

Let's talk about PFAS

April 14

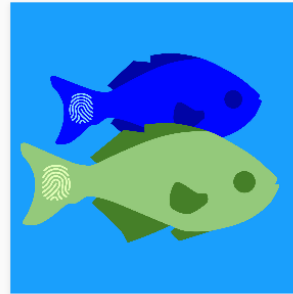
Rainer Lohmann

University of Rhode Island
STEEP Superfund Research Program

STEEP

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

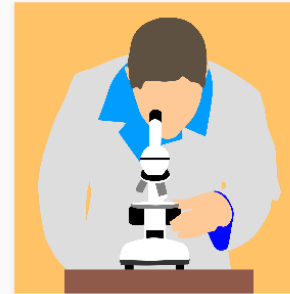
Connecting science and people



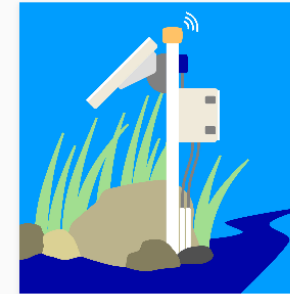
STEEP Research:
Environmental Fate
& Transport



STEEP Research:
Childhood Risk

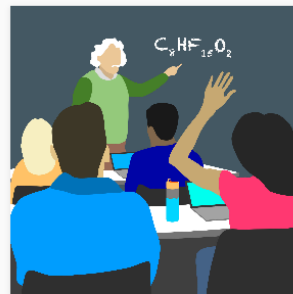


STEEP Research:
Metabolic Effects

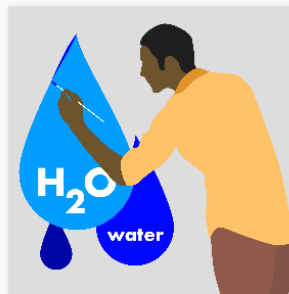


STEEP Research:
Detection Tools

www.uri.edu/steep



**STEEP Core: Next
Generation**



STEEP Core:
Research
Translation

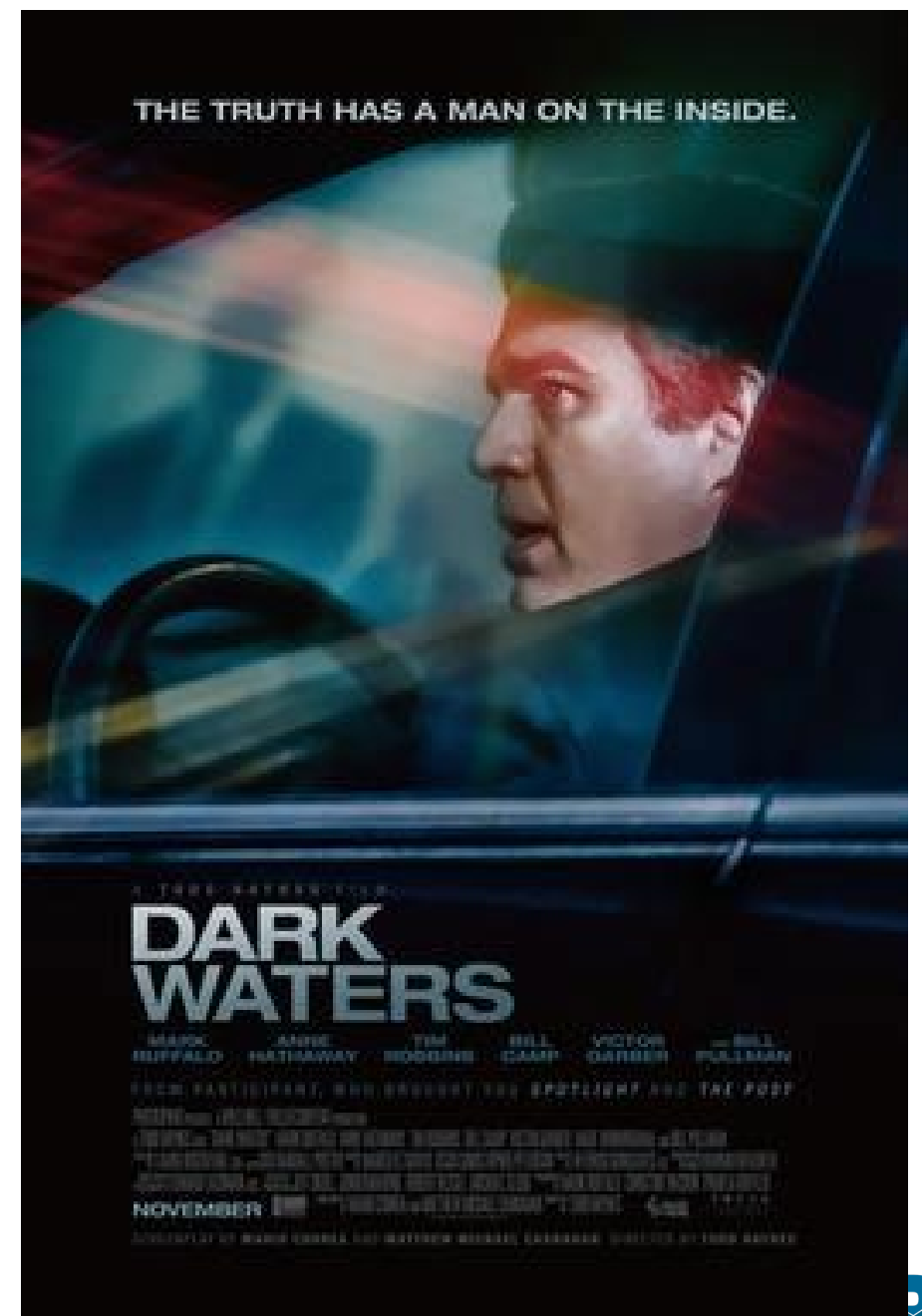
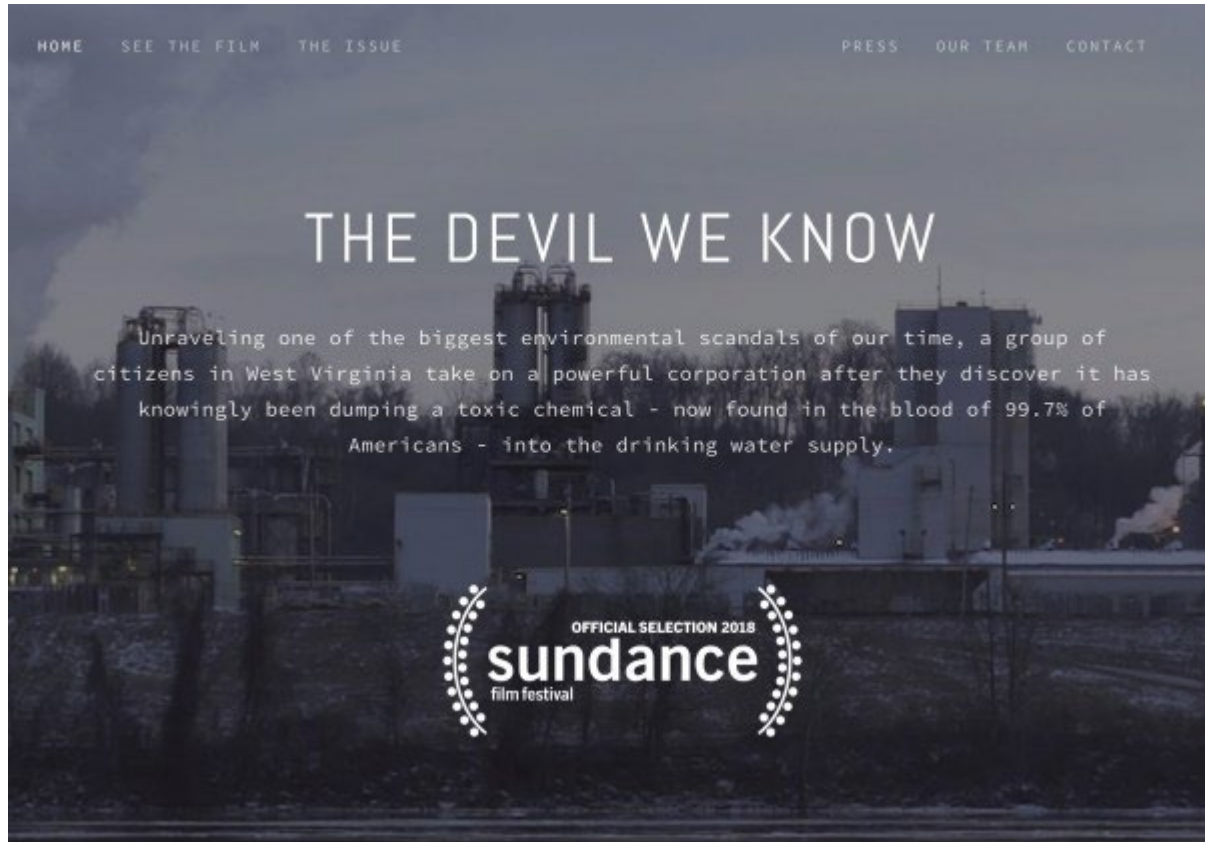
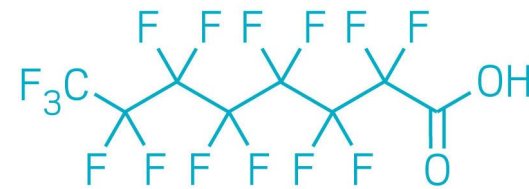


STEEP Core:
Community
Engagement

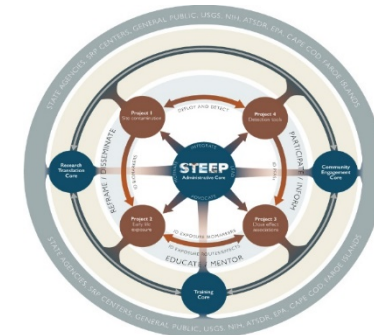
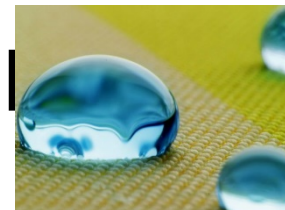


STEEP Core:
Administrative

PFASs: primer



PFASs: Challenging compounds



- Unique physical-chemistry, strong surfactants; oleophobic

- Widespread environmental presence



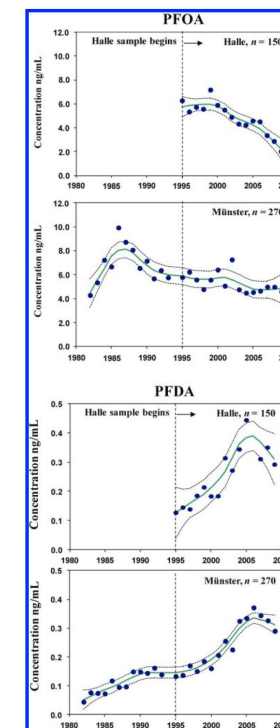
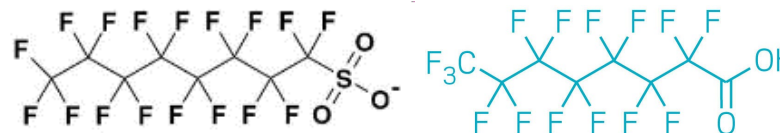
- Everyday exposure for all



- Wide range of adverse effects (humans/animals)



- Limited regulatory action



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

Environmental Science Processes & Impacts Ian Cousins et al., 2019



CRITICAL REVIEW

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Cite this: DOI: 10.1039/c9em00163h

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

Ian T. Cousins,^{†*} 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

Products that do or did contain PFAS



Forever, or everywhere chemicals?

Other use categories

Aerosol propellants	Metallic and ceramic surfaces
Air conditioning	Music instruments (3)
Antifoaming agent	Optical devices (3)
Ammunition	Paper and packaging (2)
Apparel	Particle physics
Automotive (12)	Personal care products
Cleaning compositions (6)	Pesticides (2)
Coatings, paints and varnishes (3)	Pharmaceuticals (2)
Conservation of books and manuscripts	Pipes, pumps, fittings and liners
Cook- and bakingware	Plastic, rubber and resins (4)
Dispersions	Printing (4)
Electronic devices (7)	Refrigerant systems
Fingerprint development	Sealants and adhesives (2)
Fire-fighting foam (5)	Soldering (2)
Flame retardants	Soil remediation
Floor covering including carpets and floor polish (4)	Sport article (7)
Glass (3)	Stone, concrete and tile
Household applications	Textile and upholstery (2)
Laboratory supplies, equipment and instrumentation (4)	Tracing and tagging (5)
Leather (4)	Water and effluent treatment
Lubricants and greases (2)	Wire and cable insulation, gaskets and hoses
Medical utensils (14)	

Industry branches

Aerospace (7)	Mining (3)
Biotechnology (2)	Nuclear industry
Building and construction (5)	Oil & gas industry (7)
Chemical industry (8)	Pharmaceutical industry
Electroless plating	Photographic industry (2)
Electroplating (2)	Production of plastic and rubber (7)
Electronic industry (5)	Semiconductor industry (12)
Energy sector (10)	Textile production (2)
Food production industry	Watchmaking industry
Machinery and equipment	Wood industry (3)
Manufacture of metal products (6)	

(Gluege et al., 2020)



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

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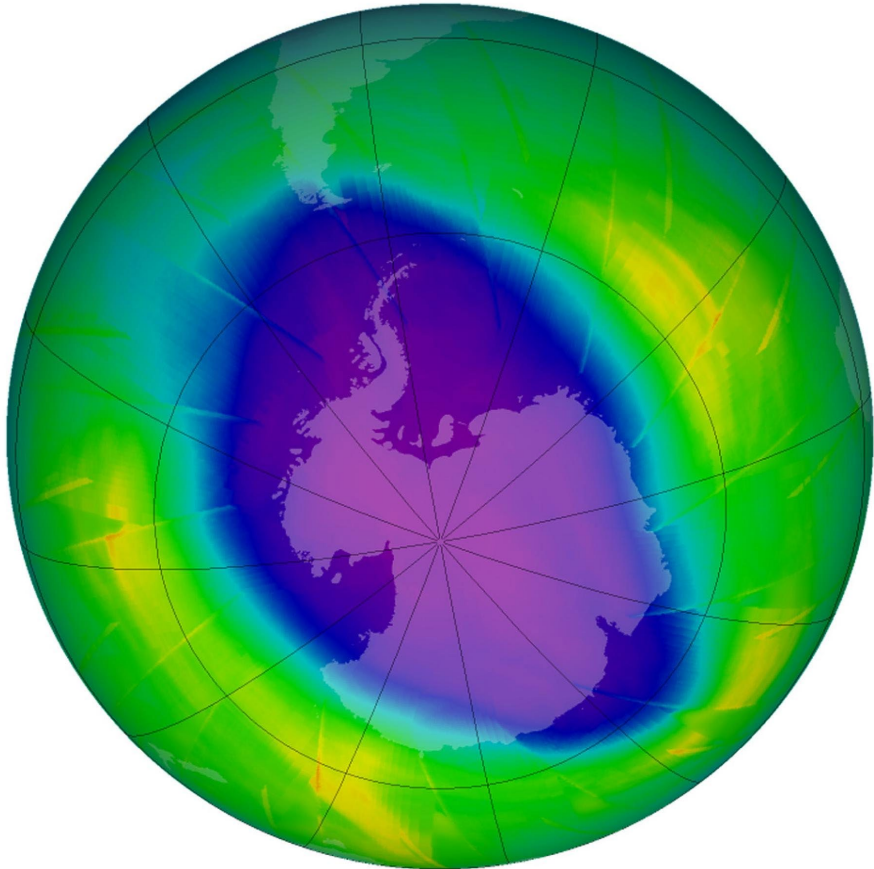
Based on these definitions, how many use categories can we define for PFAS?

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.

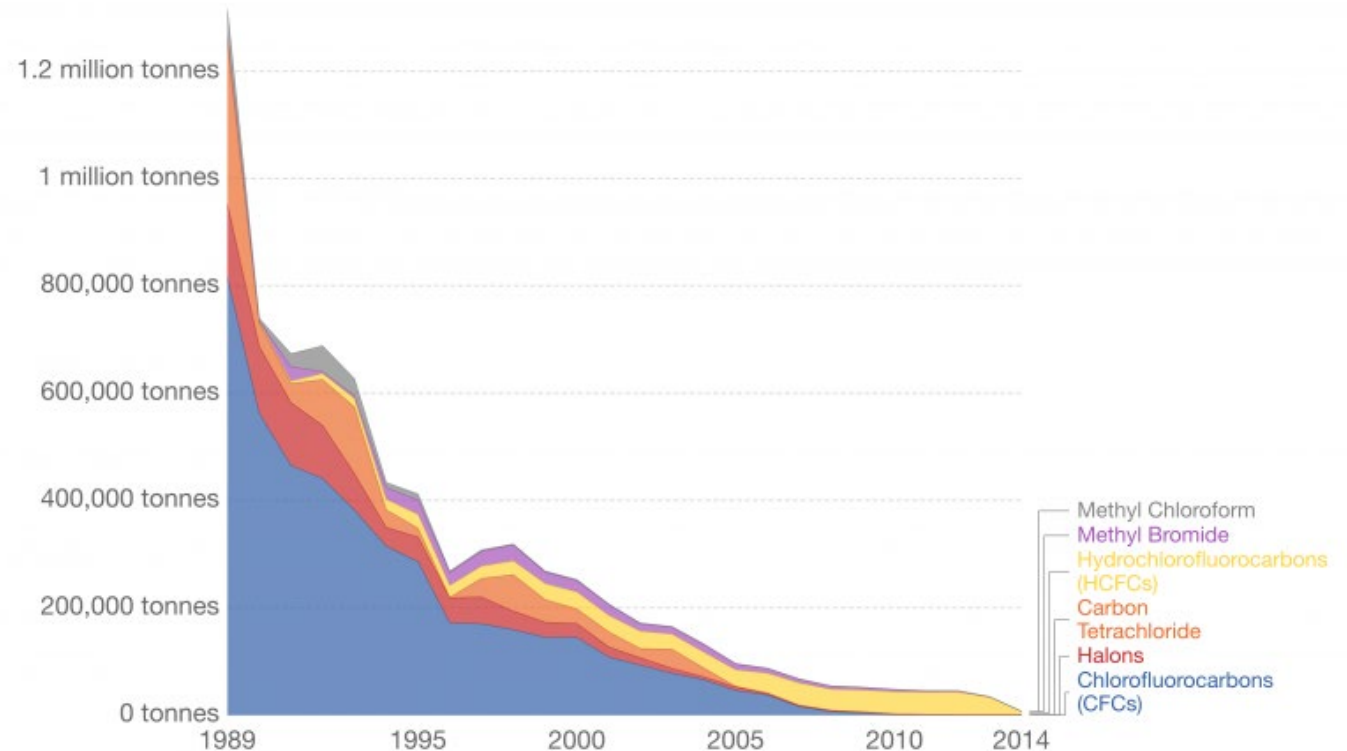
For background – ozone had gone missing

- Way back when



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

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.

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 eight-carbon fluorinated chemistries are available, including six and four carbon PFAS, 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

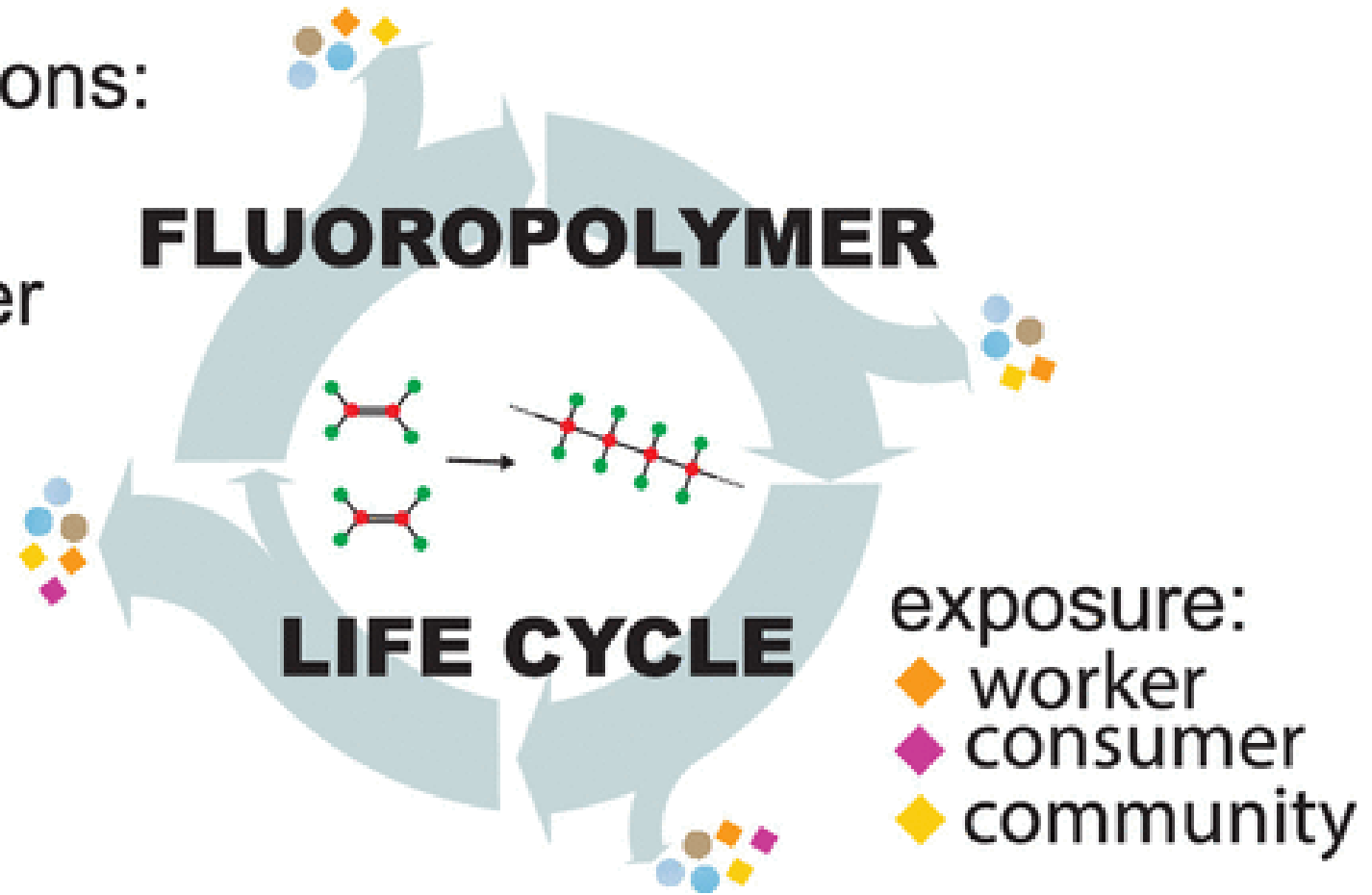
However, R&D is warranted to identify safer alternatives to PFASs in these applications.

Another consideration of PTFE



emissions:

- air
- soil
- water



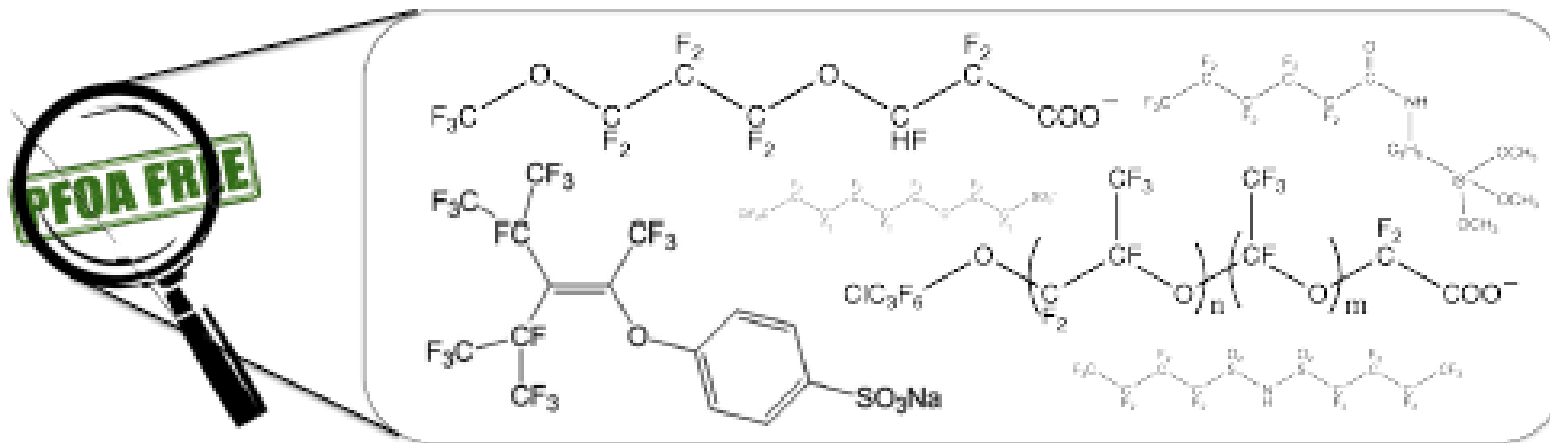
A lifecycle perspective is needed for the class of PFAS.

Lohmann et al., 2020

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.



PFOA-free does not mean PFAS-free and PFOA is only one of many PFAS.

Are there non-essential PFAS, and

! products?



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<https://retailerreportcard.com/>

Click for our detailed findings on the following retailers.



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The way forward

Need for concerted action for a reduction in PFAS use and exposure

- Individual/NGOs
- Retailers, producers
- Towns – purchasing policies
- State mandates, regulations
- EPA...
- Stockholm Convention

Thanks to

- NIEHS, of course
- RI C-AIM for HPLC-MS/MS;
- RI STAC and SERDP for passive sampling tube work
- Partners/collaborators

- Faroe Islands



Deildin fyri

Arbeiðs- og Almannaheilsu

Denmark (lab support)

Syddansk Universitet

SDU

THE
UNIVERSITY
OF RHODE ISLAND



SCHOOL OF PUBLIC HEALTH
Department of Environmental Health



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



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Mark Ellis