The universal PFAS restriction

A 10-page explainer for anyone interested in the topic

Executive summary

PFAS[1] *– or forever chemicals – are receiving increased attention in the media and in the policy-making sphere because of numerous pollution scandals and public health issues, as well as calls for bold action from scientists, policymakers, and environmental organisations.*[2]

On 7th February the European Chemicals Agency (ECHA) published the "universal PFAS restriction dossier" ("uPFAS"), paving the way for a broad ban of PFAS under the EU's chemical regulation, REACH.

The dossier is impressive and of unprecedented ambition, and its technical and procedural aspects can be daunting. We try to shed light on these to make the 2000-page document more palatable and to provide a rough structure to guide the reader.

Moreover, REACH restrictions follow complex processes with uncertain timing and speculative outcome. Here we attempt a brief explanation of the logic.

1. The universal PFAS restriction

While announcing such a ban is relatively easy, making it happen in reality is a complex and slow process. It takes detailed scientific knowledge, a good understanding of practical applications of PFAS, mastery of the European regulatory landscape, political acumen, and lot of tenacity to bring it to fruition.

In this report, we aim to explain what this process looks like, at least in theory, and how the 2000-page PFAS dossier justifies the proposed ban.

Let us first have a look at the legislation and the procedures, then at PFAS and at the dossier.

2. REACH restrictions

2.1. Is a restriction a ban?

"Restriction" is the REACH[3] word for what in everyday language could be called a "ban". Like other bans, restrictions can affect only some uses (you may not smoke in the street, but you

[1] The PFAS world is full of acronyms, where knowing the full name if often of little help. Very often, the acronyms are used more frequently than the full names; therefore, we introduce the acronyms without the full names. In section 8, we have provided a glossary giving the full names and a short explanation what the name means.

[2] The "Ban PFAS Manifesto" was signed by more than a hundred organisations. It contains a wealth of information and references on PFAS pollution and health or environmental effects, as well as recommendations for action.

[3] The REACH legislation sets the legal framework for restrictions in Art. 67 to 73.

may at home), only some types of substances (you may smoke tobacco, but not weed), only after a certain date or only above a certain concentration.

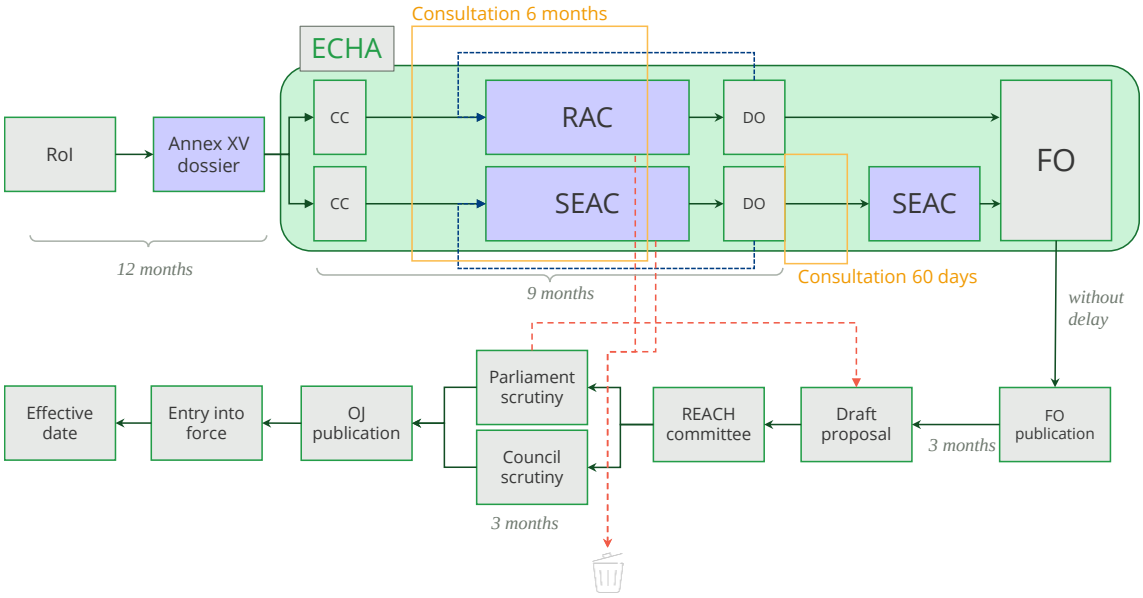
Restrictions can cover production of a substance, importing or selling it (*placing on the market*), or using it. A restriction can be as simple as the obligation to put a warning label on the article containing the substance.

Restrictions are designed to control an unacceptable risk from the manufacture, use, or placing of a substance on the market.[4]

2.2. The restriction procedure

Restrictions can be made following two different procedures,[5] depending on the uses and the type of hazards identified. In the case of the uPFAS restriction, the full procedure (see Figure 1) is applicable: it involves member states, ECHA and its scientific committees, the Commission, as well as, in the final stage, the European Parliament and the European Council.

Figure 1: Schematic of the full restriction procedure in REACH. The purple shapes represent processes where substantial content is developed. Deadlines are legally established but do not correspond to real-life timing. RoI: registry of intentions, CC: conformity check, DO: draft opinion, FO: final opinion, OJ: official journal.



The theoretical, i.e. legal, maximum time from publication of the intention until the submission of a restriction proposal to the REACH committee is two years. In practice, most restriction proposals have far exceeded the legal deadlines.[6]

Most of the content of the restriction is defined by three instances:

- The dossier submitter (DS) draws up the "Annex XV"[7] dossier explaining the hazards, risks, and uses of the substance(s) to be restricted and proposes conditions and

[4] As stipulated by Art. 68(1).
[5] We refer here to the distinction between the "full procedure" following REACH Art. 68(1), or the "simplified" or "fast-track procedure" according to Art. 68(2), which can only applied for some hazard categories, and for consumer uses.
[6] See EEB's report "The need for speed", section 6.4 for a more detailed explanation and analysis of the delays.
[7] Annex XV of REACH sets a general framework for dossiers for restrictions or SVHC identifications.

derogations for the restriction. Usually, a single member state acts as the DS, but in the case of the uPFAS restriction, five member states joined forces.

- The Risk Assessment Committee (RAC) is composed of independent experts. It analyses the hazards and risks described by the DS and formulates an *opinion*, amending (or not) the DS's proposed conditions and explanations, and justifying their own choices.
- The Socio-Economic Analysis Committee (SEAC) is RAC's counterpart dealing with positive and negative consequences for the different actors in society.

2.3. PFAS restrictions

The uPFAS restriction is by no means the first or only ban on PFAS. The following substances including their related substances[8] have been restricted:

- The Stockholm Convention on POPs listed PFOS in 2009 on Annex B (restriction) and PFOA in 2019 on Annex A (elimination);
- REACH has so far adopted three restrictions on PFAS: restriction 68[9] on PFOA (effective 2020)[10], restriction 73 on C6 silanetriols in spray products (effective 2021), and restriction 68[11] on C9-C14 (effective 2023);
- Another three restrictions are currently pending:
    - PFHxS: RAC and SEAC adopted their opinions in 2020;[12]
    - PFHxA: RAC and SEAC adopted their opinions in 2021;
    - PFAS in fire-fighting foams: RAC opinion adopted in 2023.

The restriction on PFHxA, its salts and related substances is potentially the most impactful so far: it affects industrially relevant PFAS – rather than restricting substances that have already largely disappeared from the market (as in the case of the PFOS, PFOA and PFHxS restrictions).

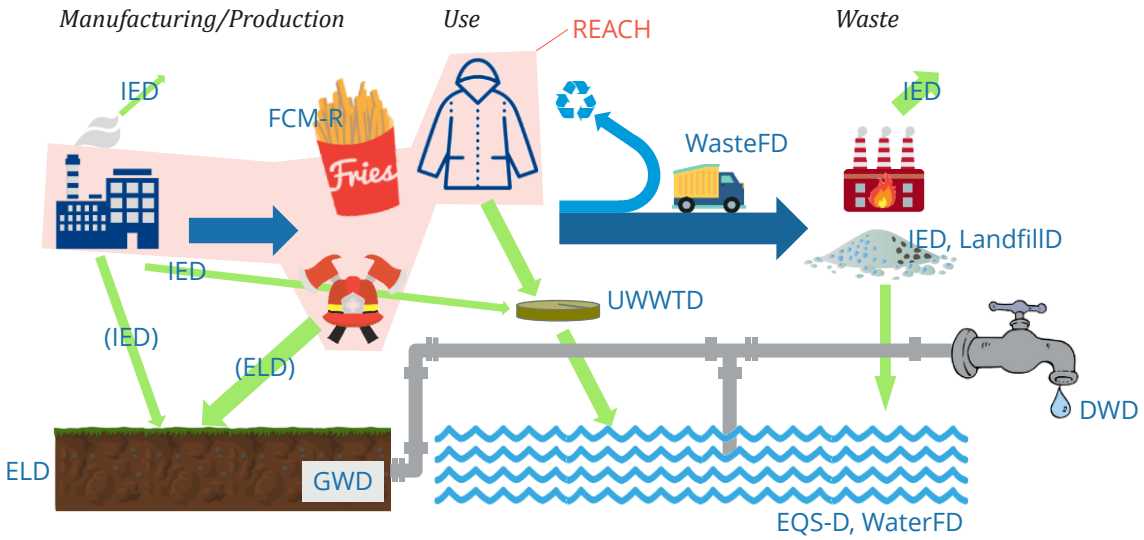
2.4. REACH in the policy landscape

Of course, there is other EU legislation that can regulate PFAS. Figure 2 shows schematically how the different pieces of regulation tie in with each other, and where they can overlap.

The IED requires operating permits setting limits on PFAS emissions from production and clean-up obligations on the site; the ELD mandates liability for environmental damages caused; the DWD, EQSD and GWD set quality standards (good quality or not) for ground water, surface water (rivers and lakes) and drinking water; food contact plastic use subject to the FCM-R (but paper regulated nationally).

[8] i.e. all substances that can degrade into the parent substance, see section 3.3. Previous restrictions have not dealt with PFAS substance by substance – but rather subgroup by subgroup, or arrowhead by arrowhead.
[9] This numbering represents the entries in Annex XVII of REACH, the repository of restrictions.
[10] And revoked subsequently as PFOA was listed under the Stockholm Convention.
[11] To confuse everyone, the same number 68 was used a second time. The first restriction corresponds to Commission Regulation 2017/1000, the second one to 2021/1297.
[12] PFHxS and related substances were added to Annex A of the Stockholm Convention in 2022.

Figure 2: Schematic of EU legislation regulating PFAS



All these pieces of legislation cover different parts of the pollution pathways and must be effective on their own. There is a common misconception that REACH should deal with everything.

3. What are PFAS again?

The PFAS problem is currently widely known thanks to impressive media attention. Many people will know that PFAS are fluorinated molecules, and many people can cite PFOA and PFOS as important examples of the PFAS class.[13] Yet, what is or is not a PFAS depends on the exact definition.

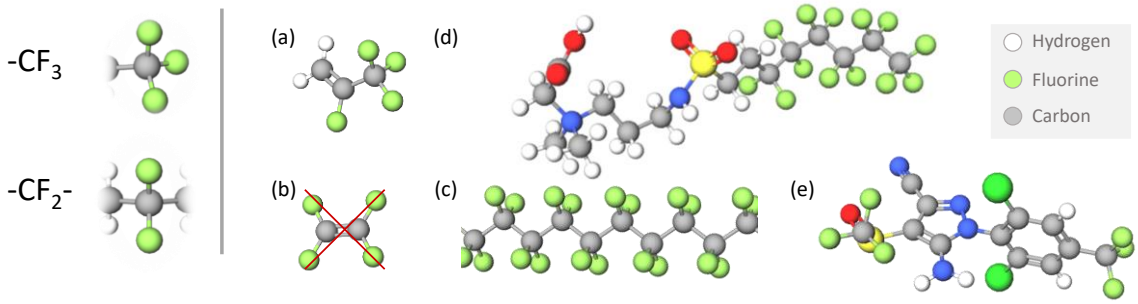
3.1. According to the definition

Currently, the most broadly accepted definition is the one proposed by the OECD in 2021,[14] which is also the basis for the definition used in the uPFAS restriction. Figure 3 shows the PFAS definition visually as molecular models, next to a few illustrative PFAS examples.

Alternatively, one can *roughly*[15] say that a molecule is a PFAS when it contains one C atom that is bound to 3 F and 1 C, or 2 F and 2 C atoms (F=fluorine, C=carbon).

[13] For a general introduction into PFAS, the interested reader is referred to our report "Avoiding the streetlight effect" (esp. section 5 and 6), published in 2020 as an explainer for the PFHxA restriction. It did not address F-gases.
[14] OECD 2021, Reconciling terminology of the universe of PFAS, available here.
[15] But only *roughly*, as this way the rule about H/Cl/Br/I atoms is disregarded. However, this oversimplification gains in attraction when non-persistent PFAS (see 4.3) are considered.

Figure 3: Visual rendering of the PFAS definition (left)[16] and examples (right): (a) refrigerant R-1234yf; (b) TFE (not a PFAS!); (c) the monomer for PTFE aka Teflon; (d) a fluorosurfactant[17] in fire-fighting foams and (e) biocide fipronil.



3.2. PFAS applications

The most famous industrial PFAS use is probably as a polymerisation aid in fluoropolymer production, as brought to popular attention by the Hollywood film *Dark Waters* (2019), but also by pollution scandals in Spinetta Marengo, Trissino, Dordrecht and Burgkirchen an der Alz. This use is likely to dwindle in the coming years, after announcements from producers such as Solvay or Gujarat to use non-fluorinated polymerisation aids.

Other uses of PFAS[18] are manifold, from fire-fighting foams and outdoor textiles to industrial uses in metal plating and electronics, cable sheaths and uses in flexible photovoltaics, medical devices, refrigerants…

The different PFAS cannot be freely interchanged. Their physical properties will have to meet the needs of each application: a gaseous PFAS cannot be used in outdoor wear; solid PTFE is useless for a fire-fighting foam; a water-soluble PFAS cannot be used for a medical implant.

3.3. The uPFAS classification logic

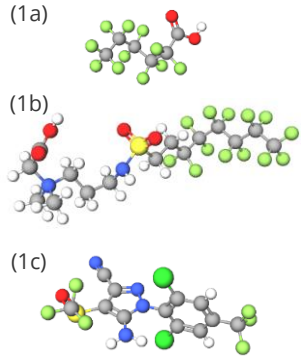
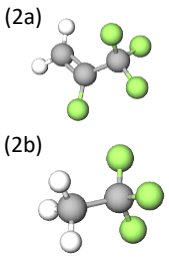
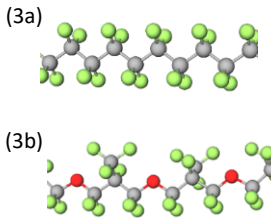
The uPFAS dossier found a remarkably simple way to subdivide the PFAS jungle into three groups, as shown in Figure 4:

- Group 1:[19] the "classic PFAS" and their derivatives (including SCFPs), which can decompose[20] into the "classic PFAS". Ranging typically from C1 to C13, from ultra short to very long chains.[21] They can be solids or liquids. The effective focus of the restriction proposal is on shorter-chain PFASs (see footnote 19), as longer-chain PFASs have largely been regulated away.

[16] The top molecular fragment corresponds to a "fully fluorinated methyl" carbon atom; the bottom one to a "fully fluorinated methylene" carbon atom, to use the wording of the definition. When the $-CF_3$ or $-CF_2-$ moiety is attached to a hydrogen, chlorine, bromine or iodine atom, the substance is not considered a PFAS (not shown here).
[17] A surfactant is a substance that reduces surface tension of a liquid, like soap.
[18] Good lists of uses can be found in the uPFAS dossier itself (table 2, p. 53), but also e.g. on the OECD's website. None of these lists is likely exhaustive, but they convey a rather faithful picture.
[19] All other REACH restrictions have exclusively targeted Group 1 PFAS; the uPFAS restriction includes for the first time the C4 family (based on PFBS) and individual PFAS, such as GenX, ADONA, cC6O4.
[20] Readers reacting with "I thought they did not decompose" are referred to our report "Avoiding the streetlight effect". The final PFAA the derivatives degrade into are often referred to as *arrowhead* substances.
[21] Denoting the number of carbon atoms – for the oddities of counting carbon atoms, see the box on p. 2 of our report "Avoiding the streetlight effect", section 6.3.

- Group 2: aka "F-gases", PFAS that are gases or very low-boiling liquids. There are HFCs,[22] PFCs and HFOs. They are small molecules generally not beyond C6.
- Group 3: polymers: the "plastic PFAS", FPs and PFPEs. They are "long and boring molecules", i.e. where the same sequence of 2-5 carbons repeats over and over. They are generally hard or rubbery solids, like PTFE.

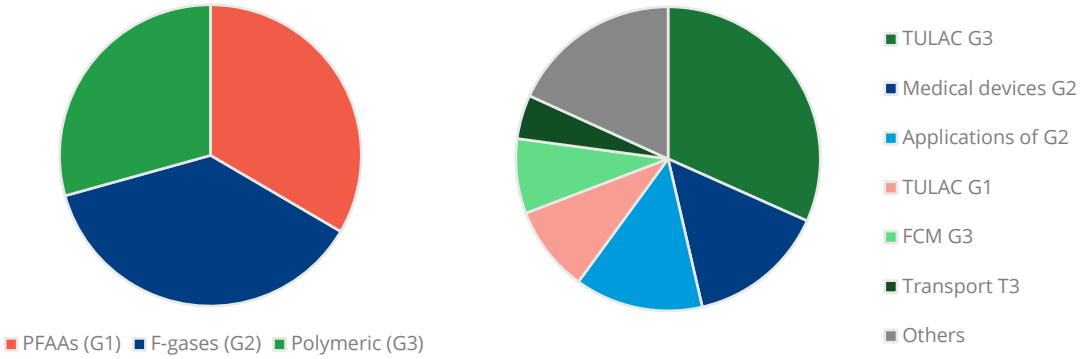
Figure 4: Subdivision of PFAS as proposed by the DS and a few examples: (1a): PFHxA; (1b): a fluorosurfactant; (1c): fipronil; (1d): side-chain fluorinated polymer (SCFP) (the polymeric backbone is indicated in yellow); (2a): an HFO; (2b): an HFC; (3a): a fluoropolymer; (3b): a perfluoropolyether.

Group 1	Group 2	Group 3
PFAAs and PFAA precursors	Fluorinated gases	Polymeric PFASs "FPs and PFPEs"[23]
		

3.4. Large-scale or niche uses?

The three groups of PFAS (PFAAs, F-gases and polymeric PFAS (FPs and FPFEs)) are produced in roughly equal shares, of the order of 80 000 or 90 000 t/y each (**Error! Reference source not found.**, left).[24]

Figure 5: Manufactured tonnages of the three groups of PFAS (left) and relative shares of top six uses (right):[25]



[22] HFCs have been restricted by the Kigali Amendment (2016) to the Montreal Protocol as they harm the climate.
[23] The DS (section 1.3.1 of the Annex XV dossier) calls the 3rd group "polymeric PFASs" and clarifies that side-chain-fluorinated polymers (SCFPs) are allocated to group 1, as they can degrade to PFAAs. Calling the 3rd group "fluoropolymers and perfluoropolyethers" would have avoided this slight inconsistency.
[24] Data from the dossier, EEA 2020, Table 3, p. 55, mid estimates. These estimates strongly refine the coarse estimate in our earlier report "Avoiding the streetlight effect", Figure 5, which is based on registration tonnage bands.
[25] The manufactured tonnages and the total used tonnages in the three groups in the dossier do not coincide, possibly because of an allocation of SCFPs to Group 3 instead of Group 1.

The six top groups of application make up more than 80% of the total volume of PFAS:

- a third of all PFAS used are polymers in the TULAC sector, i.e. above all PTFE membranes in outdoor clothing;
- F-gases in medical devices, esp. for metered dose inhalers e.g. for asthma patients;
- "applications of F-gases" relates esp. to refrigerants (i.e. in heat pumps, air conditioning and industrial cooling systems), but also to insulating gases in electrical switchgear;
- A smaller share of PFAS are SCFPs used as a waterproof coating in outdoor clothing;[26]
- Uses of polymeric PFAS in food contact materials include the famous Teflon pan, but also industrial uses in food processing;
- Transport applications of polymeric PFAS include seals, gasket, paint additives.

4. Why should PFAS be banned?

The justification for restriction rests largely on persistence ("P-sufficient" approach), impossibility to remove PFAS and increased likelihood of effects.

The removal of PFASs [...] is technically extremely difficult and very costly, if at all possible.
The increasing stock pollution will result in increasing likelihood that known and unknown effects occur.[27]

4.1. Health effects and environmental effects

Reported adverse effects from PFAS are almost as varied as the PFAS themselves; the so far unknown effects are likely also diverse and numerous.

The P-sufficient approach did not deter the dossier submitter from being thorough; the extant literature is summarised in the 714-page annex B!

4.2. Persistence

Neither bacteria, nor water, nor light – only very high temperatures – can break the very strong bonds between carbon and fluorine atoms. Non-fluorinated parts of the PFAS molecules[28] can degrade, giving rise to degradation products, which are PFAS themselves.[29] These substances, called *arrowhead substances*, do not further degrade, at least not at any timescale relevant to us. This is why PFAS are called *forever chemicals*.

[26] As these SCFPs are C6 PFAS, the use is already fully covered by the pending PFHxA restriction.
[27] Quotes from p. 1 and p. 24 of the dossier.
[28] See e.g. molecules 1b, 1d, 2b in Figure 4: they contain parts where hydrogen atoms (white balls) surround the grey carbon atoms.
[29] Some of which –the last ones in longer degradation cascades – are often referred to as *arrowhead* substances; see section 6.3 of our earlier report "Avoiding the streetlight effect".

4.3. Non-P PFAS: exceptions confirming the rule

Recently, lobby group CropLife Europe pointed out[30] that some PFAS can degrade.[31] In the uPFAS dossier, the DS therefore excluded some subgroups of PFAS that bear e.g. an oxygen or a nitrogen atom next to the perfluorinated carbon atom. However, they carved a bit too generously, removing some PFAS that have even been shown not to biodegrade.[32]

5. The structure of the restriction

The dossier is a 200-page document (including a digestible 3-page summary) with another 1800 pages of annexes – making it easy enough to be overwhelmed, get confused, or fall asleep…

5.1. A ban…

The heart of the dossier is the proposed "Annex XVII entry" on p. 4-8, detailing the proposed[33] conditions of the restriction. Condition 1 bans the manufacture, import and use: this way PFAS cannot be imported, exported, or hoarded. Condition 2 specifies the concentration limits that apply, e.g. for an article containing a PFAS. These concentration limits intend to ban intentional use, while not requiring excluding traces of PFAS – as PFAS are everywhere anyway. Condition 3 specifies that this ban will start 18 months after the restriction enters into force.

5.2. …with exemptions…

Active substances (and only those) used in biocides, pesticides, pharmaceuticals, and veterinary products are exempted from the restriction, as these substances are regulated by dedicated EU legislation.

5.3. …and many derogations…

These concise conditions are followed by a flurry of derogations: 25 derogations for either 5 or 12 years after the end of the general transition period. There is only one time-unlimited derogation,[34] expressing hope that innovation will come up with alternatives when there is time pressure. After 12 years, Europe's economy would be essentially PFAS-free.

In a novel way, the dossier submitter also mentions 20 "square bracket" derogations, i.e. derogations that could be considered if evidence is made available, but that are currently not recommended because of "too weak […] evidence".[35]

[30] The position paper can be accessed via the compilation of comments to the restriction of PFAS in fire-fighting foams, attachment to input #3568.
[31] Such as the presence of an oxygen or nitrogen atom next to a -CF_3 moiety.
[32] E. Rudin *et al.* listed (see supporting material, table S3), among others, 13 fully REACH-registered substances (e.g. EC 695-906-1) that meet the exclusion criteria but that are not readily biodegradable, according to registration data.
[33] Better to repeat that this is only a proposal.
[34] Derogation 5.t for analytical reference and instrument calibration materials, needed for environmental monitoring.
[35] Indicating that companies potentially interested in such derogations did not provide convincing evidence to the dossier submitter during the drafting phase.

5.4.…but with improved transparency…

Users of derogations are asked to submit information annually on uses and quantities to ECHA.[36] This way, one can monitor progress in using alternatives and estimate emissions.

5.5.…analysing hazards and risks…

A crucial part of the dossier is the description of hazards and risks related to PFAS. The 700 pages of annex B detail the known hazards, estimated quantities and emissions per type of use, as well as exposures of PFAS. The proposal, however, largely rests on "the very persistent property of the substances"[37] and the necessity to avoid regrettable substitution. The dossier also notes that "the [properties other than persistence] add substantially to the overall concern which is very similar to those of the PBT/vPvB substances".[38]

5.6.…and socio-economic impacts…

The dossier analyses two versions of the restriction: a complete ban without derogations and the proposed ban with its derogations. The complete ban, which would not even give derogations for essential uses (see section 6.3) is discarded as having unproportional socio-economic impacts.

Table 9 of the dossier summarises (on 22 pages) the content of the 500-page Annex E, and details, application by application, the expected impacts on the sector and the justification for a derogations and transition times, where applicable.[39]

5.7.…but not weakening existing regulation.

The restriction proposal also promises not to undercut earlier decisions (condition 9), which is important given the history of PFAS restrictions. However, the content of any pending decisions (see section 2.3) risks being rediscussed and redecided.

6. What is missing?

The following non-exhaustive list intends to demonstrate that even a 2000 page document can leave some central questions unanswered, or, worse, unaddressed.

6.1.Life-cycle aspects

An open question remains regarding the fate of the fluorine atoms in PFAS in incineration.[40] The DS recognises that research has shown incomplete destruction of PFAS and formation of long-lived greenhouse gases. They recognise that much higher temperatures would be needed and that full mass balances[41] are missing. Yet, they equate[42] "no data" to zero emissions!

[36] Similar requirements already exists in the RAC and SEAC opinion on the PFHxA restriction (conditions (RAC) and 9 (SEAC)), and, in a weaker version, in the proposal on PFAS in fire-fighting foams (condition 4).
[37] See section 1.1.2 of the dossier.
[38] See section 1.1.6 of the dossier.
[39] See also section 6.2 for an assessment of the socio-economic analysis in the dossier.
[40] See Annex B, section B.9.18.2.4.
[41] This means the following: where 1000 fluorine atoms get into an incinerator, 1000 must get out in one or another way. Where fewer than 1000 are found, something has been overlooked. Most studies overlook the vast majority.
[42] In table B.57

6.2. One-sided socioeconomics

Regular participants in SEAC meetings may be forgiven for thinking that SEAC's job is to analyse impacts on companies producing the substances to be restricted.

The dossier submitters did this, in allocating, use by use, (qualitative) "producer surplus losses" to roughly all producers and downstream users of PFAS, mostly disregarding expected benefits to alternative suppliers.

In contrast with this, ECHA's official guidance[43] clarifies that in such a case, "there is no net cost from the perspective of society [...], but just a redistribution of income", that such transfers and redistributions represent "private costs" but not "social costs", and that the "economic analysis should strip out [...] private cost[s] [...] which are actually 'transfers'".

Such transfers are even, in many cases, transfers within one and the same company.

6.3. Essential uses

Over the last couple of years, the concept of *essential uses* has been talked about repeatedly, mostly as the logic underpinning when to grant derogations. The concept dates to the Montreal protocol,[44][45] agreed in 1987 to protect the Earth's ozone layer. Initially, the dossier submitters intended to use the concept, but later dropped the idea.[46]

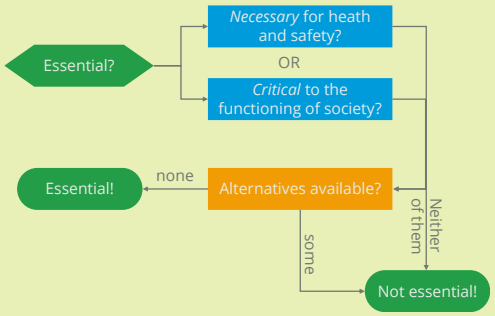
The concept is remarkably simple and obvious (see box), and most *proposed* derogations follow it implicitly. However, to ultimately *decide* on the derogations, the concept would have provided a clear and structured logic.

Essential uses

The Montreal Protocol definition roughly says that if a substance serves health and safety or the functioning of the society *and* if there are no alternatives available, then the use is essential.

Note that as soon as there is an alternative, the use is not essential.

Also note that the use of a substance can be essential, not the substance itself.



7. Take-home messages

The uPFAS restriction proposal is unprecedented in its scale, scope, and complexity, but also in its potential to reduce and prevent emissions and impacts.

The dossier is overall clear and well-researched, and its drafting involved many public authorities, scientists and industrial producers.

Yet, some of these producers have substantial stakes in PFAS production, and fierce lobbying to derail the restriction train can be expected.

[43] SEAC guidance, 2008, section 3.5.1, 3.5.2 and others.
[44] table 8 and 9 in the dossier and in annex E.
[45] More specifically, Decision IV/25.
[46] The Chemicals Strategy for Sustainability announced (p. 10) that "criteria [...] will have to be properly defined", frustrating hopes that the arguably most successful environmental policy instrument would be followed directly.

8. Annex

ADONA	(a complicated name)	Auxiliary used by 3M/Dyneon in FP production, EC 700-323-3
BREF	Best Available Technique Reference document	Technical specifications, specific per industry sector, developed under the IED.
cC6O4	(another complicated name)	Auxiliary used by Solvay in FP production, EC 628-238-0
CLP	Regulation on Classification, Labelling and Packaging of Substances and Mixtures	Regulation 2008/1272, defines criteria to decide if a substance or mixture should be regarded as hazardous, and how the user should be warned; currently under revision
DWD	Drinking Water Directive	Directive 2020/2184; sets limits for PFAS in drinking water
ELD	Environmental Liability Directive	Directive 2004/35, applies when environmental damage needs remediating; partial implementation of the polluter pays principle
EQS-D	Environmental Quality Standards Directive	Directive 2008/105, with criteria to classify water in rivers and lakes as "(not) good quality". Current revision proposal adds PFAS
FCM-R	Food Contact Materials Regulation	Regulation 1935/2004, defines substances for use in ceramic and plastic food contact materials and sets a framework for other materials, handled by national legislation
FP	Fluoropolymer	PFAS polymer with an all-carbon backbone containing perfluorinated atoms
GenX	(yet another complicated name)	Auxiliary used by Chemours in FP production, EC 700-242-3
GWD	Ground Water Directive	Directive 2006/118. Like the EQS-D, currently under revision.
HFC	Hydrofluorocarbons	Fully saturated GHGs made of carbon, hydrogen and fluorine only. See legally relevant list in F-gas regulation Annex I, section 1.
HFO	Hydrofluoroolefins	Unsaturated gases made of carbon, hydrogen and fluorine. See legally relevant list in F-gas regulation Annex II.
IED	Industrial Emissions Directive	Directive 2010/75. It regulates permits and emission limit values for industrial activities; currently under revision
PBT/vPvB	Persistent Bioaccumulative, Toxic and very Persistent, very Bioaccumulative	Chemicals that do not break down, accumulate over time, cause harm in living beings. Concept used in REACH Art. 57 and Annex XIII, and, more recently, in CLP Annex I
PFC	Perfluorocarbons	Fully saturated GHGs made of carbon and fluorine only. See legally relevant list in F-gas regulation Annex I, section 2
PFAA	Perfluoroalkyl acids	Carboxylic or sulphonic acids with a fully fluorinated alkyl (i.e. saturated carbons only) "tail". PFOS and PFOA are typical examples. Typical arrowheads are PFAAs
PFBS	Perfluorobutane sulphonic acid	Linear sulphonic PFAA with 4 (perfluorinated) carbon atoms; the basis of C4 PFAS
PFHxA	Perfluorohexanoic acid "C6"	Linear carboxylic PFAA with 6 carbon atoms, 5 of which are perfluorinated; the basis of industrial C6 PFAS
PFPE	Perfluoropolyether	FP with a backbone made of perfluorinated carbons and oxygen atoms
PTFE	Polytetrafluoroethylene or "Teflon"	Polymer consisting of a very high number of $-CF_2-$ linked to each other
SCFP	Side-chain fluorinated polymers	Comb-like (mostly (meth)acrylic) polymers, with a non-fluorinated backbone and fluorinated "teeth", which can be cleaved off, giving rise ultimately to PFAAs. Detailed OECD report
TULAC	Textiles, upholstery, leather, apparel, carpets	
UWWTD	Urban Waste Water Treatment Directive	Directive 91/271, currently under revision
Waste FD	Waste Framework Directive	Directive 2008/98, setting rules and definitions how to avoid and handle waste

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