IOGP Europe statement on the ECHA proposed PFAS restriction proposal related to the Carbon Capture, Transport and Storage (CCS) Technology

Please note this statement is intended to be submitted as part of the ECHA consultation as an attachment to IOGP Europe's response related to IOGP Subsea Flexible Pipes (on behalf of the 'Petroleum and Mining' sector, as per ECHA annex XV).

1. Executive summary

IOGP Europe acknowledges that Per-and polyfluoroalkyl substances (PFAS), due to their characteristics, need to be controlled to prevent health risks for people and the environment. However, because of their unique characteristics, some PFAS, provide the safest operating parameters for multiple applications across many usages including the Carbon Capture and Storage (CCS) value chain, while CCS technologies are recognized as critical ones to achieve the net-zero climate objective of the EU. For these reasons, we propose that PFAS, in particular fluoropolymers (used in the CCS value chain), be excluded from the PFAS restriction, or failing that, benefit from an unlimited-time derogation period from the proposed restriction.

CCS, a rapidly growing industrial sector, aims to upscale the secure, long-term containment of carbon dioxide (CO_2) within geological formations, prioritizing environmental and human health safeguards. This proven technology offers an effective and environmentally benign strategy for mitigating climate change through the geological sequestration of human-made emissions from industrial and energy sources. CCS projects are mandated to ensure the safe, enduring confinement of CO_2 and minimize leakage risks across the entire value chain, encompassing capture, transportation, and sequestration processes.

The CO_2 stream, consisting overwhelmingly of carbon dioxide, includes impurities derived from the source materials or the capture processes (H_2O, O_2, H_2, N_2, NOx, SOx, etc.). The stream being acidic, it requires appropriate processes and equipment, including those with PFAS, which prevent the formation of impurities and the risk of leakages.

IOGP Europe would like to draw the attention on the fact that CCS does not have yet a category in Annex XV of ECHA Universal PFAS Restriction Report (the ECHA report).

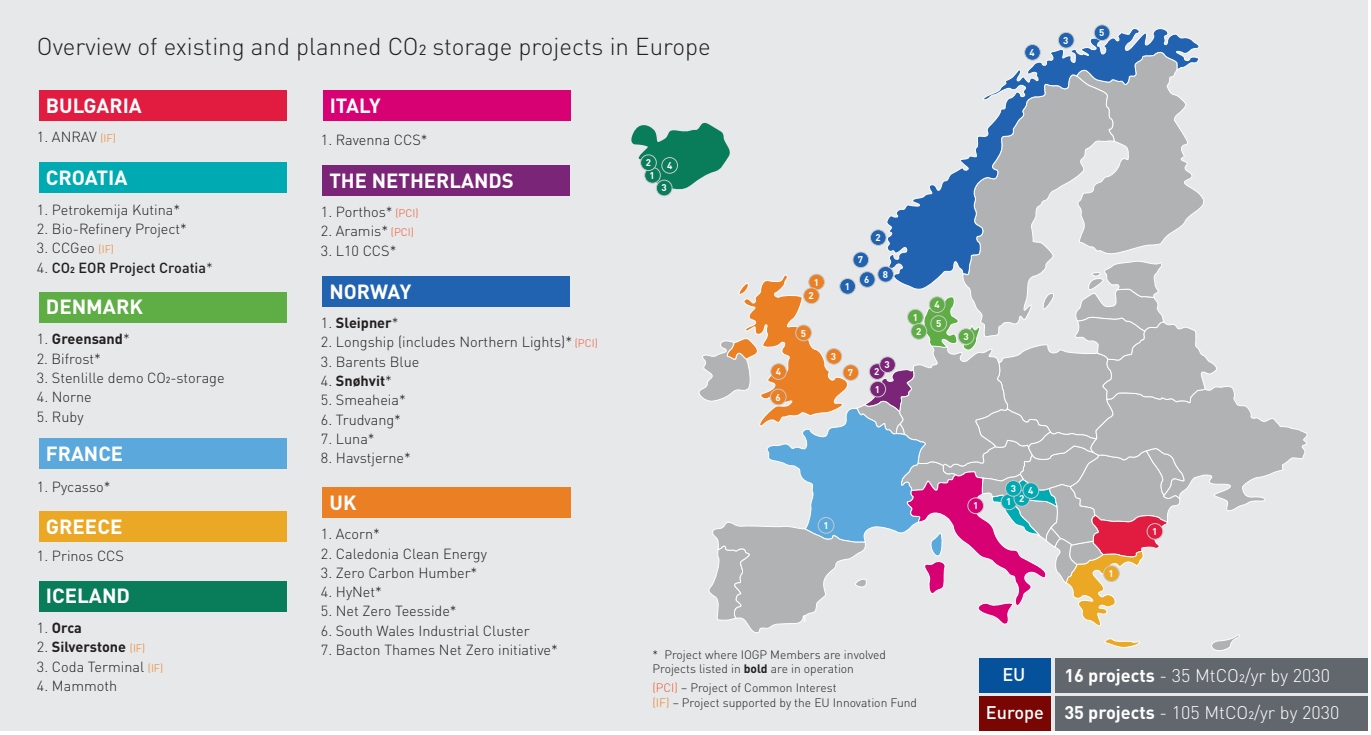
However, for the purpose of responding to the ECHA consultation, many processes, equipment and facilities used for CCS, may be compared to those included in the 'Petroleum industry' sector such as:

- Use of same equipment & operating ranges as in the gas extraction, treatment, and transport
- CO_2 management requires high resistance to corrosion, to temperature & mechanical degradation as (natural) gas management
- Large amount of Petroleum codes and Standards are applicable with some codes (API/ISO) specific to CO_2 as fluid
- Chemical processes required for capture & conditioning are equivalent to those found in refineries and upstream petroleum sector for gas treatment, separation and conditioning
- The equipment found in the CCS sector is the same as equipment and piping used in extraction/production, transport, and storage of petroleum resources

- CO_2 Capture & Conditioning (i.e. natural gas processing and CO_2 EOR operations)
- Cryogenic Export/Import Terminals (i.e. LNG)
- Transport modalities (pipelines onshore/offshore, shipping, rail, and trucks)
- CO_2 export stations/terminals (compression/pumping) (i.e. natural gas processing and CO_2 EOR operations)
- Injection facilities
- Wells
- Monitoring Tools

Capture & CO_2 conditioning facilities (dehydration, filtration) are/will be present in many other industries (Power plants, oil and gas facilities, steel, petrochemicals, waste, cement industry, refineries, fertilizers/ammonia production, Hydrogen production) and are essential to the safe operation of the many CCS projects under development, as per figure 1 taken from IOGP Europe map of CCS projects (September 2023).

CO_2 storage projects in Europe



For these reasons, IOGP Europe urgently requests ECHA to provide an unlimited-time derogation for fluoropolymers used in the evolving CCS value chain.

2. PFAS application in CO_2 capture, transport and storage

A wide range of fluoroplastics and fluor-elastomers are used in the carbon capture, transport and storage industry in similar ways to their use in the refining of petroleum and chemicals, drug and food production industries. All these sectors use reactive chemicals, e.g., strong acids, where - in many instances, fluoropolymer, specifically Polytetrafluoroethylene (PTFE), a PFAS, is the only available material that can withstand the corrosion and/or extreme conditions (temperature/pressure) to prevent fugitive emissions (Ref.1 European Sealing Association).

The equipment used to capture, transport and store CO_2 uses the same equipment as listed in Annex XV of the ECHA restriction report under the 'Petroleum and mining sector' and as the other sectors listed in the paragraph above. The most common use of PFAS based materials in CCS activities is in the seal-related components of the equipment and piping.

The key functional properties that make fluoropolymers like PTFE, Teflon, FFKM or FKM important in this sector are durability, mechanical strength and corrosion resistance under the extreme environments found all long the chain. As examples,

- Containment and transport of liquified CO_2 (cryogenic) require sealing materials that can withstand corrosion and/or extreme low temperature conditions to prevent undesired leaks. These sealing materials can be identified in e.g., valves, compression, pumps. Fluoroplastics such as PTFE are able to maintain their sealing properties even at cryogenic temperature due to the extremely low temperature at which the material becomes glass like. FFKM is known for its ability to provide highly resistant seals and cleanliness in extreme temperature and chemical environments. As outlined by the dossier submitters, Teflon, Viton, and PTFE have the following properties: Chemical resistance, Low volatility/high stability, Thermal resistance, Cleanliness, UV resistance, and Flame resistance;
- As in the oil and gas industry, flexible pipelines and hoses are needed to transport and store CO_2 in offshore injection systems and subsea distribution systems. Further to the high corrosion, mechanical and thermal resistance of unbounded flexible pipes, their flexibility is important to maintain alignment between floating facilities and subsea structures;
- CO_2 injection operations are designed to minimise risks to the environment and safety. The equipment and components used are heavily regulated and are required to undergo extensive and costly testing. Fluor-elastomer seals remain the only option available for many wellhead applications (ISO 27914 Carbon dioxide capture, transportation and geological storage — Geological storage);
- Fluoropolymers are used in drilling tools composed of cable insulation for communication cables in drilling, O-ring seals and sensors;
- Fluoropolymers are also used in the tools deployed for completion and well intervention which is a critical element to store CO_2 in a safe manner. Some non-PFAS alternatives may not offer the same level of performance as FKM/FKKM. For example, EPDM may not be as resistant to heat as FKM/FKKM. Failures in oil and gas production or gas/CO_2 storage may lead to catastrophic events like explosions.

Multiple inventory items listed throughout the various industrial sector categories (as listed in ECHA Annex XV), are also used within a CCS value chain:

Gaskets & Valves (Valve bodies, valve packing, valves sealing, elastic tubes, O-Rings)	Fluid transfer equipment
Vessels	Flexible pipes
Piping	Liners in the high-pressure lines used in offshore choke & kill systems
Pumps & Compressors	Vibration dampers
Heat exchanger	Packer elements
Filters	Blow-out preventors
Membranes & Filtration equipment	Stators and "mud motor"
Ejectors	Subsea hydraulic couplers
Laboratory equipment	Pump liners
Measuring instruments	Packaging vents -leaking and rupturing
Flowmeters, sensors	Dispensers, nozzles, compressors
Analytical equipment	Subsea hydraulic couplers
Actuators, Regulating / Control devices	Electrical sub-stations
Capacitive sensors and their connecting tables	Fiber optics
Pipelines	Flexible risers & Flowlines

3. Alternatives, risks and impact assessment

Systems to capture, transport and store CO_2 are designed to contain CO_2 from the point of capture to its eventual permanent geological storage. These systems use the same types of equipment as the oil and gas sector. Fluoropolymers are used in the 'Petroleum and mining sector' as 'Oil & Gas sector'. This sector has responded to earlier consultations to assess alternatives to use of PFAS and the impact(s) of a ban of this type of material. IOGP is aware that assessments have been performed by other interested parties involved in the consultation on behalf of the 'Petroleum and mining sector':

- Following the PFAS in Mining & Petroleum assessment, (Ref.2) alternative solutions to fluoropolymers can be replicated some functionality in some cases, no identified alternatives that can match all required functionality. In many cases, the use of fluoropolymers is selected by the industry to ensure the safe operations in the harsh environment. While differences in unit cost are uncertain, the main risks are associated with loss of functionality and more frequent failure, shutdown time and maintenance, and associated impacts on the production efficiency and revenue. Loss of functionality can possibly increase leakage of oil or chemicals increasing risk to health and/or the environment in some installations. Known alternatives to PFAS for seals (e.g., graphite) provide significantly worse sealing performance and add additional friction to the valve motion. This friction increases the entire energy consumption of the industrial plants leading to even more emissions to provide that power. Furthermore, it does not meet the international standards.
- Following the IOGP "Flexible pipe dossier as sub-use of 'Petroleum and mining sector' (Ref.3) Fluoroplastics and fluor-elastomers are essential materials for key components in unbounded flexible pipe. According to the previous responses from oil and gas sector to earlier consultation (Ref.2), "despite significant research, currently, **there is no known substitute for extruded PVDF or current uses of PVDF and PTFE in flexible pipe design and manufacturing**. Any restriction or ban could have a devastating effect on energy affordability and security of supply. In most cases, whenever alternative materials are technically feasible, these are already in use. Furthermore, it should be highlighted that **materials considered as alternatives in the proposal are not technically feasible replacements for the abovementioned application**. As acknowledged in section 2.15 of annex E of the restriction proposal, the development of alternative products could take several decades, if even possible. **In the absence of technically feasible alternatives, established designs of safety-critical equipment might have to be changed. The lack of technically feasible alternatives will have an impact on all High-Pressure High-Temperature (HPHT) producing or to-be-developed fields: existing fields can be severely impacted or closed and new fields not developed at all, thus impacting the EU energy security of supply and affordability for decades to come"**. As pointed out by the dossier submitters, PVDF has the following features: non-reactive inert chemically stable, flexible, and thermally resistant. As pointed out by the dossier submitters (Ref 5), steel pipes could be an option, but they are more carbon-intensive. Other reports have also concluded that choosing non-metallic, flexible pipes provides the least GHG emissions from a cradle-to-grave perspective (Ref 6 & 7).
- **Following the European Sealing Association report** (Ref.1) "PFAS fluoropolymer (Fluoroplastic & Fluor-elastomer) materials are used when other alternative plastics cannot offer the required chemical & thermal resistance combination for industrial applications: **There is no other chemistry available to replace the performance that Fluoropolymers provide for chemical, thermal, plasma and radioactive resistance as seals**. By definition any chemical that could withstand those situations would also be considered persistent. A ban, or a class regulation, of polymeric PFAS materials and their raw materials will have a profound impact on global industry and everyday lives".
- PFAS in Drilling: Fluorinated surfactants can be used in some specific cases as hydrocarbon foaming agents in drilling fluids. These helps reduce the amount of fluid lost during drilling and reduce potential formation damage. PFAS-based products can also be used as anti-foaming agents in Drilling fluids, preventing the formation of foam during the preparation of a treatment fluid. Other Non-polymeric PFAS-based products, such as tracers, can be required during drilling operations.

Following the PFAS in Mining & Petroleum assessment, (Ref.2):

- Alternatives exist to replace antifoaming agents based on fluorinated silicones or siloxanes but represent a small number of applications. Unit cost of alternatives is lower but required application rate is higher. No additional risk expected, more data on Polybutylene terephthalate (PBT) properties are needed.

- For fluorinated alkanes products used as tracers, alternative solutions are available and can be used in all but a small number of applications.
- Codes & Standards: International Organization for Standardization (ISO) standards are widely used across Europe and incorporate PFAS as an essential element in the standards. API standards are also used within Europe (ref 4).

For CCS, the ISO 265 Technical Committee manages International Standards for the design, construction, operation, environmental planning and management, risk management, quantification, monitoring and verification, and related activities in the field of CO_2, transportation, and geological storage. ISO 265 focus is on abating, transport and storing CO_2 being emitted from large stationary point sources and industrial clusters in general.

An example of ISO/27914 - Carbon dioxide capture, transport and geological storage, is one of the 16 ISO references where the use of PFAS-containing equipment is identified. This standard is adopted by the European Committee for Standardization (CEN). The review of these standards usually takes between 3-5 years and requires significant technical resources. Once changes to the standards are introduces, the process of redesigning, retesting, and recertifying equipment starts which is resource and time intensive.

There are multiple CCS projects throughout Europe that are under advanced development, being their data available insufficient or limited yet to perform a quantitative assessment of the impact of PFAS ban on CCS activities. However, as already mentioned, CCS uses the same type of equipment and design constraints as the oil and gas industry, therefore the assessment can be based on work performed by Petroleum sector and other relevant industrial associations/ organizations.

A full ban on PFAS would put at risk the many CCS activities under quick expansion and which require field proven, commercially and technologically available equipment with high performing leak-free properties, such as the equipment and piping already in use for the extraction, transport, and storage of petroleum resources.

As representatives of the CCS sector we strongly encourage to assess in detail the full ban of fluoropolymers for the reasons stated above and we would like to keep a continuous dialogue regarding the Research & Development programs, the derogation periods and alternative materials availability and development. A ban, or a class regulation, of polymeric PFAS materials and their raw materials will have a profound impact on the deployment of CO_2 storage projects which is likely to put in jeopardy the ambition of the EU's 2050 Net-Zero climate objectives.

References

Ref.1 ESA (European Sealing Association) Position statement on proposed PFAS regulation – March22

Ref.2 Wood - PFAS in Petroleum - Emissions and Alternatives PFAS in mining_Wood_July2021.pdf

Ref.3 PFAS PUBLIC CONSULTATION - IOGP Europe response covering Flexible pipes as a sub-use within 'Petroleum and mining sector'.

Ref.4 API – EU PFAS Restriction Proposal API Standards Analysis

Ref.5 rest_pfas_annex_e_31106_en – page 506 // "it is noted that steel is considered less favorable as the pipelines or other components are heavier, less flexible, and more carbon intensive to produce."

Ref.6 Zubail, A. et al (2021), Carbon and energy footprint of non-metallic composite pipes in onshore oil and gas flowlines, Journal of Cleaner Production, Volume 305, Retrieved on: //doi.org/10.1016/j.jclepro.2021.127150 here.

Ref.7 DNV report here, published in 2022 DNV, Strohm, and the Non-Metallic Innovation Centre study reviews lifecycle carbon footprint of pipelines.

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