



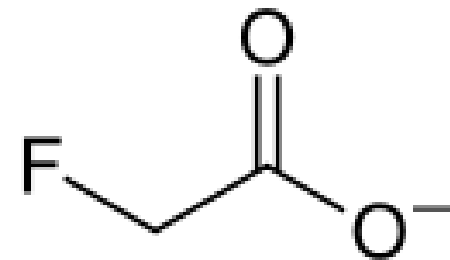
PFAS – vad är det och är det ett problem?

Anna Kärrman
MTM Forskningscentrum
Örebro universitet

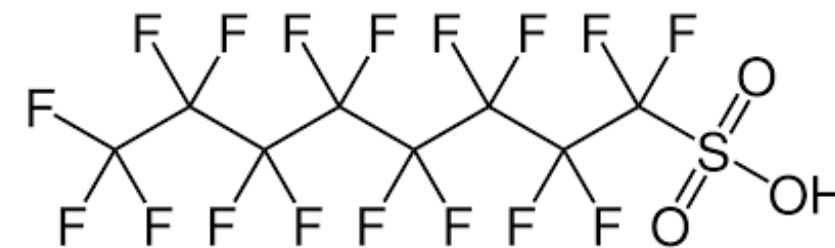
Forever fluor



Mest förekommande form i naturen



Naturligt förekommande organiska fluorföreningar



Antropogena organiska fluorföreningar

Ex.

- CaF_2
- NaF
- $\text{Na}_2\text{PO}_3\text{F}$

Ex.

- *Trifluormetan*
- *Fluoracetat*
- *Fluorerade fettsyror*

Ex.

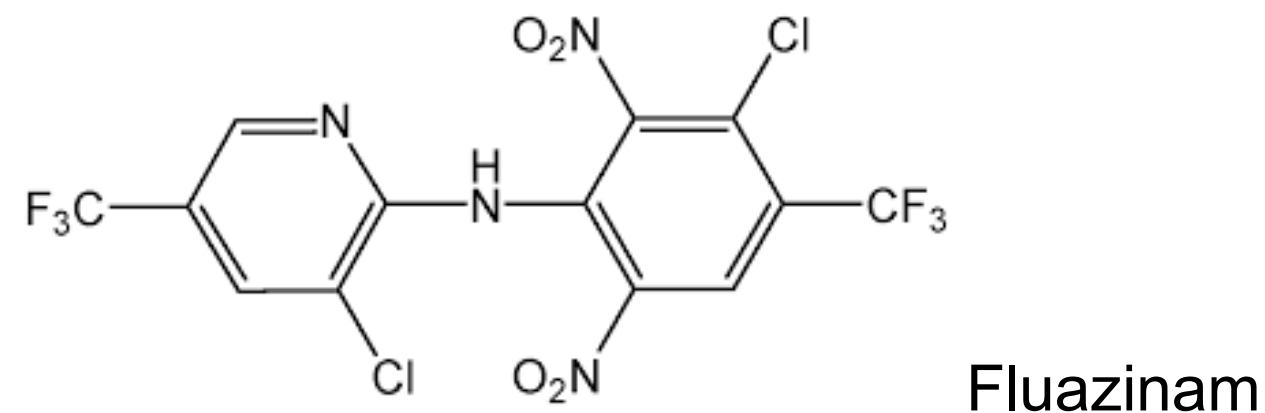
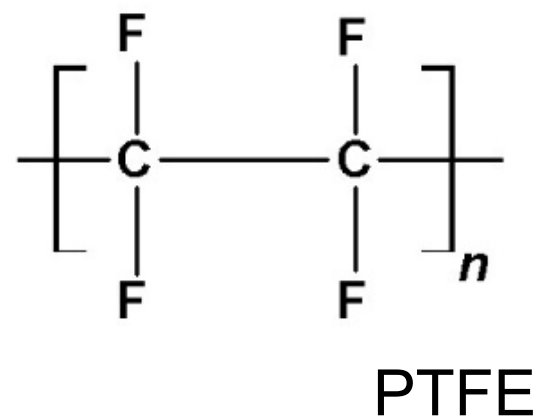
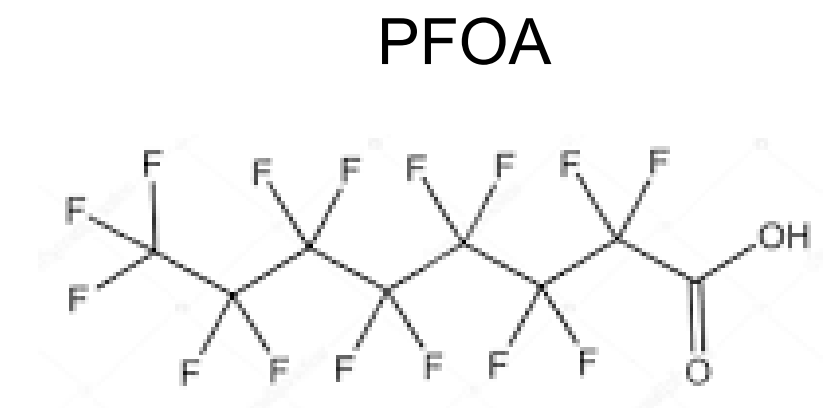
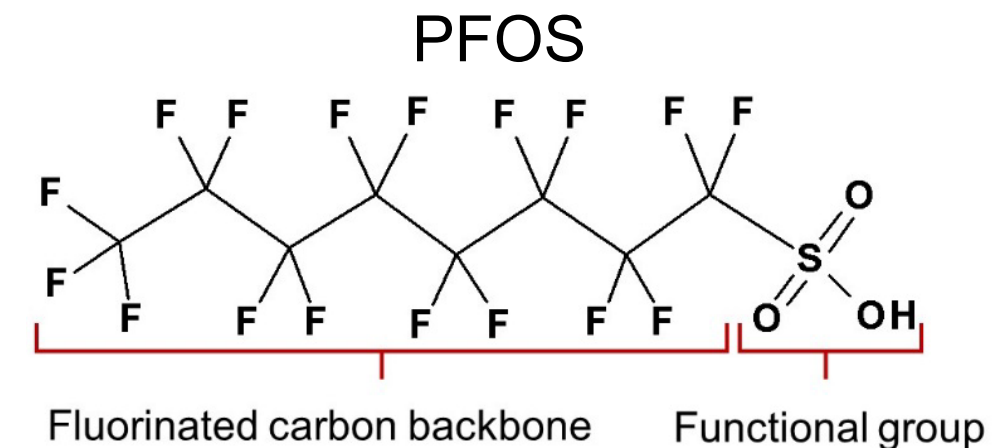
- *Läkemedel*
- *Agrokemikalier*
- *F-gaser*
- *Industrikemikalier*

- Stabilitet
- Fettlöslighet
- Ytaktiv
- Biotillgänglighet
- Låg ozonnedbrytningspotential

Per- och polyfluorerade alkylämnen (PFAS)

Definition av PFAS:

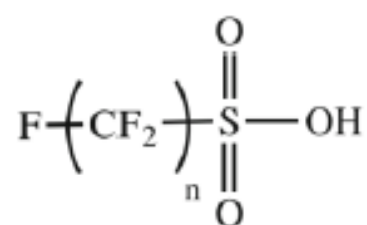
- 2011 - En eller flera perfluoralkylkedjor (C_nF_{2n+1}) och minst en funktionell grupp (Buck et al. 2011)
- 2021 - Minst en fullständigt fluorerad kolatom (utan H/Cl/Br) (OECD 2021)



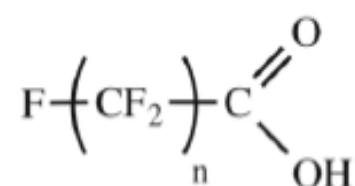
Olika PFAS grupper

Perfluoralkyl syror

Exempel:



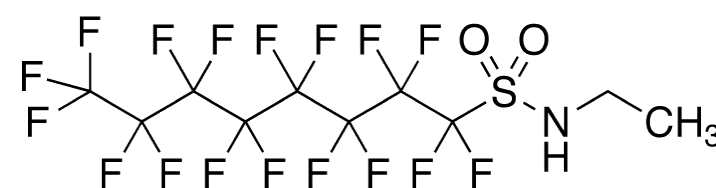
PFASs t.ex. PFOS



PFCAs t.ex. PFOA

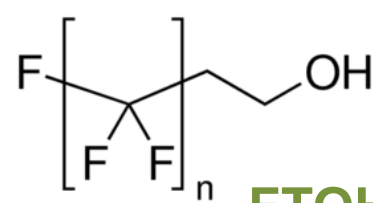
Prekursorer (föregångsämnen)

Exempel prekursorer till PFASs:

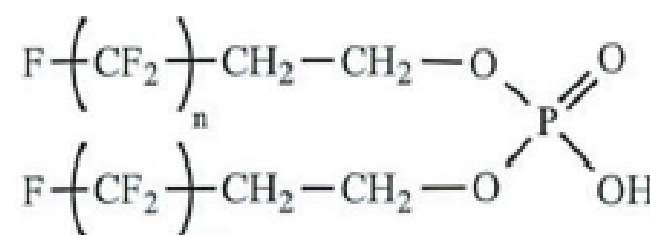


Et-FOSA

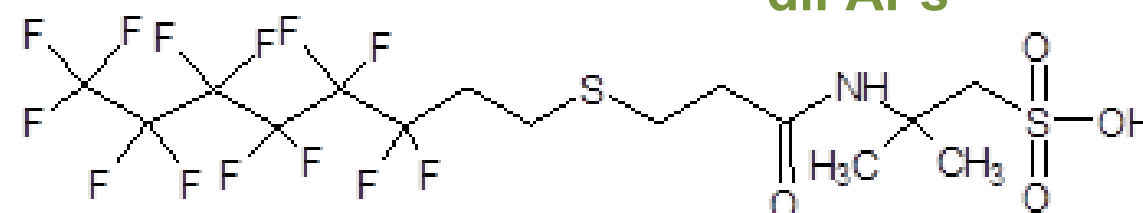
Exempel prekursorer till PFCAs:



FTOHs



diPAPs



6:2 FTSAS

Övriga

Polymerer

Perfluoropolyeterar

Fluorerade alkaner

Olika PFAS grupper

Perfluoralkyl syror

Prekursorer (föregångarämnen)

Övriga

Exempel:

Exempel prekursorer till PFASs:

Polymerer

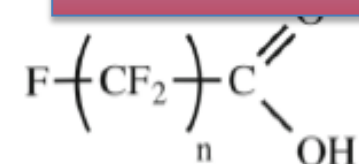
Kunskap om förekomst och effekter



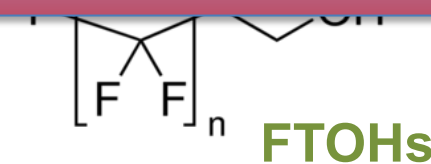
PFASs ex. PFOS



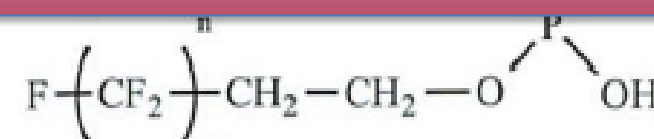
Et-FOSA



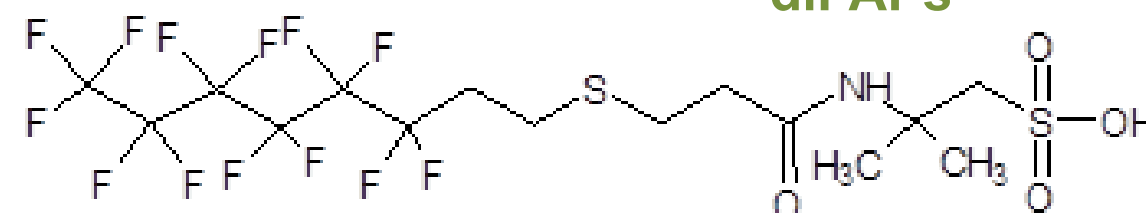
PFCAs ex. PFOA



FTOHs



diPAPs



6:2 FTSAS

Tillverkningsvolym

Är det ett problem?



Chemosphere 64 (2006) 1582–1591

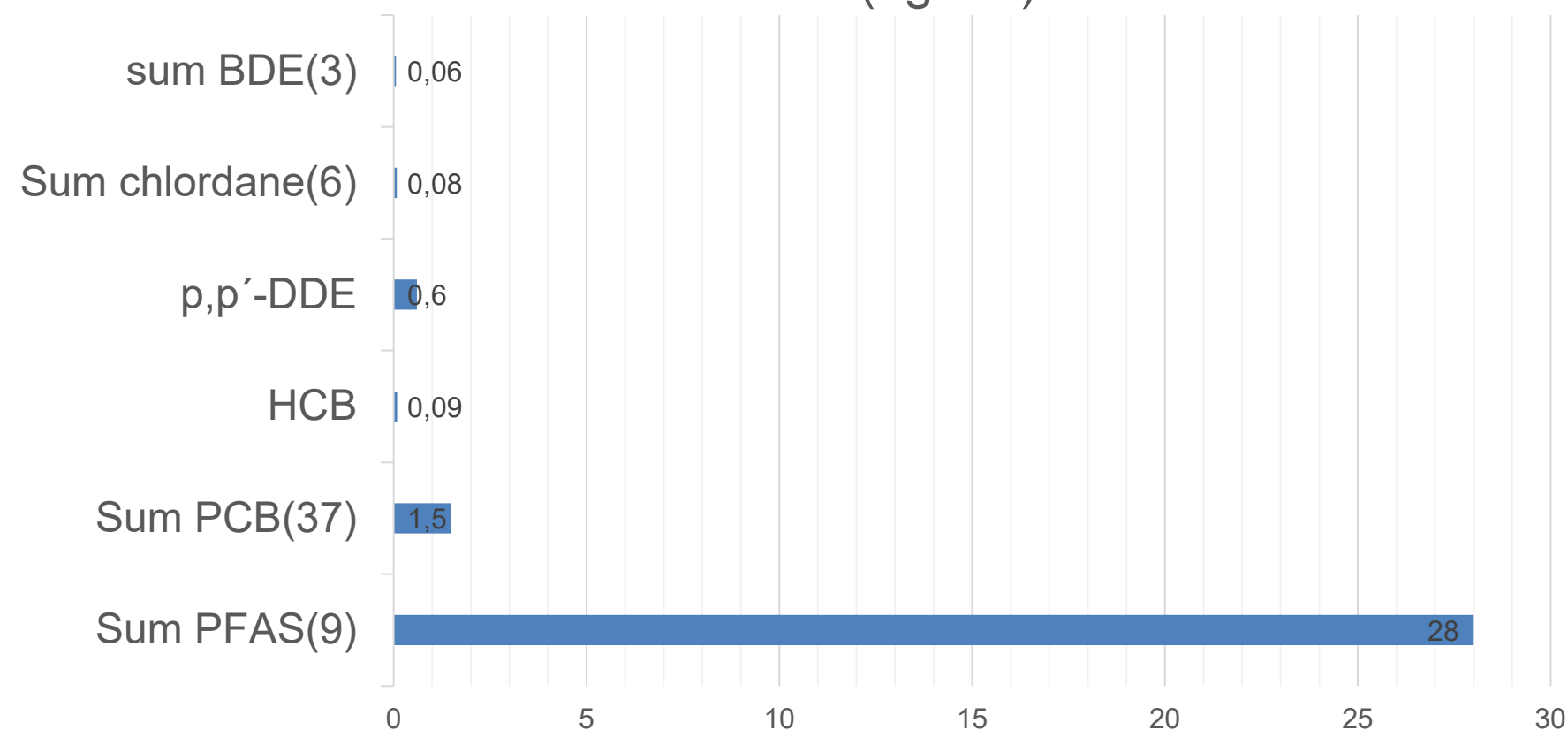
CHEMOSPHERE

www.elsevier.com/locate/chemosphere

Perfluorinated chemicals in relation to other persistent organic pollutants in human blood

Anna Kärrman^{a,*}, Bert van Bavel^a, Ulf Järnberg^b, Lennart Hardell^a,
Gunilla Lindström^a

Blood levels (ng/mL)



VOLUME 115 | NUMBER 2 | February 2007 • Environmental Health Perspectives

Research

Exposure of Perfluorinated Chemicals through Lactation: Levels of Matched Human Milk and Serum and a Temporal Trend, 1996–2004, in Sweden

Anna Kärrman,¹ Ingrid Ericson,¹ Bert van Bavel,¹ Per Ola Darnerud,² Marie Aune,² Anders Glynn,² Sanna Lignell,² and Gunilla Lindström¹

¹Man–Technology–Environment (MTM) Research Centre, Örebro University, Örebro, Sweden; ²National Food Administration, Uppsala, Sweden

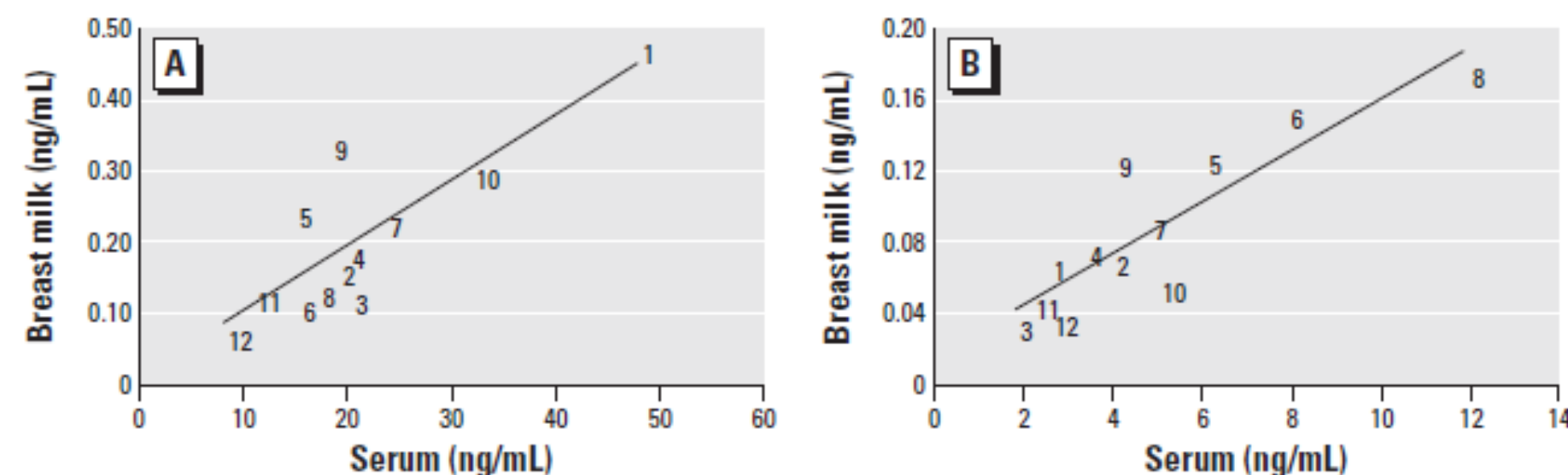
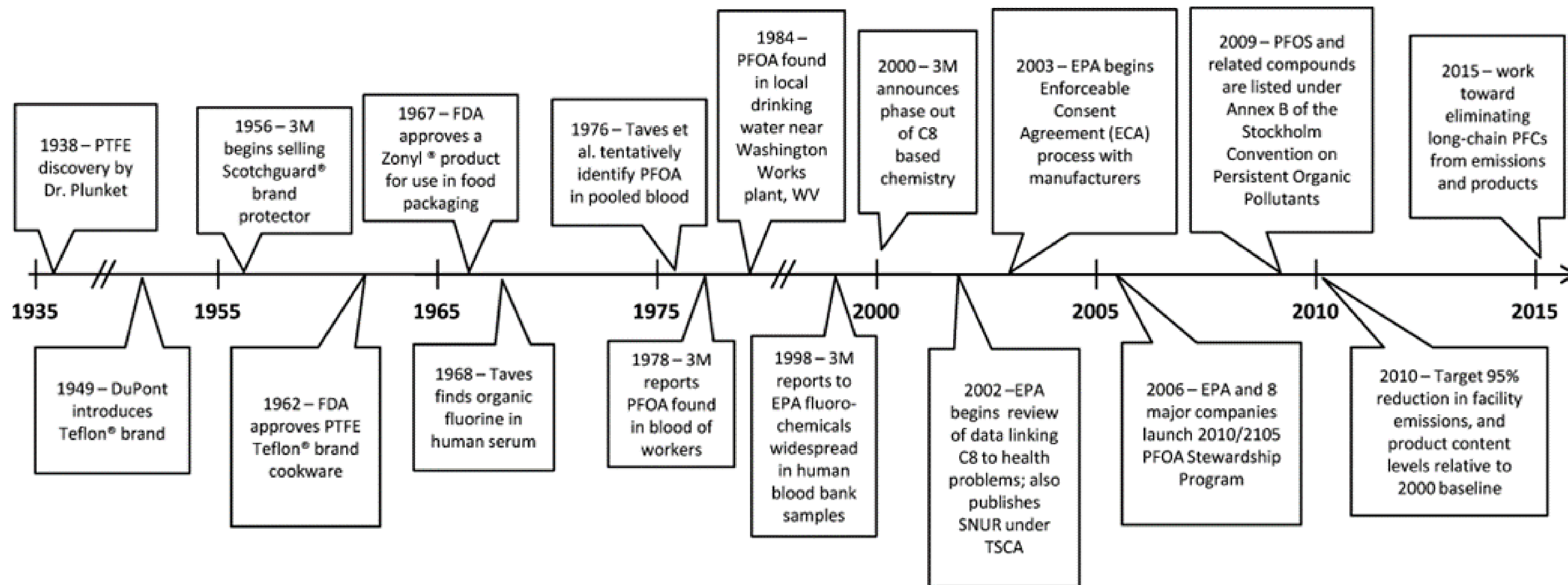


Figure 1. Scatterplot and regression analysis of levels in matched serum and milk samples from 12 Swedish primiparous women (numbered 1–12), 2004. (A) PFOS (M:S ratio, 0.01:1; CV, 38%; $y = 0.0092x + 0.0104$; $r^2 = 0.6868$). (B) PFOA (M:S ratio, 0.02:1; CV, 28%; $y = 0.0144x + 0.0178$; $r^2 = 0.7707$).

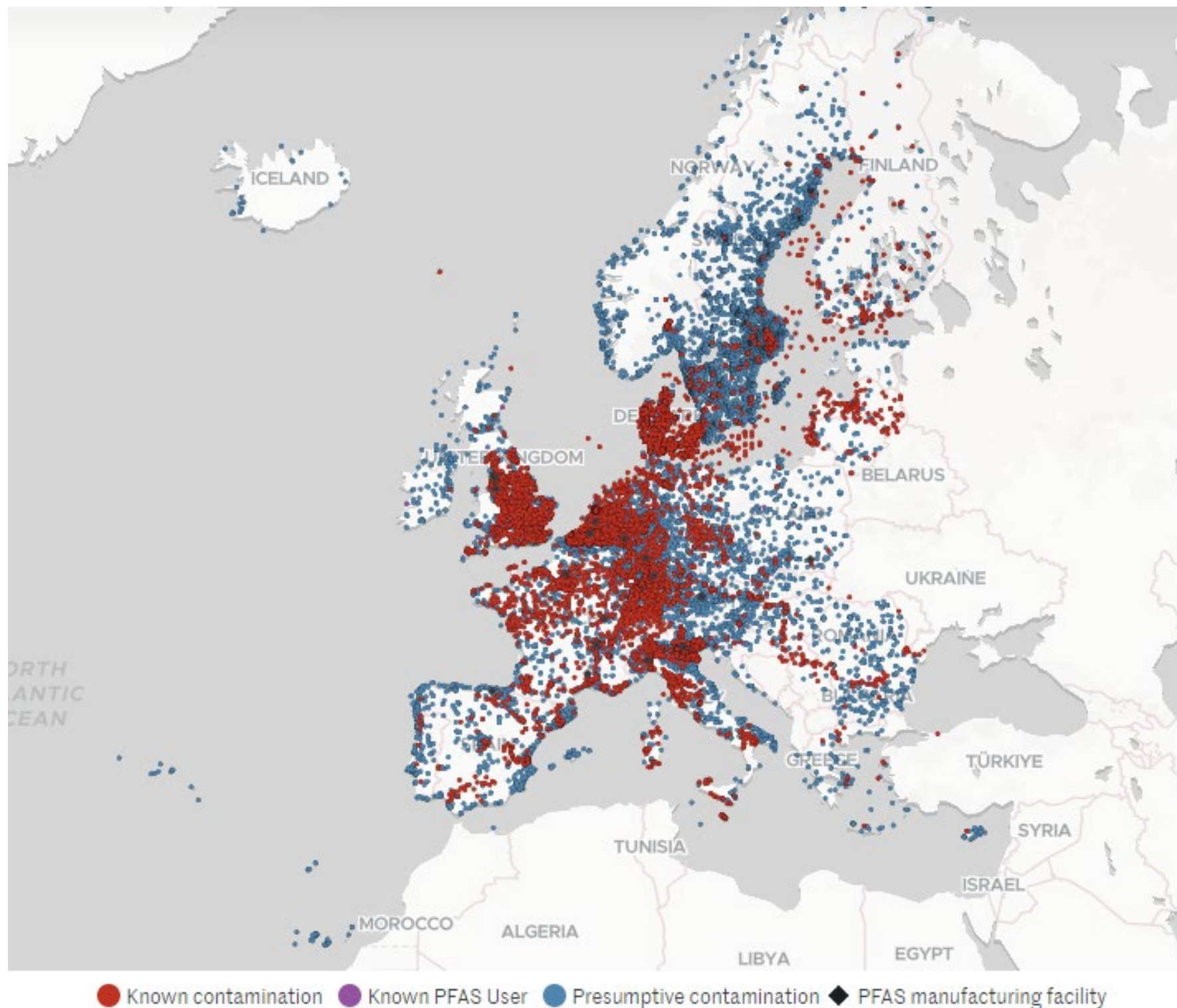
Historik



Användningsområden

1	Industry branches.....	2	Other use categories		
1.1	Aerospace.....	2.1	Aerosol propellants	2.22	Medical utensils
1.2	Biotechnology	2.2	Air conditioning	2.23	Metallic and ceramic surfaces.....
1.3	Building and Construction	2.3	Antifoaming agent.....	2.24	Music instruments and related equipment.....
1.4	Chemical industry.....	2.4	Ammunition	2.25	Optical devices
1.5	Electroless plating	2.5	Apparel	2.26	Paper and packaging
1.6	Electroplating (metal plating).....	2.6	Automotive	2.27	Particle physics
1.7	Electronics industry	2.7	Cleaning compositions	2.28	Personal care products and cosmetics.....
1.8	Energy sector.....	2.8	Coatings, paints, and varnishes	2.29	Pesticides.....
1.9	Food production industry.....	2.9	Conservation of books and manuscripts	2.30	Pharmaceuticals
1.10	Machinery and equipment.....	2.10	Cook- and baking ware.....	2.31	Pipes, pumps, fittings and liners
1.11	Manufacture of metal products	2.11	Dispersions	2.32	Plastic, rubber and resins
1.12	Mining	2.12	Electronic devices.....	2.33	Printing (inks)
1.13	Nuclear industry	2.13	Fingerprint development	2.34	Refrigerant systems.....
1.14	Oil and gas industry.....	2.14	Fire-fighting foams	2.35	Sealants and adhesives
1.15	Pharmaceutical industry	2.15	Flame retardants	2.36	Soldering
1.16	Photographic industry.....	2.16	Floor covering including carpets and floor polish	2.37	Soil remediation
1.17	Production of plastic and rubber	2.17	Glass	2.38	Sport article.....
1.18	Semiconductor industry	2.18	Household applications.....	2.39	Stone, concrete and tile
1.19	Textile production	2.19	Laboratory supplies, equipment and instrumentation	2.40	Textile and upholstery.....
1.20	Watchmaking industry	2.20	Leather	2.41	Tracing and tagging
1.21	Wood processing.....	2.21	Lubricants and greases.....	2.42	Water and effluent treatment
				2.43	Wire and cable insulation, gaskets and hoses.....

Föroreningskällor

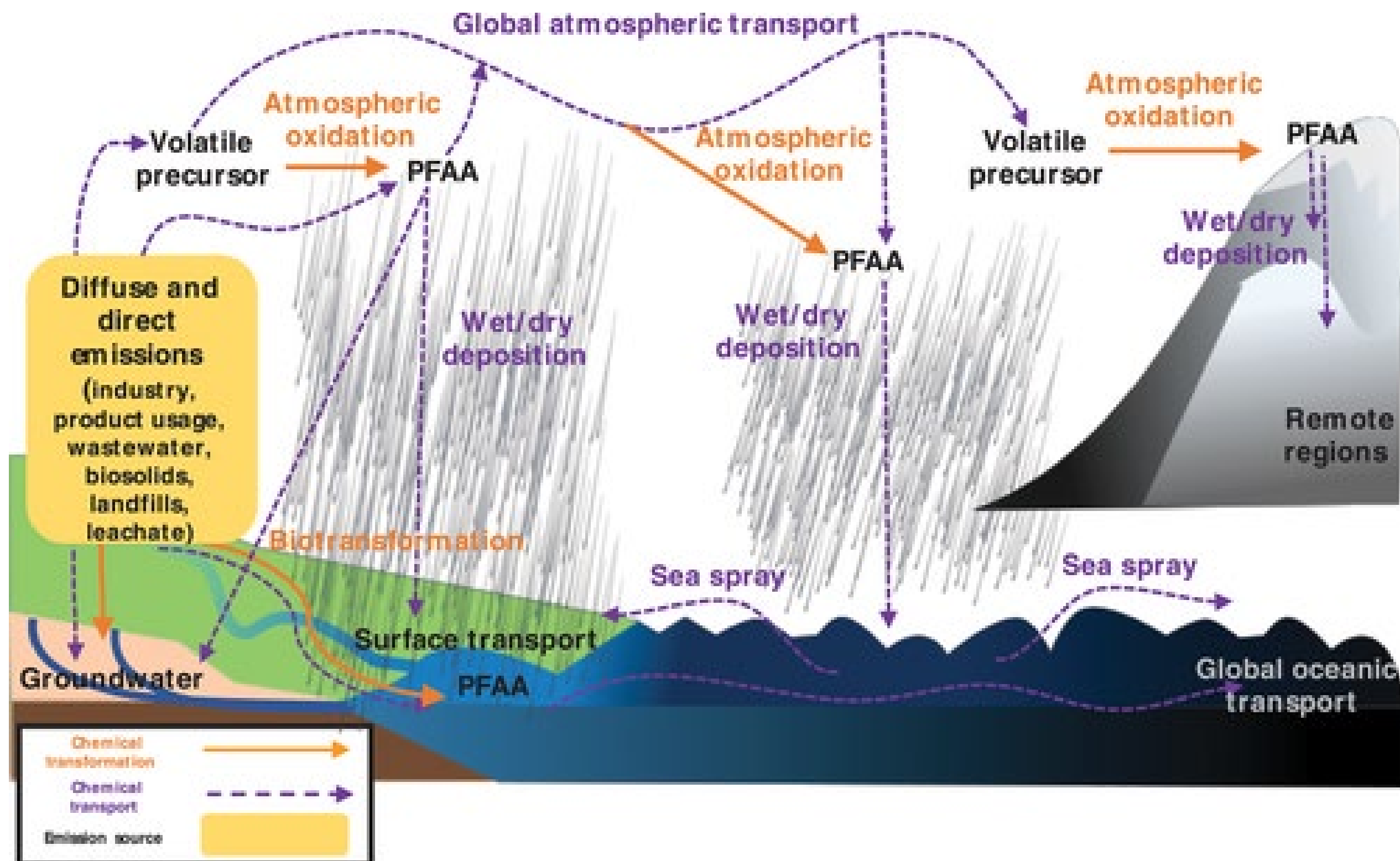


Source: Forever Pollution Project

Le Monde Feb 2023

- Brandövningsplatser
- Större bränder
- Flygplatser
- Industrier (tillverkning och användning)
- Deponier och anläggningar för farligt avfall
- Avloppsreningsverk
- *Atmosfärisk spridning*

Spridningsvägar



Hur påverkar det oss?

		Serumhalter (ng/ml)			
Serum halveringstid		P1	P2	P3	P4
4,3-5 år	PFOS	15	66	27	349
8,5 år	PFHxS	2	25	2	265
2,1-3,8 år	PFOA	1,5	4,2	535	10

P1



- Mat och dricksvatten
- Inomhusmiljö

P2



- Brandmän

P3



- Yrkesexponering skidvalla

P4



- Kontaminerat dricksvatten

EU Chemicals Strategy for Sustainability Towards a Toxic-Free Environment (2020)

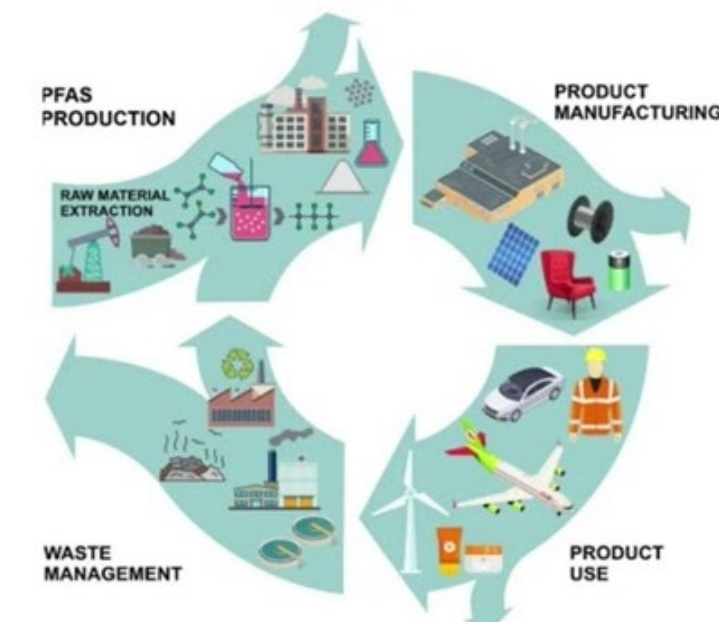
PFAS⁶²

The Commission will:

- ban **all PFAS** as a group in **fire-fighting foams** as well as in **other uses**, allowing their use only where they are essential for society;
- address PFAS with a **group approach**, under relevant legislation on water, sustainable products, food, industrial emissions, and waste;
- address PFAS **concerns on a global scale** through the relevant international fora⁶³ and in bilateral policy dialogues with third countries;
- establish an EU-wide approach and provide financial support under research and innovation programmes to identify and develop **innovative methodologies for remediating PFAS contamination** in the environment and in products;
- provide research and innovation funding for safe **innovations to substitute PFAS** under Horizon Europe.

Restriction proposal to ban all PFAS use in the EU (2023)

75 000 tonnes of emissions in 2020



Source:
https://ec.europa.eu/environment/pdf/chemicals/2020/10/SWD_PFAS.pdf

Current and upcoming PFAS restrictions

