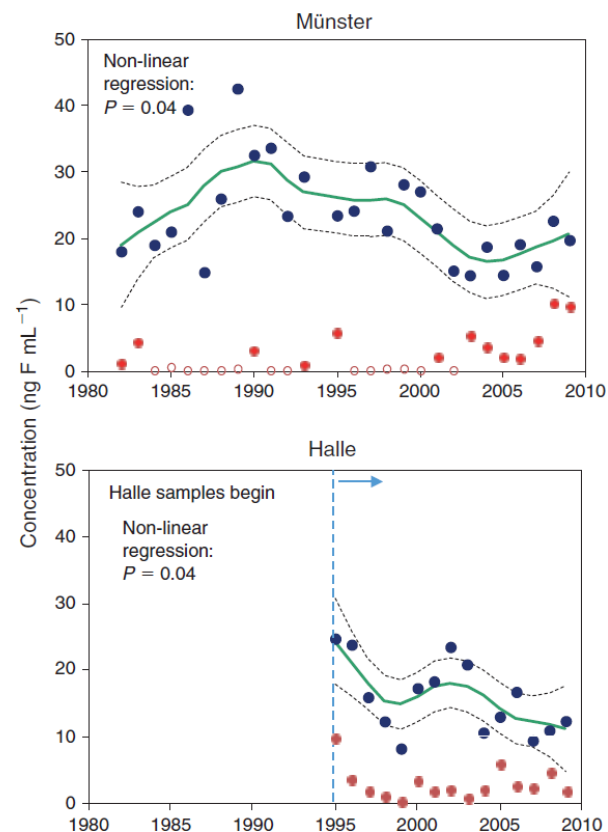


Fig. 3. Temporal trends of extractable organofluorine (EOF) and unidentified organofluorine concentrations (ng F mL^{-1}) in German plasma. (Blue dot indicates the mean value of EOF, dotted line indicates the 95% confidence interval of the trend and green line indicates the trend generated using locally weighted regression smoother (LOESS); red dot indicates the mean value of unidentified organofluorine; open red dots indicates no unidentified organofluorine.)

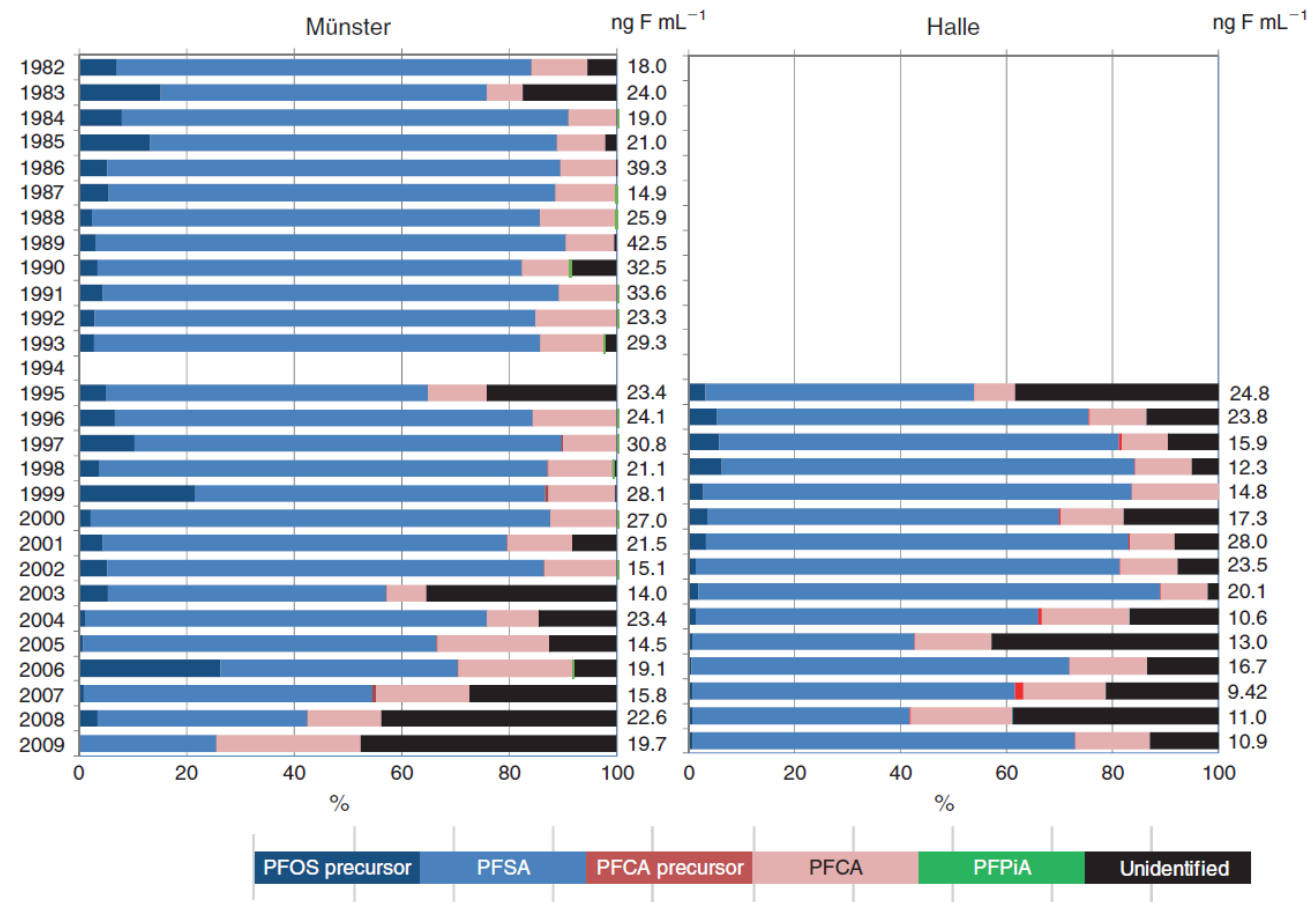


Fig. 4. Composition and concentrations (ng F mL^{-1}) of extractable organofluorine (EOF) in German blood plasma samples (perfluorooctane sulfonate, PFOS; perfluoroalkyl sulfonate, PFSA; perfluorinated carboxylates, PFCAs; perfluorinated phosphinates, PFPiAs).

(Yeung and Mabury, 2016)

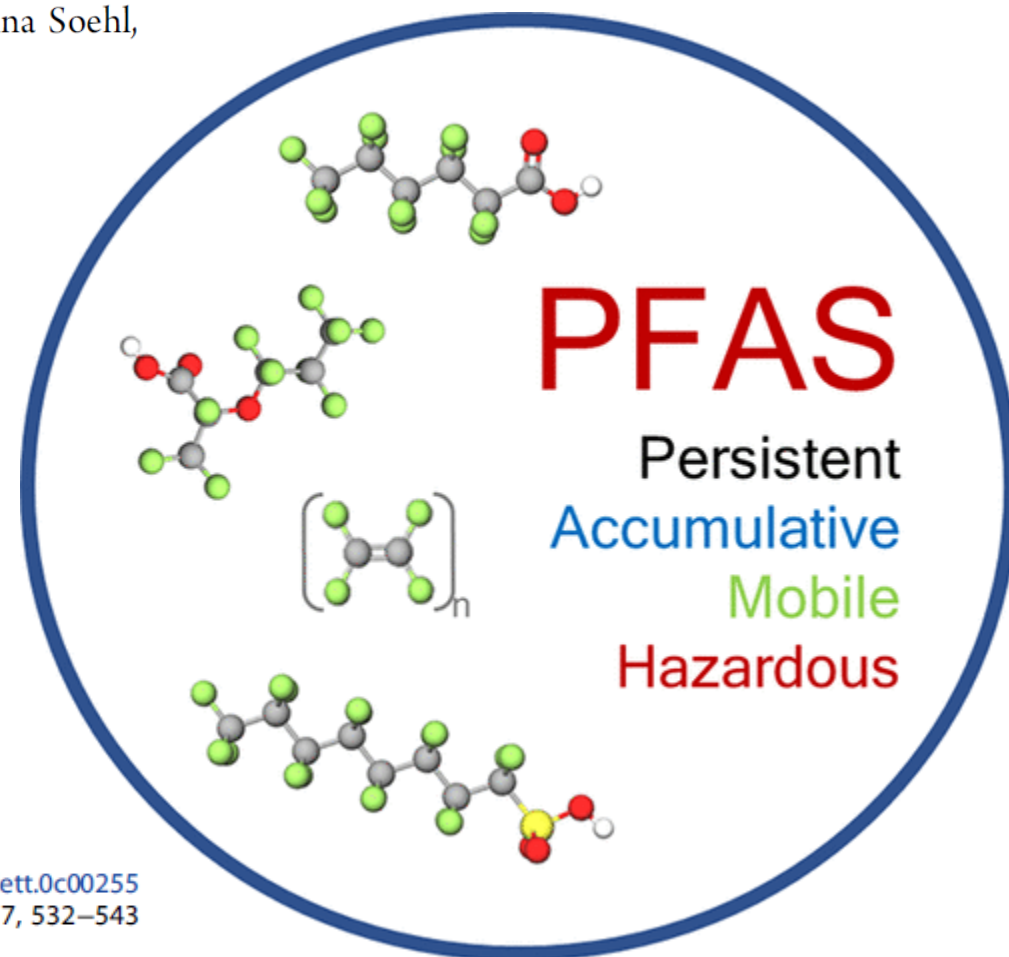
1 option – PFAS as a class

Scientific Basis for Managing PFAS as a Chemical Class

Carol F. Kwiatkowski,* David Q. Andrews, Linda S. Birnbaum, Thomas A. Bruton, Jamie C. DeWitt, Detlef R. U. Knappe, Maricel V. Maffini, Mark F. Miller, Katherine E. Pelch, Anna Reade, Anna Soehl, Xenia Trier, Marta Venier, Charlotte C. Wagner, Zhanyun Wang, and Arlene Blum

Box Key Messages

1. Per- and polyfluoroalkyl substances (PFAS) make up a class of extremely persistent chemicals, numbering in the thousands, that accumulate in the environment and living organisms and can be highly mobile, leading to global contamination.
2. The use of PFAS in numerous consumer and industrial applications has led to widespread human and environmental exposure from, for example, drinking water, food, and consumer products.
3. Toxicological and epidemiological studies have identified a broad range of adverse health outcomes associated with exposure to PFAS in people and animals.
4. We suggest a class-based approach to managing the human and environmental risks associated with all PFAS, including polymers.
5. We provide options for how governments and industry can apply the class-based approach, emphasizing the importance of eliminating non-essential uses of PFAS, and further developing safer alternatives and methods to remove all existing PFAS from the environment.



<https://dx.doi.org/10.1021/acs.estlett.0c00255>
Environ. Sci. Technol. Lett. 2020, 7, 532–543

Products that do or did contain PFAS



PFAS are in over 60 different use categories

Are all of these uses essential?

Personal care products/cosmetics	Ski waxes	Fire-fighting foams	Apparel
Waterproof clothing	Easy care clothing	Food contact materials	Food production equipment
Medical devices	Pharmaceuticals	Laboratory supplies	Carpets and furniture
Cleaning products	Paint and lacquers	Pesticides	Sealants
<i>These are only a few of the known use categories for PFAS.</i>			

What is an essential use for a PFAS?



Cite this: DOI: 10.1039/c9em00163h

The concept of essential use for determining when uses of PFASs can be phased out

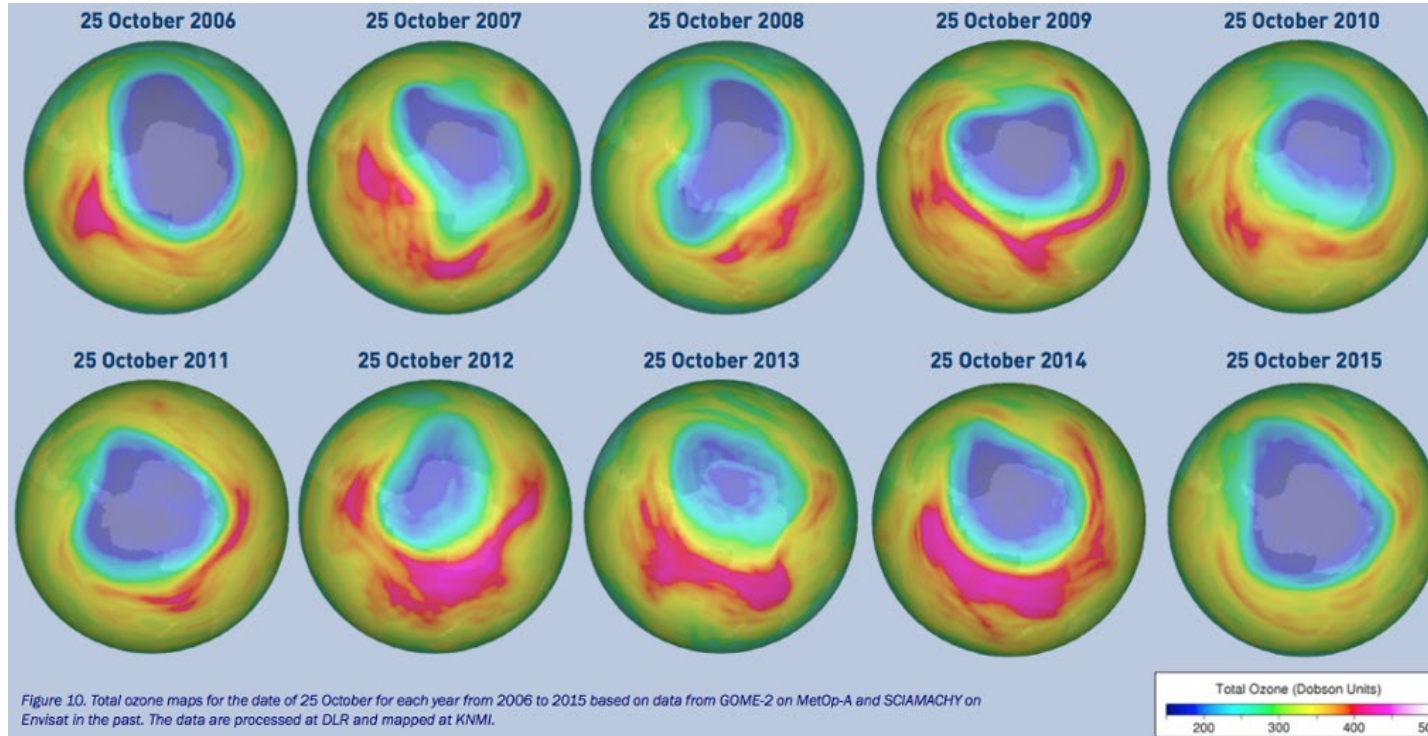
Ian T. Cousins,^a Greta Goldenman,^b Dorte Herzke,^c Rainer Lohmann,^d Mark Miller,^e Carla A. Ng,^f Sharyle Patton,^g Martin Scheringer,^h Xenia Trier,ⁱ Lena Vierke,^j Zhanyun Wang^k and Jamie C. DeWitt^l

Based on these definitions, how many use categories can we define for PFAS?

Based on the Montreal Protocol, which defined the concept of essential use for chlorofluorocarbons (CFCs).

- An essential use is a use necessary for health or safety or for the functioning of society.
- An essential use is a use for which there are no available technically and economically feasible alternatives.

We had a gaping hole



Adopted on 15 September 1987, the Protocol is to date the only UN treaty ever that has been ratified every country on Earth - all 198 UN Member States.

Photograph: WMO

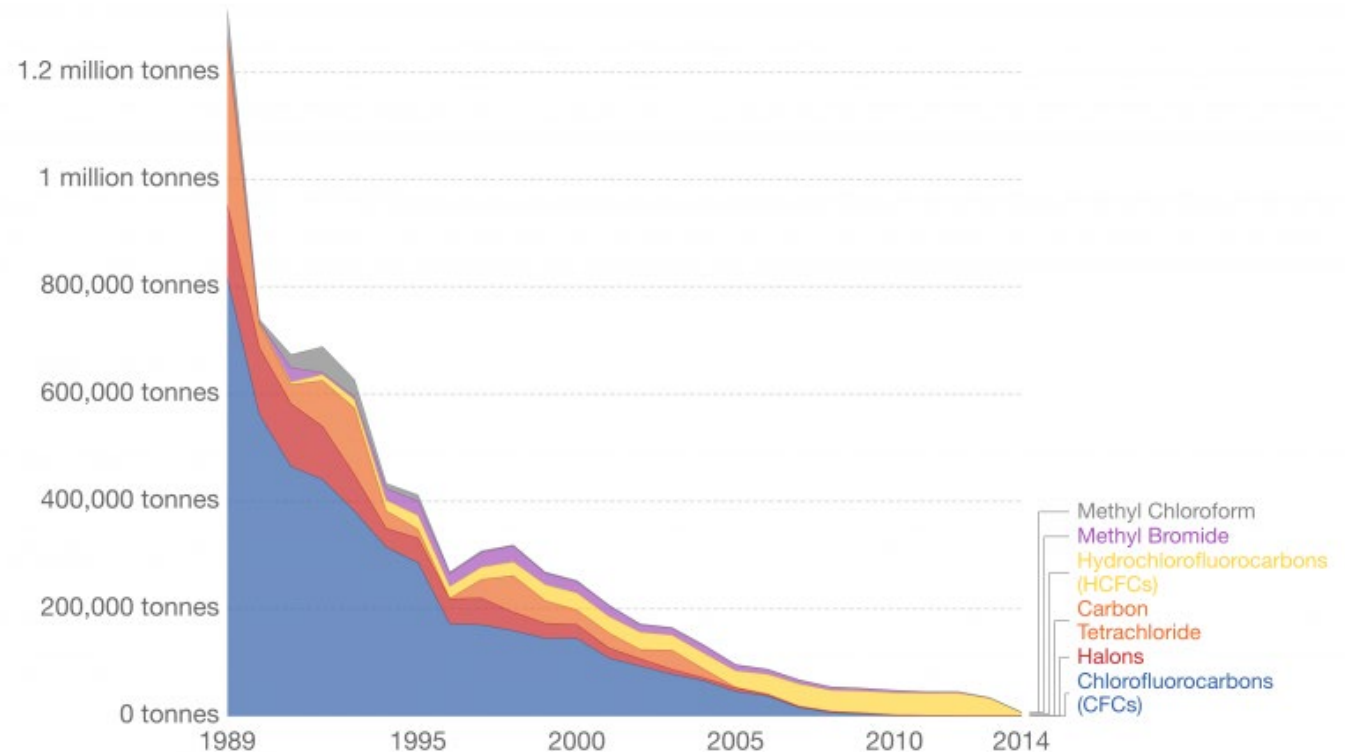
For background – ozone had gone missing

Sequential progress,
not simply regrettable
substitutions:

- CFCs (MP)
- HCFCs (Montreal Amendment)
- HFCs (Kigali Amendment)

Ozone-depleting substance consumption, World

Annual consumption of ozone-depleting substances (ODS). ODS consumption is measured units of ODS tonnes, which is the amount of ODS consumed, multiplied by their respective ozone depleting potential value.

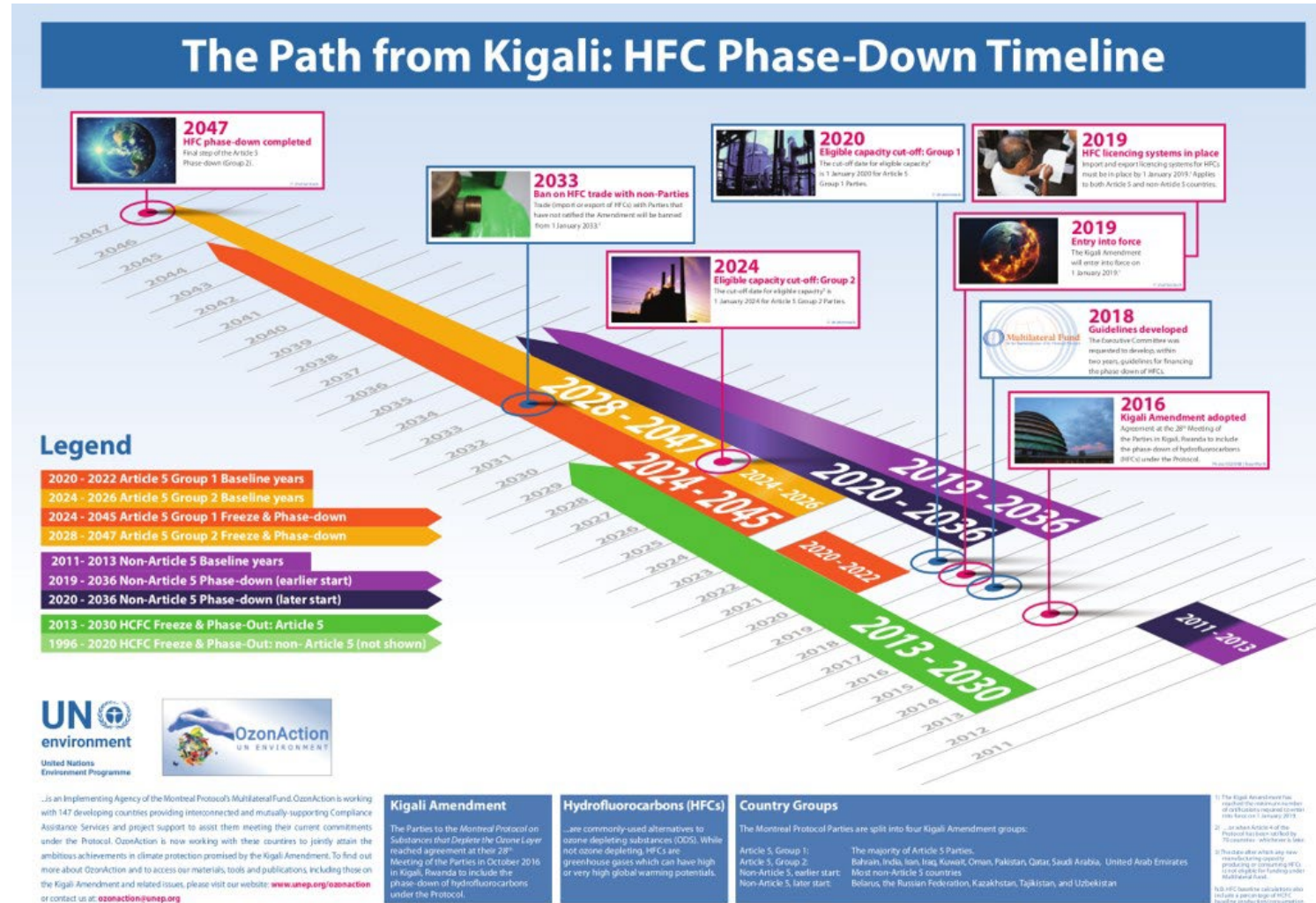


Source: UN Environment Programme

OurWorldInData.org • CC BY-SA

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Leading the way



Essential use concept for PFAS

Table 1 Three essentiality categories to aid the phase out of non-essential uses of chemicals of concern, exemplified with PFAS uses

Category	Definition	PFAS examples
(1) “Non-essential”	Uses that are not essential for health and safety, and the functioning of society. The use of substances is driven primarily by market opportunity	Dental floss, water-repellent surfer shorts, ski waxes
(2) “Substitutable”	Uses that have come to be regarded as essential because they perform important functions, but where alternatives to the substances have now been developed that have equivalent functionality and adequate performance, which makes those uses of the substances no longer essential	Most uses of AFFFs, certain water-resistant textiles
(3) “Essential”	Uses considered essential because they are necessary for health or safety or other highly important purposes and for which alternatives are not yet established ^a	Certain medical devices, occupational protective clothing

^a This essentiality should not be considered permanent; rather, a constant pressure is needed to search for alternatives in order to move these uses into category 2 above.

Table 2 Essentiality of PFASs in selected use categories

Use	Table 1 Category ^a
Personal care products including cosmetics	1
Ski waxes	1
Fire-fighting foams (commercial airports)	2
Fire-fighting foams (military)	2 or 3
Apparel (medical: long operations)	3
Apparel (protective clothing oil and gas industry)	3
Apparel (medical: short operations, everyday)	2
Apparel (military: occupational protection)	2 or 3
Waterproof jacket (general use)	2
Easy care clothing	1
Food contact materials	1, 2 or 3
Non-stick kitchenware (fluoropolymers)	1 or 2
Medical devices (fluoropolymers)	1, 2 or 3
Pharmaceuticals	2 or 3
Laboratory supplies, equipment and instrumentation	1, 2 or 3
Perfluorosulfonic membranes in fuel cells	2
Perfluorosulfonic membranes in chlor-alkali process	3

^a Note that the categories in the above table represent the current evaluation and may change in the future.

Essential use concept for PFAS

“When considering chemical alternatives for PFASs, the focus should be on the service the product should deliver. The compound should therefore be evaluated for performance using the specifications required for the product as opposed to comparing directly to the PFAS being replaced...

Additionally, the potential for health hazard and potential for exposure...must be considered...”

PFAS in personal care products and cosmetics such as hair products, powder, sun blocks, and skin creams.



PFAS do not appear to confer an essential function to these products and presence leads to direct human exposure to PFAS.

Decision of major retailers/brands to phase-out PFAS indicates that alternatives have been readily available.

Category 1 – non-essential

PFAS in leisure clothing for water repellency.

PFAS in certain applications, such as polytetrafluoroethylene (PTFE) breathable membranes appear to be essential for water repellency.

Alternatives to PFAS are available (and on the market), including waxes, silicones, and hydrocarbons.

Category 2 – substitutable





PFAS in protective clothing for certain types of health care activities and for firefighter turn-out gear appears to be essential.

Category 3 – essential

However, R&D is warranted to identify safer alternatives to PFASs in these applications.

Non-stick cookware coated with PTFE.
PTFE is “inert” in products.

Another consideration of PTFE



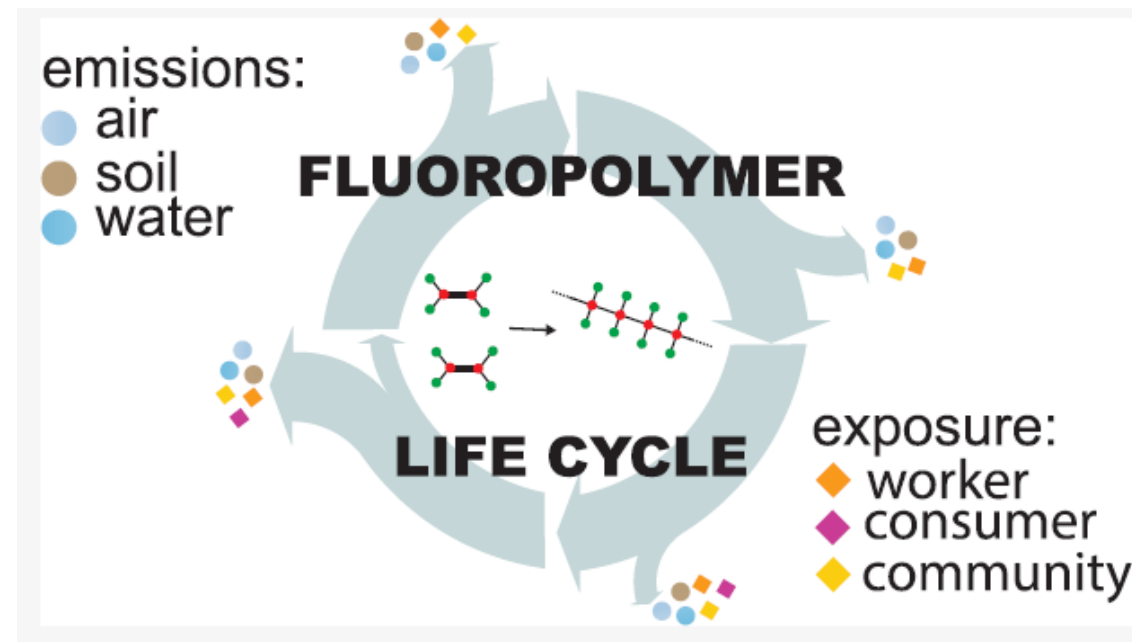
- PTFE is not inert when being produced:
- Other PFAS are released during manufacture, including PFOA (i.e., in China) and GenX (a PFOA replacement used in manufacturing).
 - What happens when product has reached end-of-life?

**A lifecycle perspective is
needed for the class of PFAS.**

A closed loop process with zero discharge is a great step toward reducing the environmental and human health burden of PFAS...but is it feasible?

Questions of **essentiality** should also be considered, especially when the **lifecycle** of PFAS becomes part of the equation.

In general, production of **persistent chemicals** is always a bad idea.



What is the status of efforts to supplant the use of PFAS?

It depends

- Consumer pressure (textiles, cosmetics, furniture)
- Manufacturers' action (carpets)
- Legislation (food contact materials, AFFF)
- Litigation

<https://pfascentral.org/pfas-free-products/>

Where has essentiality caught on?

- EU:

In October 2020, the European Commission published the Chemicals Strategy for Sustainability. Among its many actions, it includes **phasing out the use of PFAS in the EU, unless their use is essential** and initiatives to reduce their emissions using all available legislative and non-legislative tools.

🕒 This article is more than **8 months old**

Maine bans toxic ‘forever chemicals’ under groundbreaking new law

State is the first to enact a broad ban of PFAS compounds, which are found in everything from cosmetics to cookware



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Thanks, again

- NIEHS, of course
- Global PFAS Science Pane;
- Partners/collaborators, grad students

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HARVARD
T.H. CHAN

SCHOOL OF PUBLIC HEALTH
Department of Environmental Health



SILENT SPRING INSTITUTE
Researching the Environment and Women's Health

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Environmental Health Sciences
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More information about STEEP is available at: www.uri.edu/steep/

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Thank you.

Questions?

Substitutions?

category	PFAS use essential	Substitutes available	Status
textiles	No *	yes	some progress
medical equipment	Yes	Maybe	Little
solar panels	unsure	unsure	Little
construction materials	Probably not	Probably yes	Little progress
household products	No	yes	some progress
firefighting	No *	yes	Major progress