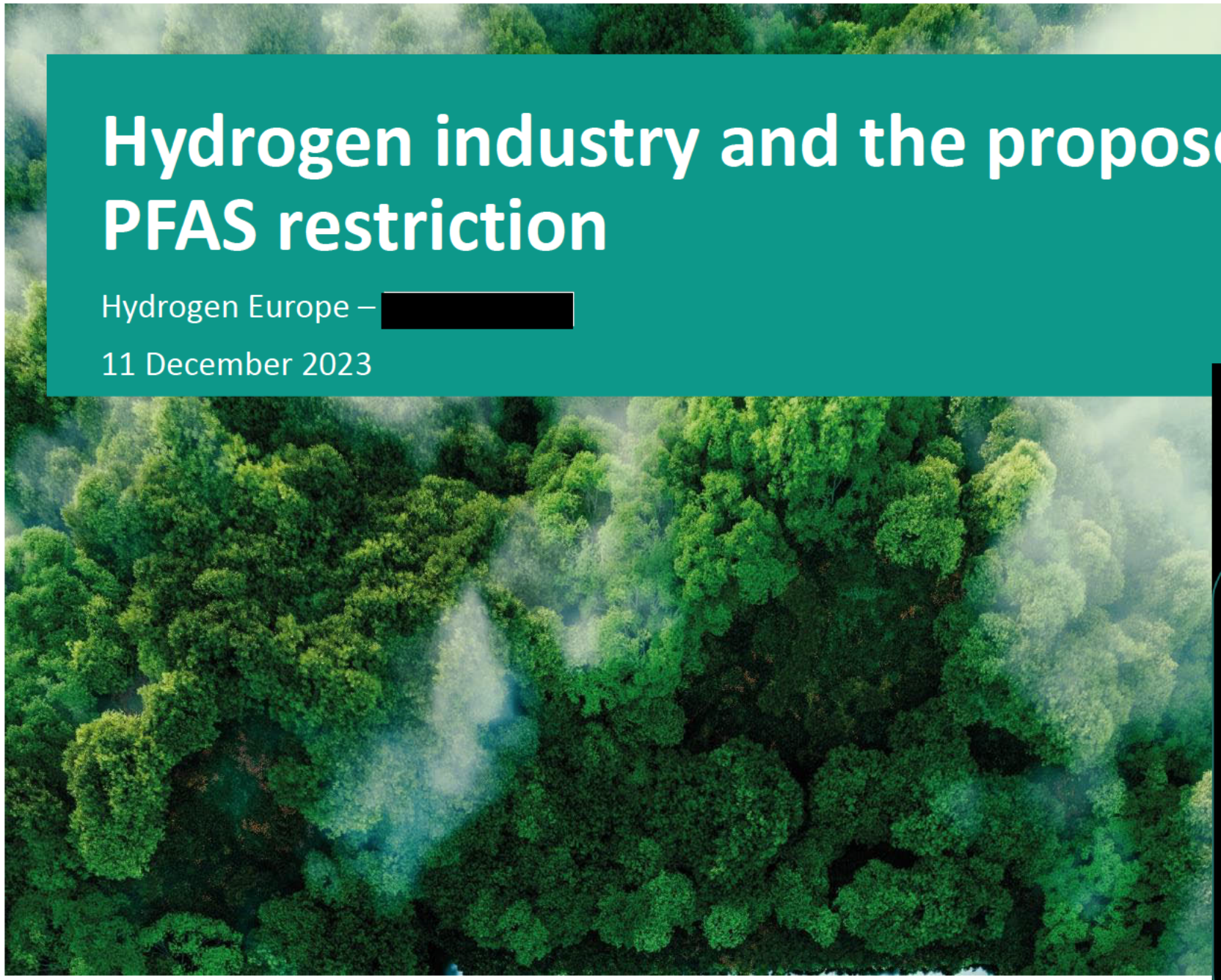


Hydrogen industry and the proposed PFAS restriction

Hydrogen Europe – [redacted]

11 December 2023

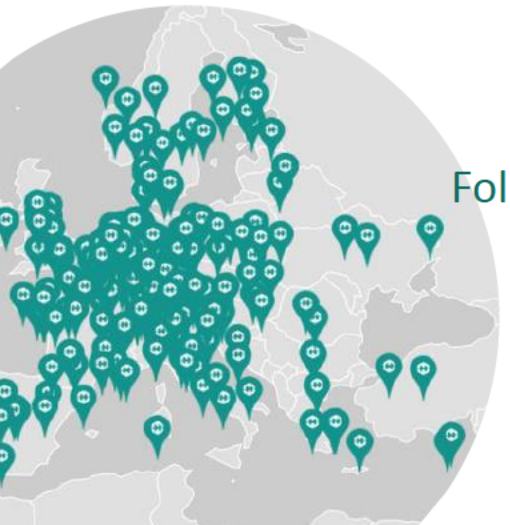
Hydrogen Europe

Hydrogen Europe in a nutshell

500+ Members

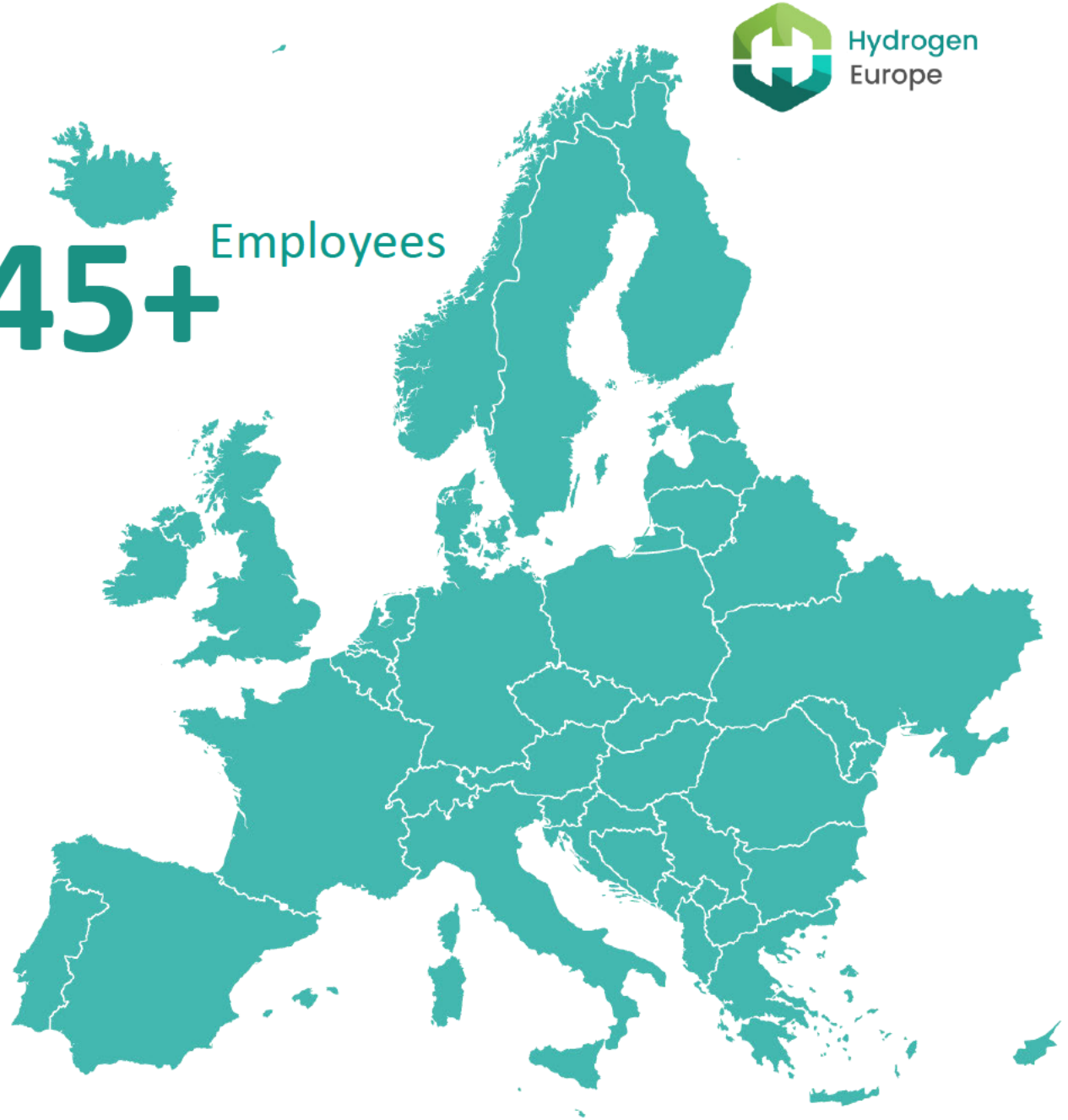
We encompass the entire value chain of the hydrogen ecosystem: from production, distribution to end uses, including Industry, EU regions & H2 National Associations.

120k+ Followers
on Social Media



Follow us on:

45+ Employees



Fluoropolymers are used everywhere in the hydrogen and energy/industrial ecosystem

- **Hydrogen**
- Batteries
- Semiconductors
- Water management and water treatment
- Electricity grid insulation
- Aerospace and defense
- Heat pumps
- Medical equipment

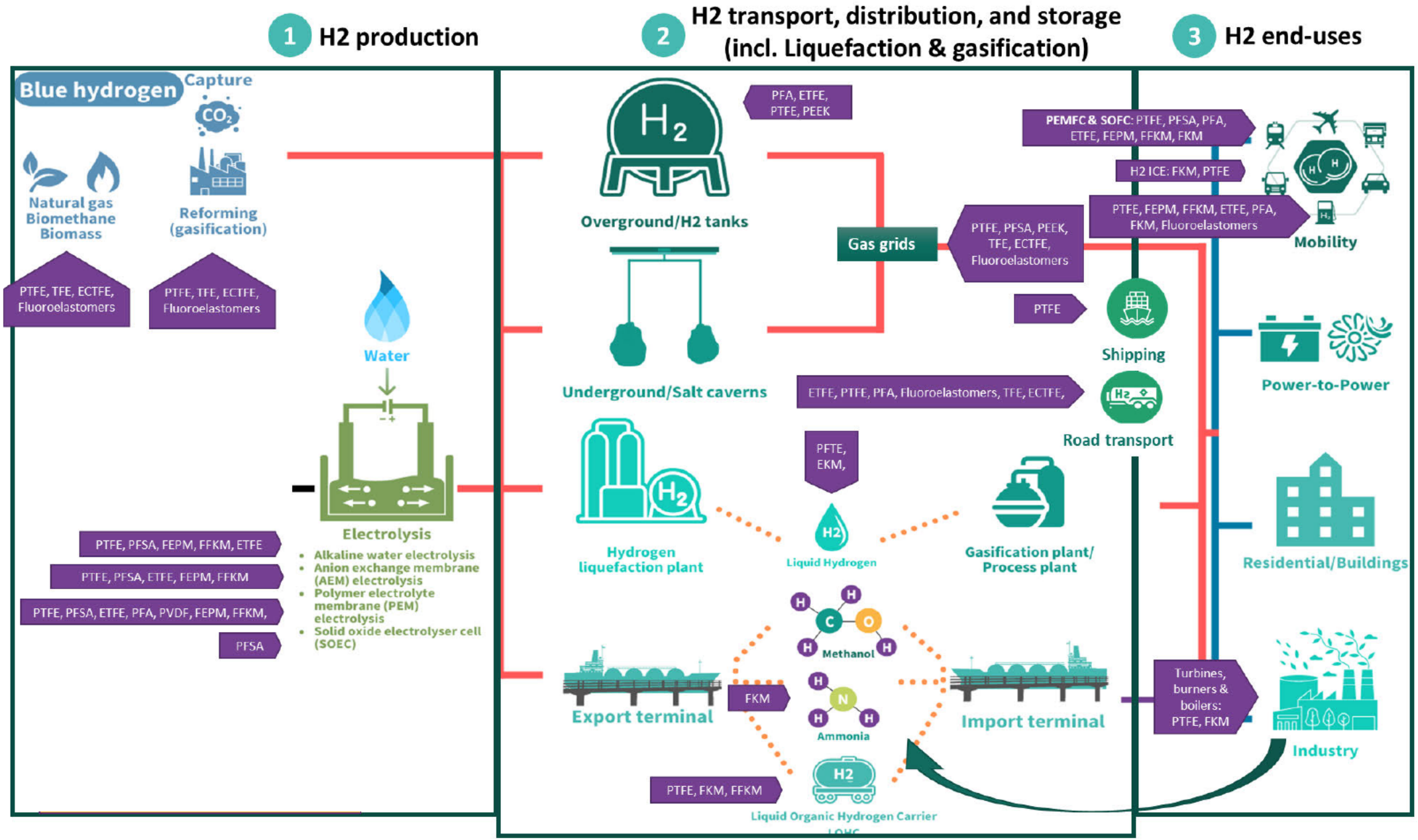
etc.

Fluoropolymer joint letter with associations

- 15 associations co-signing (energy and digital transition, focus on NZIA sectors)
- Aiming for an exemption for fluoropolymers under the PFAS restriction
- Annex with short overview of fluoropolymer use per sector
- Sent on 3 October to Commissioners Sinkevicius, Simson, Breton and EVP Sefcovic

The H2 industry uses fluoropolymers all across its value chain

Hydrogen Europe



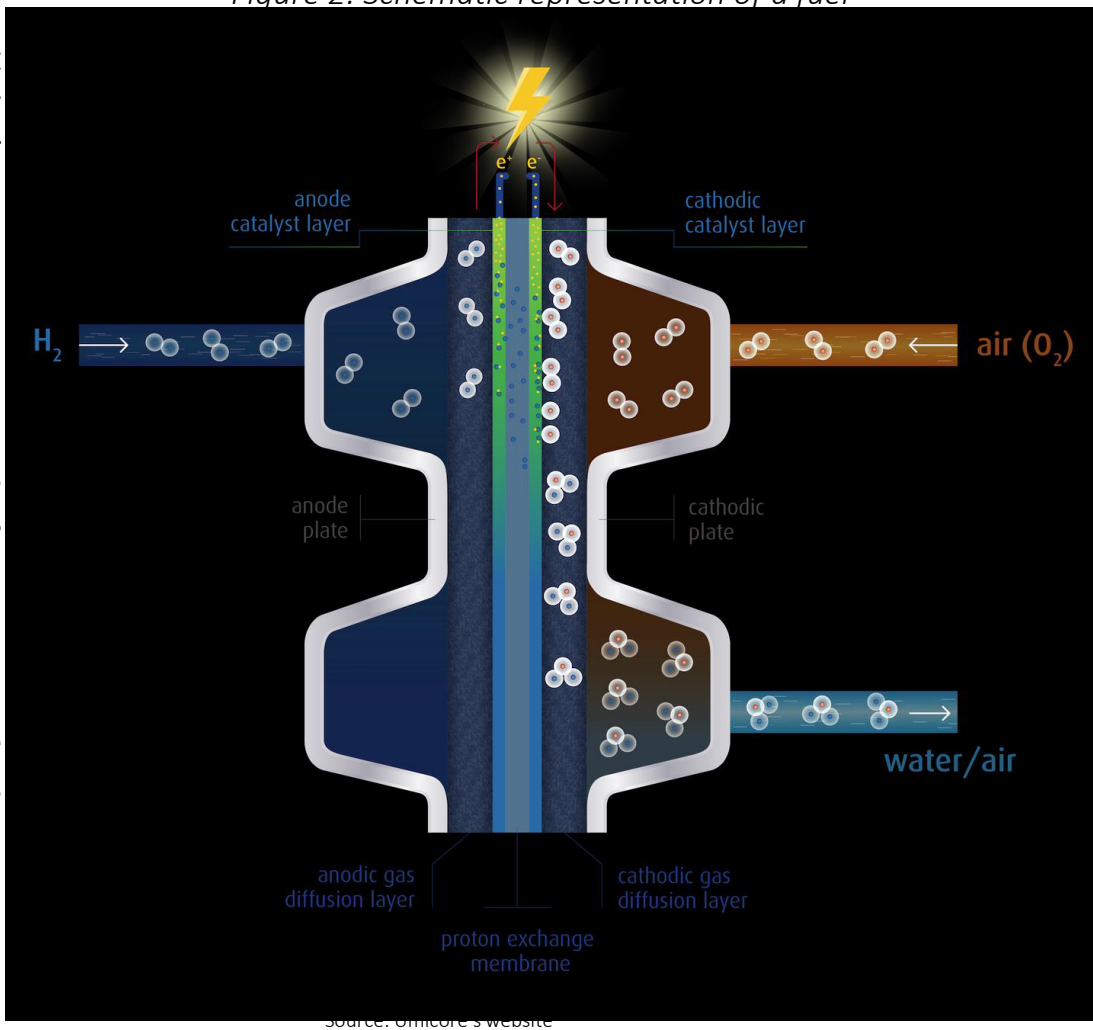
Why are fluoropolymers relevant for H2: PEM fuel cell example

- Membrane
  - **PFSA ionomers**: perfluorinated copolymers that carry sulfonic acid groups (SO3H); most commonly **reinforced by PTFE** (therefore, fluoropolymers) → it separates protons and electrons and provides the proton conductivity (thereby producing electric current) while separating the reactants: hydrogen and air (oxygen), in the case of a fuel cell
  - Examples: Nafion; 3M ionomer, Solvay Aquivion ionomer...
  - In PEM Fuel Cell and Electrolyser, DMFC, chloralkali Electrolysers...

- Gas Diffusion Layers (GDL)
  - These consists of carbon fibre paper or felt. The GDL substrate currently contains **PTFE**. It is used as hydrophobic agent and – depending on the GDL type – also as binder.

- Microporous layers (MPL)
  - GDL are often equipped with an additional layer at the interface to the electrode, an MPL, made of **PTFE** due to its hydrophobic properties It equalizes the GDL surface and, therefore, prevents damage of the membrane and improves electrical and thermal contact between GDL and the electrode.

Figure 2: Schematic representation of a fuel



Source: Umicore's website

Why are fluoropolymers relevant for H2: entire value chain

Some typical sealing materials, such as gaskets, in fuel cells, as well as in equipment in the distribution network (regulator membranes, meters, etc.)

Coating materials: PTFE to protect against harsh processing conditions. Alkaline electrolysis technologies introduce warm caustic solutions

Infrastructure: aboveground storage and salt caverns, gas grids, cryogenic liquid hydrogen carriers, liquid organic hydrogen carriers, road and water transport of bulk hydrogen

Hydrogen Refuelling Stations: PTFE bands used in valves, flow meters, dispersers and key in compressors.

What is the potential for alternatives and research?

- **Material properties of perfluorinated polymers are unique and technically impossible to replace in the near future.**
- **Restrictions on fluoropolymers** (including PTFE) **would render several critical applications** from water electrolysis, fuel cells, to H2 transport technologies **unfeasible**, or would dramatically reduce their service life and increase the probability of malfunction.
- **Performance of alternative such as hydrocarbon membranes, is still very low because they suffer from reduced thermal and chemical stability and extremely short durability**, lasting only dozens of hours against lifetime requirements (at the very least) of >25,000 hours.
- **There is a potential for research in fluoride-free materials (e.g. Hydrocarbon membranes...), but they need to take the same KPIs of today's technologies as a benchmark.**

PFAS restriction proposal - rationale

- **Main issue with PFAS is persistence ("forever chemicals")**
  - As the substances persist in the environment, the longer the stock is allowed to increase (i.e. the restriction is not in force), the less effective the aimed emission reduction will become
  - **Additional typical features...** : mobility, accumulation in plants, bioaccumulation, long-range transport potential, ecotoxicity, endocrine activity,
  - **... inducing risks for human health and the environment.**
- 10 000+ PFAS exist, "regrettable substitutions" by industry have been commonplace as a consequence of individual-substance restrictions.

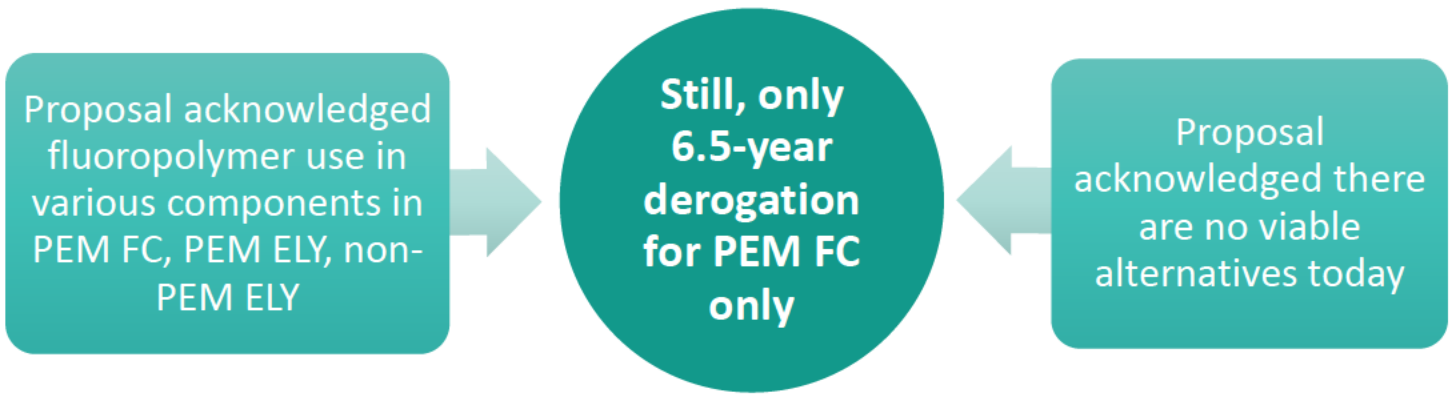
BUT Fluoropolymers (the PFAS subgroup used by hydrogen sector) are only persistent and are "polymers of low concern" according to the OECD

- **Yet, not treated in a differentiated manner in the proposal.**
- **Their alleged lifecycle emissions is the other main rationale for their inclusion in the restriction**

PFAS restriction proposal – hydrogen sector

Hydrogen industry uses get a full ban after 18-month transition, except **fluoropolymers and perfluoropolyethers for use in PEM fuel cells until 6.5 years (5y + 18 months) after entry into force**

- Proposal **only** derogates on PEM Fuel Cell, **not** on Electrolyser or other hydrogen tech



Socio-economic impacts of a ban

Due to 1) essentiality of fluoropolymers for the H2 value chain and 2) the absence of alternatives.... a precipitous PFAS ban without granting any derogation for applications in the hydrogen sector would have destructive effects on the industry, jeopardising...

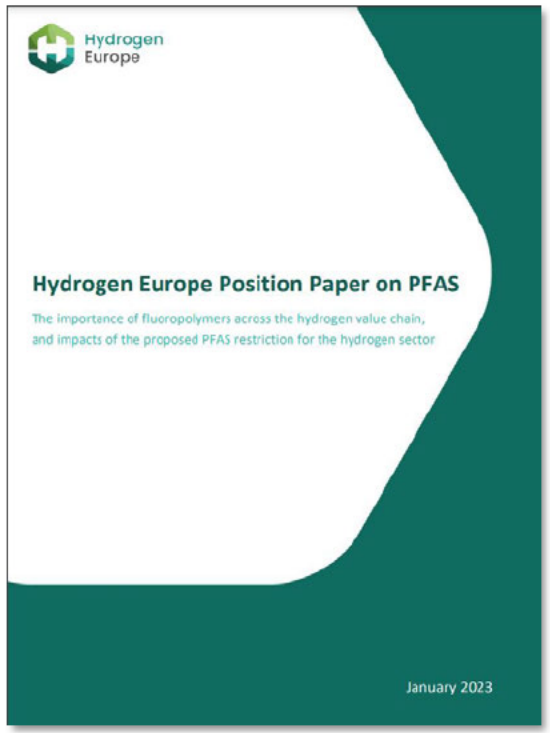
2030

- **€30-billion worth of investment** in a decade (only including electrolysers & fuel cells),
- up to **200k direct jobs and over 260k indirect jobs** within 10 years, and
- **2030 climate target** (-55% GHG + renewable H2 targets in industry & transport) and **phasing out fossil fuels** (REPowerEU)

2050

- A market with a potential **value of €820 billion**...
- ...**employing 5.4 million workers** by the middle of the century, and
- The EU's climate-neutrality target, energy security, strong industrial base.

Key messages from Hydrogen Europe



1. The proper **functioning of electrolysers, fuel cells** and other technologies across the H2 value chain **rests on the essential use of fluoropolymers** (often classified as a PFAS category).

2. **No alternative** to fluoropolymers today comes close to the same KPIs in the H2 sector – research can play a role but no fluorine-free breakthrough is foreseen in the near future.

3. **Environmental and human health risks** of fluoropolymers (considered by OECD as 'polymers of low concern') are **extremely limited** across the hydrogen value chain (both in terms of environmental and human exposure; also B2B products).

4. **Best practices and incentivisation** can and should be set up to both **limit emissions and foster recovery of materials** at EoL to a maximum (and inherent economic incentive to recover PGM + fluorine).

5. **Not exempting** the use of fluoropolymers in the H2 sector would **threaten the whole European hydrogen industry** and its global competitiveness, as well as **jeopardise the achievement of the EU's climate, energy security, and industrial objectives.**

Thank You

[redacted]

Hydrogen Europe

Av. de la Toison d'Or 56-60
Brussels / Belgium

secretatariat@hydrogeneurope.eu
hydrogeneurope.eu