

Per- and polyfluoroalkyl substances - PFAS

DGEM DPPC MRBC

Content



What and why are PFAS?

Chemical identity and uses
Human health hazards and risks
Environmental hazards and risks



How are they regulated?

History of regulation
EU CSS
REACH restrictions
Stockholm convention



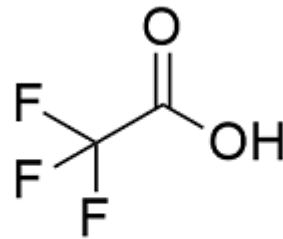
What is BE doing?

Planned and ongoing actions
CCIEP group

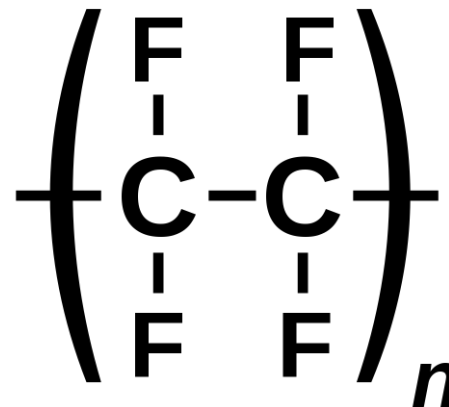
PFAS: Per- and Polyfluoroalkyl substances

PFASs 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.

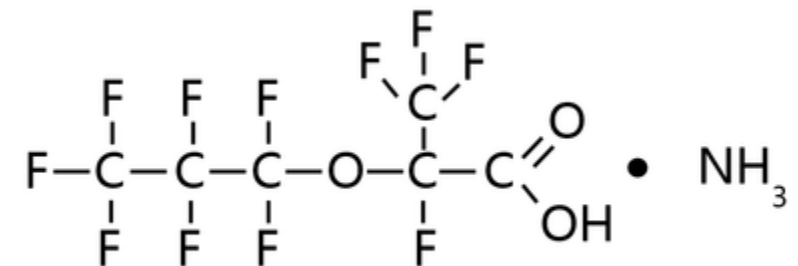
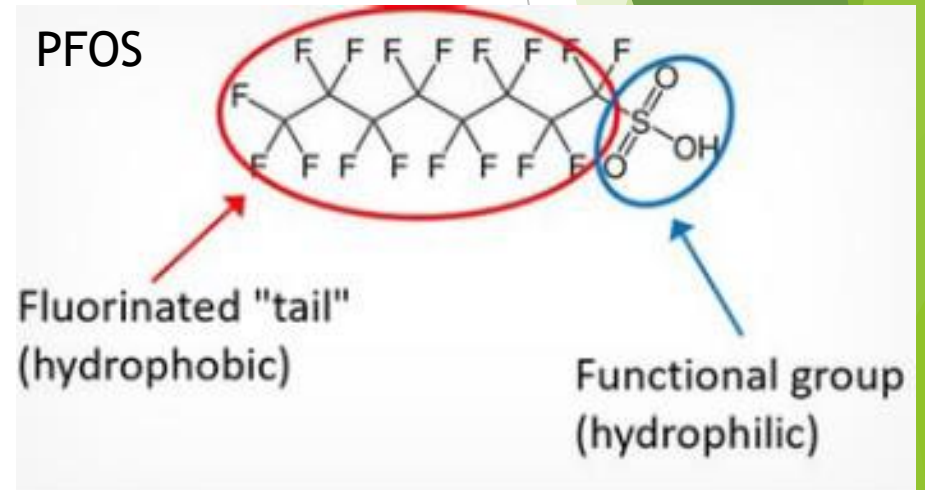
- ▶ Man-made chemicals
 - ▶ Produced since 1950s
- ▶ Defined by Carbon Fluor bond (C-F)
 - ▶ One of the strongest chemical bonds
 - ▶ → “forever chemicals”



trifluoroacetic acid



PTFE (Teflon)



GenX Chemical Structure

Very large group of substances

- ▶ Very large group of substances
- ▶ Over 4000 substances
- ▶ Several large groups
 - ▶ Classically known PFAS (PFOS, PFOA, etc.)
 - ▶ Fluorinated polymers
 - ▶ Fluoropolymers
 - ▶ Side-chain fluorinated polymers
 - ▶ Fluorocarbons
 - ▶ F-gases
 - ▶ ...



PFAS use

- ▶ C-F bond is very strong → very stable molecules → interesting characteristics
 - ▶ Stability and thermo resistance (can withstand high temperatures)
 - ▶ Electrical wire coating
 - ▶ Use in Personal Protection equipment (fire fighting gear)
 - ▶ Fire fighting foams
 - ▶ Water and grease repellent characteristics
 - ▶ Outdoor gear like tents, shoes and raincoats (for example Gore-Tex)
 - ▶ Non-stick pots and pans (Tefal)
 - ▶ Food contact materials (popcorn bags, pizza boxes, ...)





Airconditioning



Fire
extinguishers



Heat pumps



Refrigeration

Essential uses?



Uses of fluoropolymers

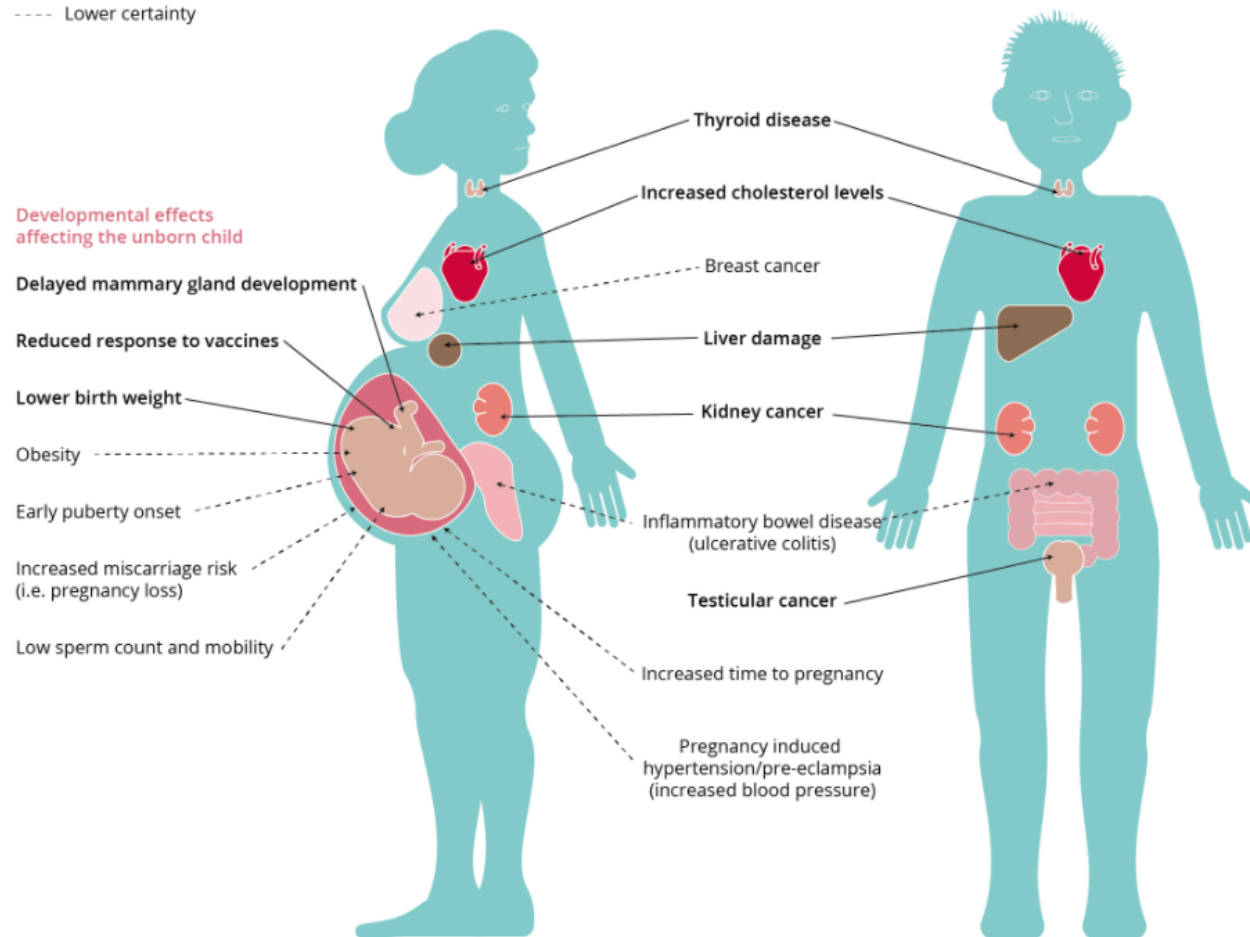
- Promoting sustainable and smart mobility through electric vehicles.
- Extending the lifespan of medical equipment and devices, reducing the need for replacements, risk of failure and cross infections.
- Enabling a data driven economy through the manufacturing of microprocessors and semi-conductors.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

PFAS Hazards

- ▶ Overarching concern: persistence!
- ▶ Health concerns defined for some PFAS are:
 - ▶ Bioaccumulation
 - ▶ Endocrine disrupting effects
 - ▶ Carcinogenicity
 - ▶ Toxicity to reproduction
 - ▶ Effects on immune system
 - ▶ link with COVID vaccine efficiency!
 - ▶ ...
- ▶ Only a few PFAS are extensively studied!
- ▶ Emerging concerns
 - ▶ Low-dose effects
 - ▶ Non monotonic dose response
 - ▶ Mixture effects

— High certainty
---- Lower certainty



Sources: US National Toxicology Program, (2016); C8 Health Project Reports, (2012); WHO IARC, (2017); Barry et al., (2013); Fenton et al., (2009); and White et al., (2011).

- ▶ Body of knowledge is increasing
 - ▶ But still a lot of knowledge gaps!
 - ▶ Impossible to fill in all gaps in a reasonable time

PFAS tox database

The numbers in the heat map indicate the number of studies, not the number of significant effects. Click to select studies, click again to deselect.

Colors correspond to the study type: **human** in green, **animal** in blue, **in vitro** in orange.

Colors correspond to the study type: human in green, animal in blue, in vitro in orange.																																														
PFAS	Total	Metabolic & Digestive System					Body Weight, Size & Growth			Endocrine System			Systemic/ Nonspecific/ Other			Reproductive System		Cell Toxicity / Mortality		Circulatory System			Nervous System & Behavior			Immune System			Urinary System			Respiratory System			Musculoskeletal System			Genotoxicity			Sensory System			Cancers		
PFNA	631	119	63	32	16	157	1	129	49	35	22	29	40	133	20	8	1	26	47	62	9	12	43	15	4	46	14	4	41	9	3	23	1	8	9	5	3	6	15	4	1	14	1			
PFHxS	578	125	24	23	168	33	1	125	19	37	23	14	29	134	10	3	1	15	35	61	8	8	39	14	8	49	8	1	41	7	21	3	1	8	6	2	7	4	15	1	16					
PFDA	506	70	100	36	88	71		75	35	31	9	55	47	88	14	3		17	49	29	14	11	23	13	3	30	22	5	20	16	1	16	3	1	5	7	2	4	7	9	1	10	2	3		
PFUnDA	297	54	22	19	67	28		59	15	25	10	7	18	60	9	1		8	22	26	6	7	13	7	2	17	8	2	11	4	1	13	1		2	4	1	9	1	9		1				
PFAS mix	204	40	35	11	39	31		49	24	14	5	22	10	29	15	2	2	19	18	12	14	1	7	17	2	9	12	1	7	9		5	4		4	7	2	4	4	2	9	2				
PFDODA	203	20	26	18	29	28		29	17	24	5	12	28	32	14	3		8	23	7	4	7	9	8	2	12	4		6	4	1	7	2	1	1	5		2	6	1	6		1			
PFBS	150	10	18	19	12	21		14	13	28	5	18	19	16	15	2	21	25	3	9	7	4	18	4	5	5	2	5	5	1	6	2	2	1	3	1		4	3	2	6	3	1			
PFHpA	143	25	14	17	27	9		22	9	20	5	7	17	32	4	1		6	20	12	3	4	5	3	2	8	5	2	3	3	1	4	1		1	1		1	6	1	1	6				
PFHxA	120	12	14	26	13	12		10	5	27		11	25	7	8	2	14	29	3	6	7		9	2	2	4	1	5	5	1	4	4		1	5	1		5	1	4	1	2	1			
PFBA	99	9	13	22	9	17		6	5	29	2	14	18	7	4	1	13	25	1	6	5		4	2	3	4		5	4	1	1	2		1	3	1		1	2	1	2	1				
PFTTrDA	90	11	13	7	16	18		14	13	8	2	5	7	13	6		3	5	3	3	2	1	5		3	3		3	3	1	1			4				2	1	2						
PFTeDA	67	9	7	12	6	13		5	7	11	2	3	11	4	3	1		2	11	1	1	1		3	1	2	2		3	2	1	3			2				1				1			
MeFOSAA	66	15		1	20			15	1		1	19							5			10			1			8			1		3				4			3						
PFAS + other	59	1	23	7	2	15		4	16	10		16	4	4	10		1	9	10	2	5		2	10	2		4	1	1	2		1		3		3			1		1					
PFHpS	58	11	2	1	19	3		15	3	2	1	1	1	20	1				2	5	1		5	1	1	4	2		2	1	3			1			3		1							
PFPeA	57	6	5	12	8	5		6	1	11	1	3	18	6	3		4	11	1	1	2		2		1	1	1	3	1	1	2			1	1			1		1	1	1				
EtFOSAA	49	11		1	10	1		10			2		2	14					4			9			1			6		1			1				3		4							
6:2 CI-PFESA	44	6	10	4	10	12		6	10	4	1	11	2	8	5		11	5	4	3	2	1	3		3	3		3	2						1											
GenX	29		10	9		10			8	9		9	7		6	2	10	11		5	2		4			2	1		4			1		2			2				1					
PFDS	24	5	5	1	6	4		2	2	2	1	1	2	1	1		1	1	1	1		1		1	2		3	1	1		1			1	1			1		1						
8:2 CI-PFESA	13	3	1	1	5			3	1	2		1		3	1		2	2	2			1			1			1																		
6:2 FTSA	11		3	3		5		1			2	1		1			4	1			1	1			1		1																			
HFPO-TA	6	1	1	2		1		1	1	2			1				1	2	1									1																		
ADONA	5		1	1		1			1	2		2			1		2	2		1	1		2			1			1					2		1	1		1							
PFO4DA	5	1	2	1		2		1	2	1		2	1		1		1	1	1	1			1			1		1	1	1				1												
PFO5DoDA	5	1	3			2		1	3			3			1		1		2							2		1	2					1												
PFPeS	5	2	1		1			1			1	1		1			1					1												1												
Nafion BP2	2		2			1			1			1								1										1																
PFNS	1	1									1																																			

Filters

Refresh page to reset all filters

Study Type

Click for study type specific histograms, hover for study counts

human animal in vitro

Early Life Effects

Show All Effects

Financial Conflict of Interest

(All)

Selected Studies

Hover to see details, click for PubMed.

Abe et al. 2017

Abe et al. 2017

Abercrombie et al. 2021

Abraham et al. 2020

Adinehzadeh and Reo 1998

Adinehzadeh et al. 1999

Ahmed et al. 2019

Aimuzi et al. 2019

Aimuzi et al. 2020

Ait Bamai et al. 2020

Akerblom et al. 2017

Alderete et al. 2019

Alkhalawi et al. 2016

Allendorf et al. 2019

Alves et al. 2016

Ammitzboll et al. 2019

Andersson et al. 2019

Annuziato et al. 2019

Annuziato et al. 2020

Annuziato et al. 2020

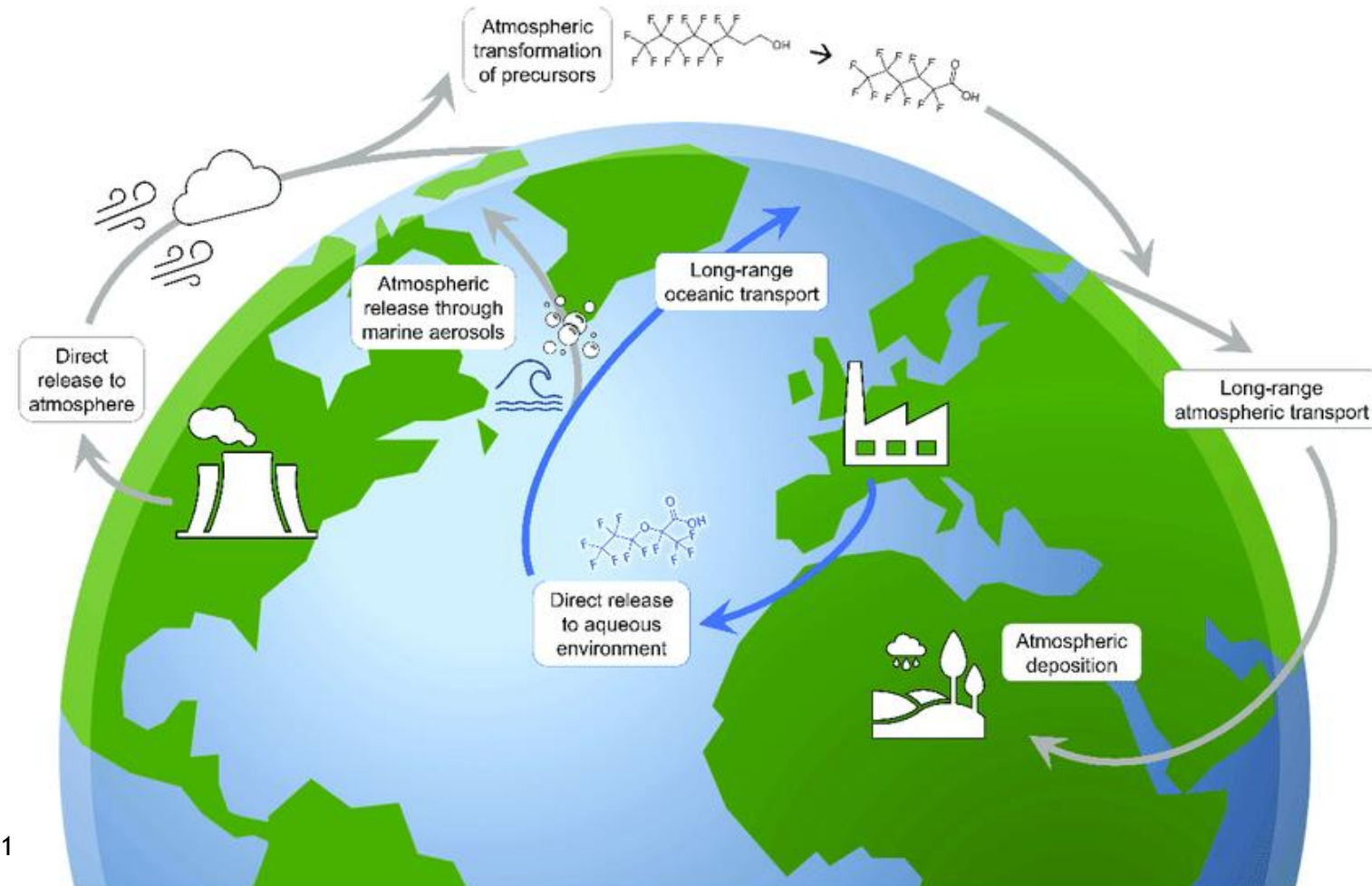
Annuziato et al. 2020

Annuziato et al. 2020

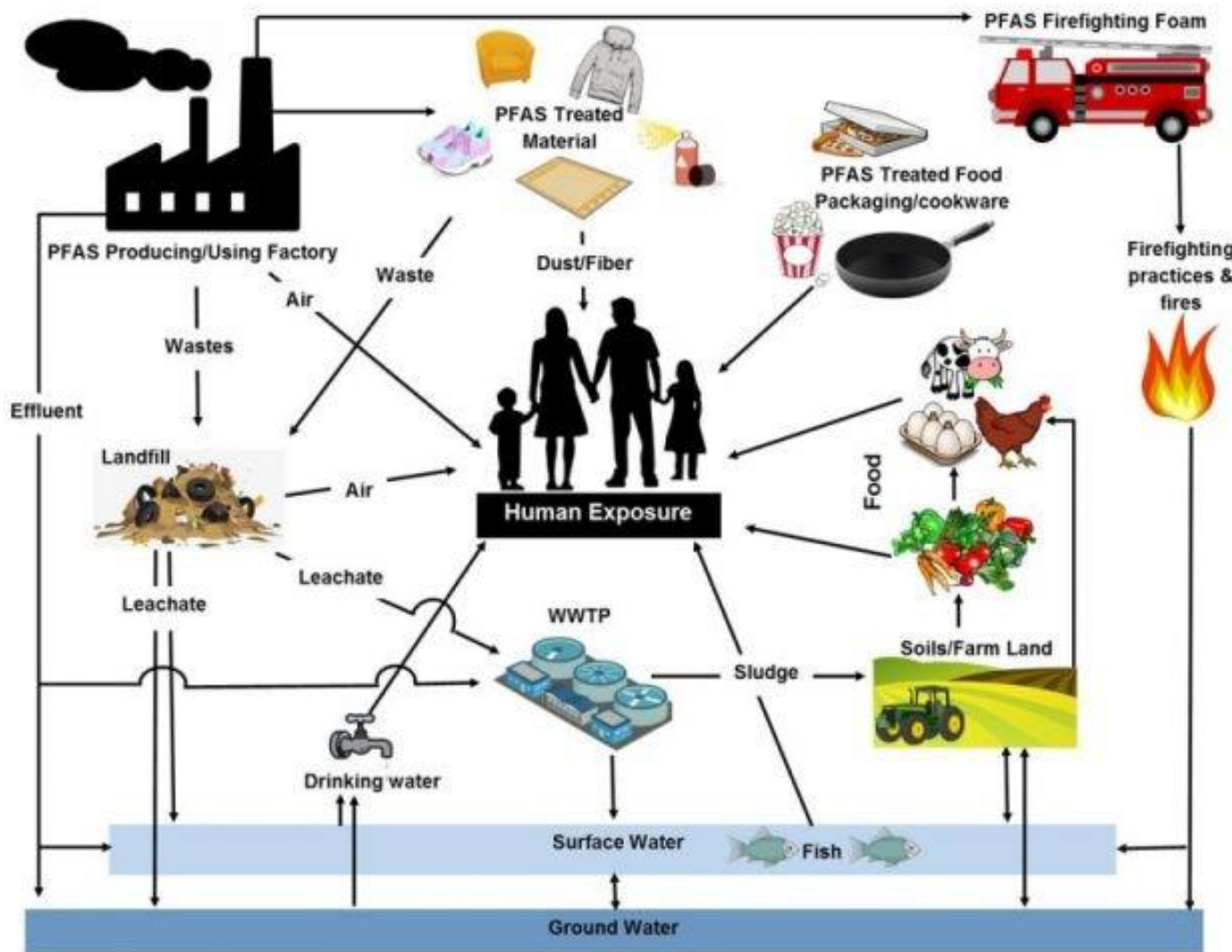
Download Study List

Environmental fate and exposure to PFAS

- ▶ C-F bond is extremely persistent in the environment
 - ▶ Irreversible environmental contamination
 - ▶ Very hard to remove from water, soil and air
- ▶ Widespread use in consumer products (textiles, food contact materials, cosmetics)
- ▶ Landfill leachate
- ▶ Incomplete incineration → release of PFAS to atmosphere
- ▶ ...



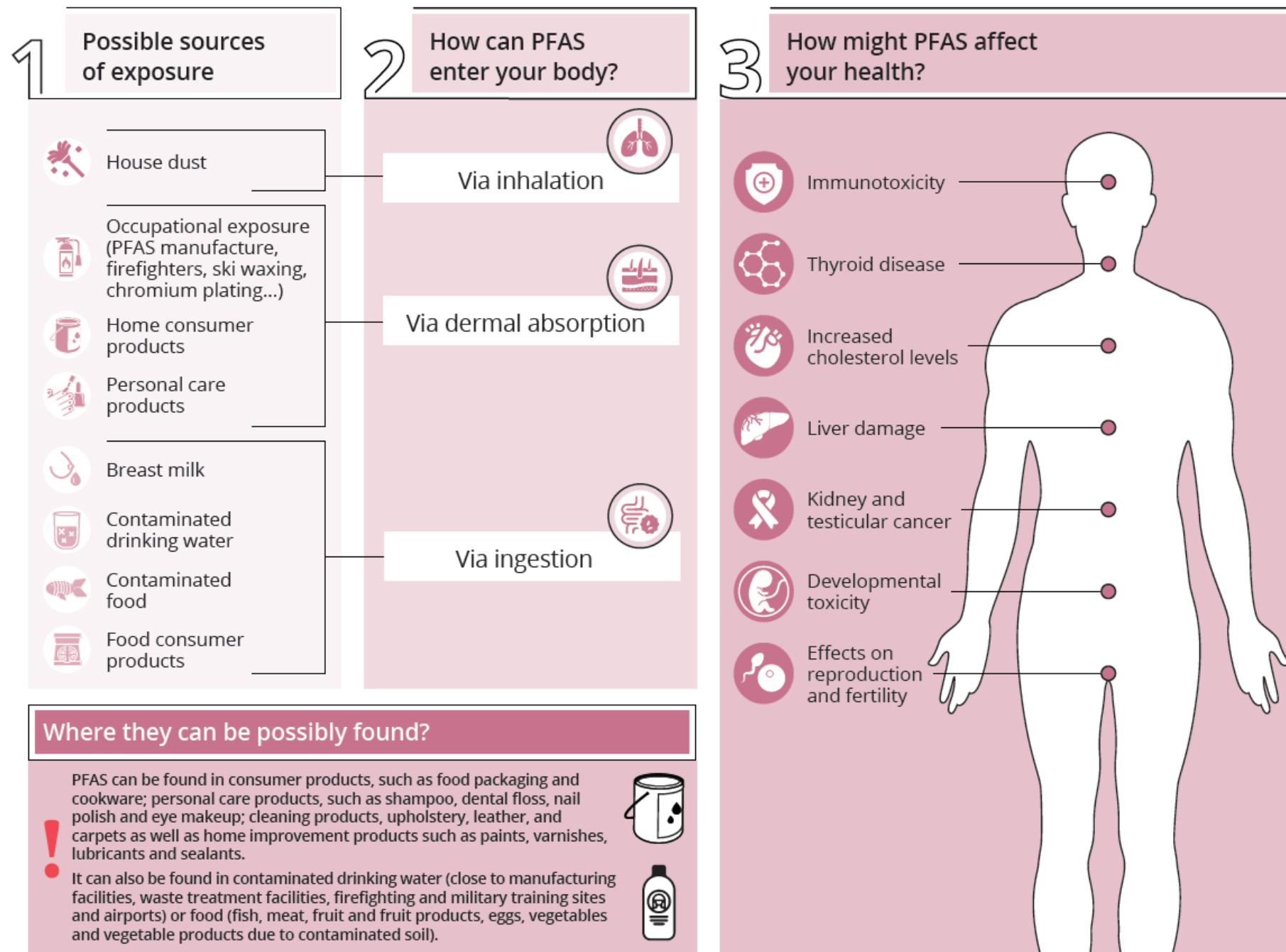
Environmental fate and exposure to PFAS



- Many different points of exposure to humans.

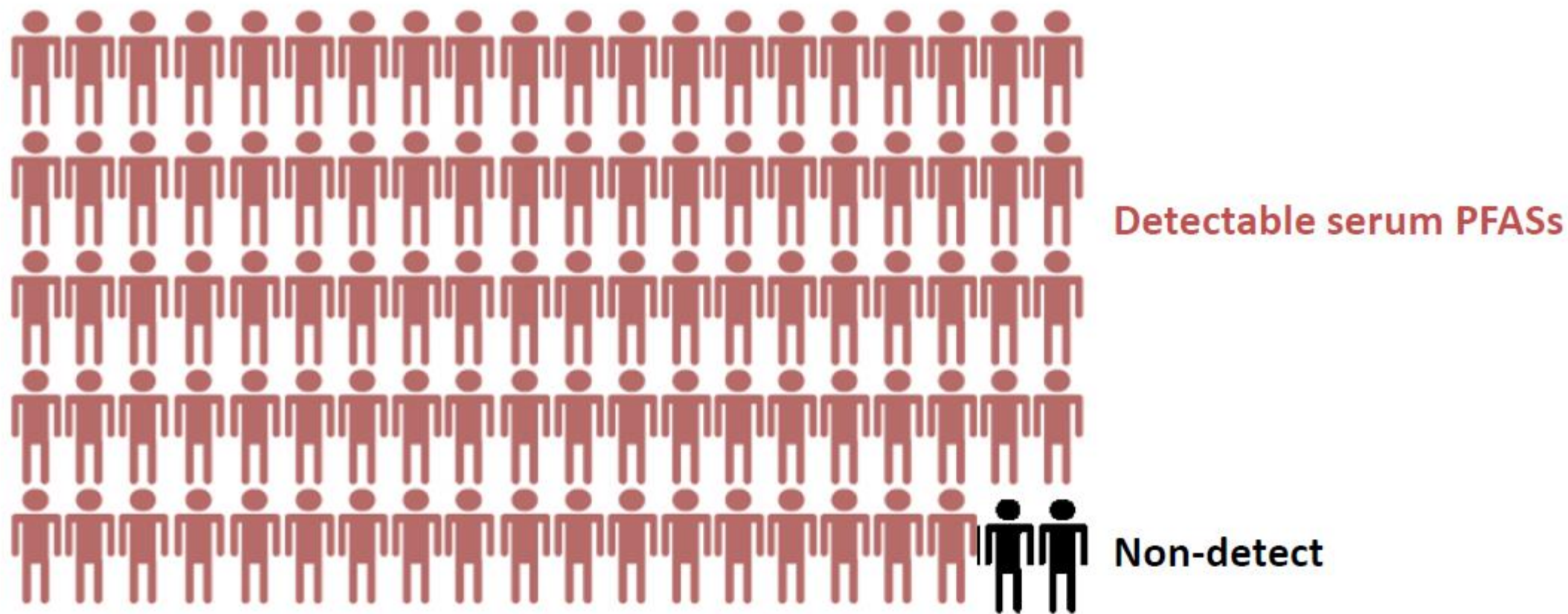
*Human Exposure and sources of PFAS
Image: DWP, adapted from Oliaei et al. 2013.*

Figure 1. Overview of exposure sources, pathways and health effects associated with PFASs



► Source: HBM4EU Policy brief

- ▶ PFAS detected in blood serum in approximately 98% of the population
- ▶ HBM show large portion exceeding the guideline values
- ▶ PFOS and PFOA levels are decreasing
 - ▶ Not the case for other PFAS!



PFAS contaminated sites

- ▶ Over the years large scale pollution near PFAS production sites have been uncovered
 - ▶ US: Dupont and 3M
 - ▶ Italy: Miteni Ltd. and Solvay
 - ▶ Netherlands: Chemours
 - ▶ Belgium: 3M
 - ▶ ...
- ▶ Significantly higher PFAS concentrations are found in populations living near such contaminated sites
- ▶ Very high costs associated to remediating the PFAS pollution (very hard due to persistent characteristics)



How are PFAS regulated?

History of PFAS policy actions

- ▶ 2006: EU restriction of PFOS (under Dangerous Substance Directive)
- ▶ 2009: PFOS added to the Stockholm Convention on Persistent Organic Pollutants (POP regulation in EU)
- ▶ 2011: PFOA and APFO identified as SVHC + CLP classification
- ▶ 2012: **ICCM3** identifies PFAS as **emerging policy issue**
- ▶ 2016: PFNA identified as Substance of Very High Concern (SVHC) + CLP
- ▶ 2017: PFOA added to the REACH restriction list (Annex XVII)
- ▶ 2017: PFDA identified SVHC + CLP
- ▶ 2019: HFPO-DA (Gen-X) identified SVHC
- ▶ 2020: PFOA added to Stockholm Convention
- ▶ 2020: PFBS identified as SVHC
- ▶ 2021: C9-C14 added to the REACH restriction list (enters into force in 2023)
- ▶ 2023: PFHxS and related substances will be added to the Stockholm Convention

Well know PFAS get regulated → lesser known related PFAS replace them!
= regrettable substitution

2020: Chemical Strategy for Sustainability (CSS)

- ▶ Published in October 2020
- ▶ Part of the EU Green Deal
- ▶ Several actions on chemicals envisaged:
 - ▶ Review of REACH and CLP
 - ▶ Take action on the “cocktail effect”
 - ▶ ...
 - ▶ Phase out of all PFAS in the EU, except for “essential uses”



CSS: EU PFAS strategy

- ▶ Goal: minimization of exposure of humans and environment to PFAS, taking into account the complete life-cycle of these substances
- ▶ Proposed actions:
 - ▶ Take action on PFAS as a group
 - ▶ Phasing out all PFAS, except for essential uses, until safer and sustainably alternatives are available
 - ▶ Development of limit values for all relevant EU legislation
 - ▶ Take action on effective enforcement
 - ▶ (Bio)monitoring, researching alternatives, developing new analytical methods, etc.

PFAS SWD



Brussels, 14.10.2020
SWD(2020) 249 final

COMMISSION STAFF WORKING DOCUMENT

Poly- and perfluoroalkyl substances (PFAS)

Accompanying the document

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN
PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL
COMMITTEE AND THE COMMITTEE OF THE REGIONS

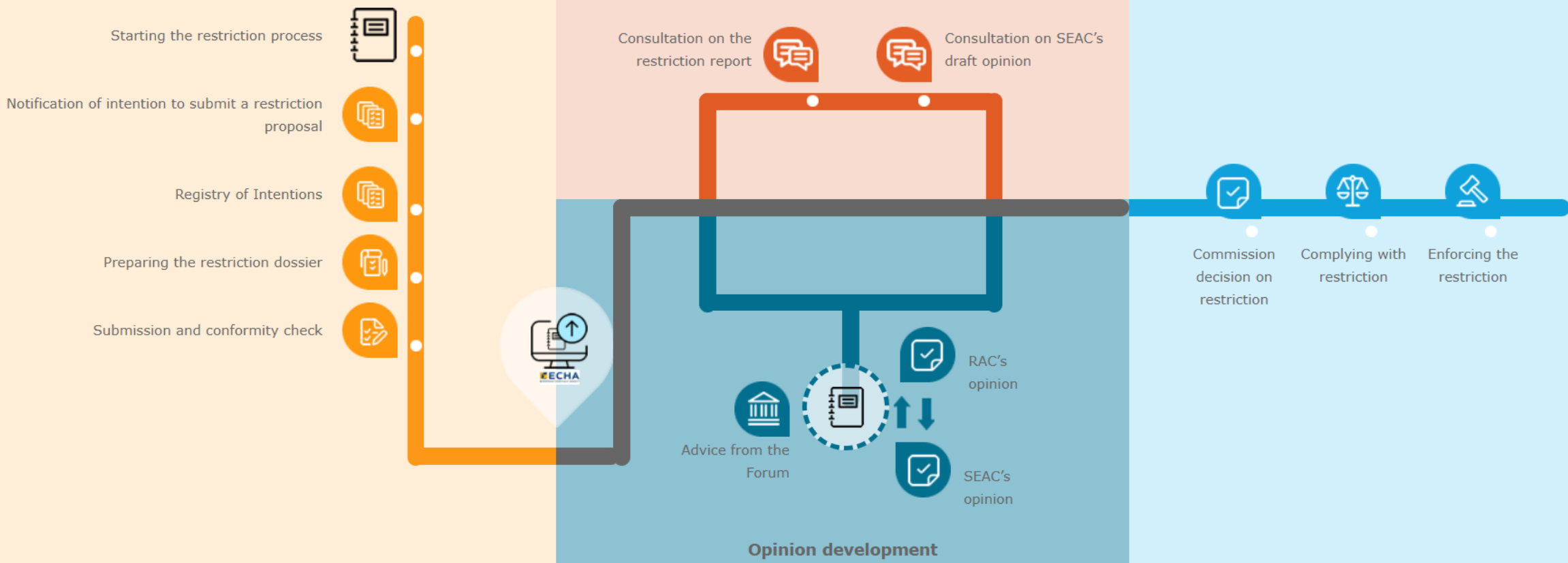
Chemicals Strategy for Sustainability
Towards a Toxic-Free Environment

18

{COM(2020) 667 final} - {SWD(2020) 225 final} - {SWD(2020) 247 final} -
{SWD(2020) 248 final} - {SWD(2020) 250 final} - {SWD(2020) 251 final}

REACH restrictions

- ▶ REACH = Registration, Evaluation, Authorisation and Restriction of CHemical substances
 - ▶ Registration of all chemical substances put on the market in the EU at more than 1 ton/year
 - ▶ Evaluation of registration dossiers and substances
 - ▶ Authorisation of chemicals which are prohibited in the EU, except when authorisations are granted
 - ▶ Restrictions, which are a broader tool to ban or limit the marketing/use or formulation of substances
- ▶ On restrictions
 - ▶ REACH restrictions: restricting the **manufacturing, placing on the market or use of a substance** on its own, in a **mixture** or in an **article**
 - ▶ When there is an unacceptable risk to human health and/or the Environment
 - ▶ Standard process:
 - ▶ Preparation of a restriction dossier (Annex XV dossier)
 - ▶ Public Consultations on the dossier
 - ▶ Development of scientific opinions of the Risk Assessment Committee (RAC) and the Socio-Economic Committee (SEAC)
 - ▶ After finalization of the Annex XV and the Opinions → EU Commission prepares a restriction entry for REACH (legal text)
 - ▶ Proposal will be discussed and voted in the REACH Committee by Member States



REACH PFAS restrictions

- ▶ Several PFAS restrictions in the pipeline

- ▶ Already in force: PFOS and PFOA (so called C8 PFAS)

- ▶ Moved to Stockholm convention (POP)

- ▶ To be entered into force

- ▶ C9-C14 PFCAs

- ▶ To be decided

- ▶ PFHxA and related substances

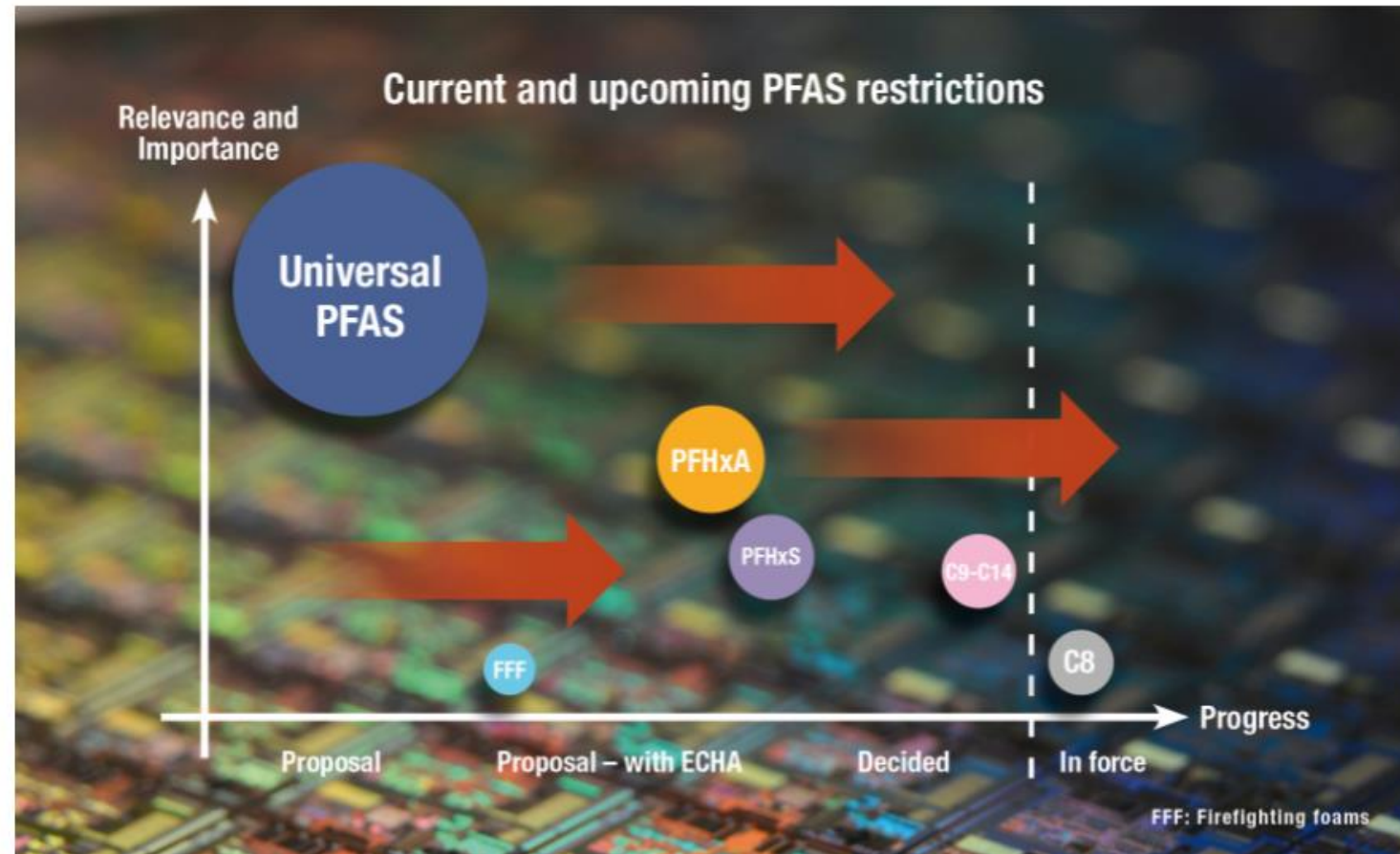
- ▶ PFHxS and related substances (will go to POP)

- ▶ In development

- ▶ PFAS in fire fighting foams

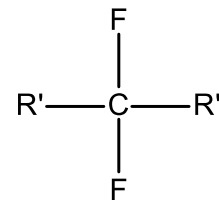
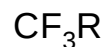
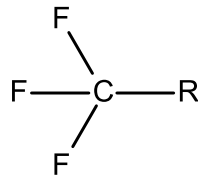
- ▶ Proposal on the way

- ▶ Universal PFAS restriction



Universal PFAS restriction proposal

- ▶ REACH restriction proposal to be submitted by 4 Member States (NL, DE, SE, DK) and NO
- ▶ Focus on the entire group of PFAS
 - ▶ “Substances that contain at least one aliphatic -CF₂- or -CF₃ element”.
 - ▶ Persistence as main common concern
 - ▶ Only “essential” uses can continue
- ▶ Proposal planned to be published in January 2023
 - ▶ Restriction entering into force: predicted for 2025
 - ▶ But probably later!



Stockholm Convention

- ▶ International Convention on Persistent Organic Pollutants
 - ▶ Implemented in the EU under the POP Regulation
 - ▶ PFAS under this convention:
 - ▶ PFOA and related substances
 - ▶ PFOS and related substances
 - ▶ PFAS to be included:
 - ▶ PFHxS and related substances
 - ▶ C9-C20 PFCAs
- ▶ Obligations for members:
 - ▶ Provide data on stocks
 - ▶ Ensure proper waste management
 - ▶ Report on inspections
 - ▶ ...



STOCKHOLM CONVENTION

What is Belgium doing?

Actions on regional level

- ▶ Walloon region
 - ▶ Monitoring projects
 - ▶ BIODIEN: PFAS in surface water and groundwater
 - ▶ CARIBOUH: PFAS in sewage sludge



Arrêté du gouvernement wallon allouant une subvention au Groupement d'Intérêt Scientifique wallon de Référence pour la qualité des EAUX (GISREAX)

RECHERCHE DE PERTURBATEURS ENDOCRINIENS ET D'AUTRES SUBSTANCES D'INTÉRÊT RÉCENT DANS LES EAUX EN VUE DE LA PROTECTION DE LA SANTÉ PUBLIQUE ET DE L'ENVIRONNEMENT

PROGRAMME DE RECHERCHE « BIODIEN »

- ▶ Flemish region
 - ▶ PFAS action plan
 - ▶ Monitoring projects and research initiatives
 - ▶ Human biomonitoring
 - ▶ Since 2021: many new projects

PFAS gemeten in de Vlaamse bevolking

	▶ 2de cyclus (2007-2011) VI referentiegroep	▶ 3de cyclus (2012-2015) VI referentiegroep	▶ 4 de cyclus (2016-2020) VI referentiegroep
 Pasgeborenen	PFOS, PFOA (n=218)	PFOS, PFOA, PFNA, PFHxS, PFBS (n=269)	
 Jongeren 14-15 jaar			PFOS, PFOA, PFNA, PFHxS, PFBS, PFDA, PFPEA, PFHxA, PFHpA, PFUNDA, PFDODA, PFHpS (n=410)
 Volwassenen 20-40 jaar	PFOS, PFOA (n=204)		
 Volwassenen 50-65 jaar		PFOS, PFOA, PFNA, PFHxS, PFBS (n=209)	

Federal level actions on PFAS

► DGEM

- Substance evaluations of PFAS substances under REACH
- Belgian Competent Authority of REACH: Belgian vote for authorisation and restriction dossiers
- NAPED: research activities on PFAS substances envisaged under this plan
- Follow-up of the CSS and the REACH and CLP revisions
- Piloting the CCIEP group on PFAS (see next slides)
- Inspection campaigns on PFAS

► Belgian Builds Back Circular

- Substitution project on PFAS
 - To be developed by FOD Economie
- Study on PFAS in textiles
 - With focus on PFAS in home textiles

► DG APF

- BE position on EU Food Law actions and Food Contact Materials
- Projects related to PFAS in food (PERFOOD and FLUOREX)



.be



Other EU and international PFAS related policy actions

- ▶ Sector specific
 - ▶ Food Contact Materials (FCM)
 - ▶ Plant Protection Products (PPP)
- ▶ Water
 - ▶ Drinking water Directive (DWD)
 - ▶ Groundwater Directive (GWD)
 - ▶ Water Framework Directive (WFD)
 - ▶ ...
- ▶ Product policy
 - ▶ Ecolabel
 - ▶ Sustainable Product Initiative (SPI)
- ▶ Food
 - ▶ EFSA opinion
 - ▶ Food contaminants regulation
- ▶ Industrial Emissions Directive (IED)
 - ▶ BAT
 - ▶ E-PRTR
- ▶ Waste
- ▶ Soil
- ▶ International
 - ▶ PIC
 - ▶ OECD PFC group
 - ▶ OSPAR
 - ▶ SAICM
- ▶ Research
 - ▶ Horizon Europe
 - ▶ ...

Competences in Belgium are divided!

CCIEP: Coordination Committee International Environment Policy

- ▶ Belgium competences regarding environment are distributed between the different authorities
 - ▶ Regional: drinking water, soil, environmental permits, ...
 - ▶ Federal: product policy, food safety, ...
- Need for coordination between authorities for EU and international policy actions on environment
- ▶ 1995: creation of the CCIEP
 - ▶ Created in line with the cooperation agreement between the different authorities
 - ▶ Existing of working groups responsible for specific environment related topics
 - ▶ For example: CCIEP-Chemicals group

2019: Creation of the “short-chain” PFAS working group

- ▶ EU and International policy actions shift from well known long-chain PFAS (PFOA and PFOS) to lesser known short-chain PFAS (PFHxA, PFBS, etc.)
 - ▶ Focus on “grouping approach” to tackle the large group of substances
 - ▶ Arrow-head approach: target degradation product of large group of substances
 - ▶ For example: PFHxA restriction process under REACH: group of substances with PFHxA as degradation product
 - ▶ Resulting in a lot of different uses being tackled in risk management measures like restrictions
 - ▶ Need for coordinated information gathering and exchange of information between Belgium authorities to follow these policy actions
- Resulted in the creation of a CCIEP short-chain PFAS working group
- ▶ As a subgroup of the CCIEP-Chemicals working group
 - ▶ To share and collect data on short-chain PFAS in Belgium

Renewal and extension of the CCIEP mandate

- ▶ May 2021: Historical pollution of PFOS near a production site in Zwijndrecht (Antwerp) gets media attention
- ▶ Results in political actions:
 - ▶ Federal: Joint-Interministerial Conference on Environment and Health (JICEH) of July 8 2021, which requested to:
 - ▶ Extend and expand on the mandate of the short-chain PFAS CCIEP working group
 - ▶ To inform and optimize different actions being taken in BE
 - ▶ Act as national expert body including all relevant authorities in order to share and collect PFAS related data

CCIEP PFAS Working Group

- ▶ New mandate negotiated and finalized in December 2021 includes:
 - ▶ Building of a BE databank on PFAS
 - ▶ Exchange of information between authorities to contribute to international actions (REACH restrictions, POPs, etc.)
 - ▶ Update the existing PFAS report
 - ▶ Expand from short-chain to all PFAS
 - ▶ Adding current challenges and perspectives
 - ▶ Exchange of information with other groups to enhance PFAS policy actions
 - ▶ Expansion of the composition → adding health competences

CCIEP PFAS Working Group - current and planned outcomes

► Outcomes:

- BE comments submitted to the Public Consultation of the PFAS in AFFF restriction proposal
- Info sharing of projects and policy actions via CCIEP report
- Cooperation between the regions on mapping exercises
- Discussions on harmonizing standard levels of PFAS over the different regions

► Upcoming:

- Providing input into the General PFAS restriction
- Further providing data into the AFFF restriction proposal
- Looking into drafting a PFAS AOB point for the ENVI Council Conclusions
- Etc.

Conclusion

PFAS Challenges

- ▶ Large amount of substances
 - ▶ Impossible to have complete toxicological profile of all PFAS
 - ▶ Impossible to have regulatory action on substance-by-substance basis
- ▶ Large amount of uses
 - ▶ Strongly imbedded into current society
 - ▶ Hard to substitute due to advantageous characteristics
 - ▶ Medical uses, green technologies, etc.
- ▶ Persistent characteristics
 - ▶ Don't break down + Very hard to remove from environment = concentrations will keep rising irreversibly
 - ▶ Even incineration has not been proven to completely break down the C-F bond

Perspectives

- ▶ Large number of substances
 - ▶ Act on PFAS as a group → REACH restrictions and Stockholm Convention
 - ▶ Prevent need for substance-by-substance analysis
 - ▶ Prevent need for in depth toxicological analysis of all PFAS → grouping based on common hazard → persistence
 - ▶ Keep expanding the PFAS knowledge base (PFAS tox and PubChem database)
- ▶ Large number of uses
 - ▶ Ensure data flow throughout the supply chain
 - ▶ Look at concepts like essential use
 - ▶ Look into alternatives and Safe and Sustainable by Design concepts
- ▶ Persistent characteristics
 - ▶ Innovation on destruction and remediation techniques
 - ▶ Look into concepts like extended producer responsibility



Thank you for your attention!

Any questions?