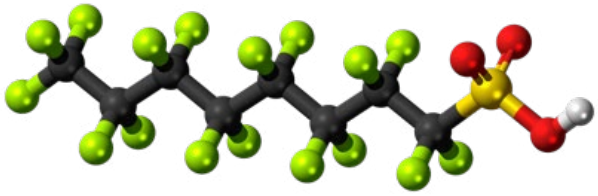
Understanding PFAS

Usage, emissions, and risks

Funded by the European Union's Horizon Europe programme under grant agreement No.101060213.

Per- and polyfluorene alkyl substances (PFAS) form a group of thousands of different persistent organic chemicals. PFAS have at least a perfluorinated methyl group (–CF3) or a perfluorinated methylene group (–CF2–), following the OECD definition.



PFAS are highly versatile materials that can be solid, liquid, or gaseous. Their properties are useful in a wide range of products in transportation, textiles, healthcare, industrial manufacturing, lubricants, agriculture, and many other sectors.

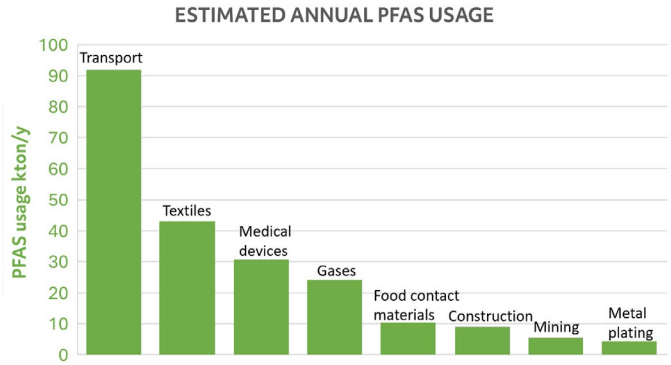
Where are PFAS emitted and how do they move? PFAS emissions can occur in many stages of a product lifecycle. Fluoropolymers generally don't cause emissions during use, but their production and their end-of-life treatment can create emissions. PFAS used as a manufacturing aid during fluoropolymer production cannot be recycled or recovered completely and may be emitted through flue gas or wastewater.

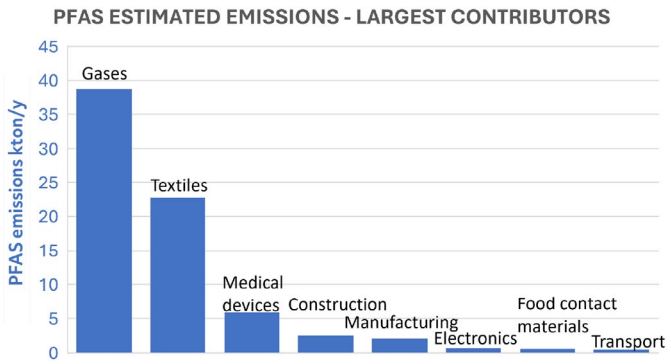
High persistence is among the main concerns related to PFAS. For some, the degradation in a natural environment is very slow, while others transform into other PFAS that barely degrade. Many PFAS are mobile and bioaccumulative, some are toxic. Not all PFAS have been proven to cause adverse health effects, in part related to the existence of thousands of different molecules that are a PFAS.

Even if a PFAS is not harmful by itself, manufacturing and end-of-life processing of that material could lead to emissions of other PFAS that are harmful.

Usage and emission volumes of PFAS were estimated in the restriction proposal under REACH. These numbers give an idea about the disconnect between the amount of PFAS used and the amounts emitted per sector.

PFAS usage in 'Transportation' is much higher than under 'Gases', but emissions show the opposite. Gases are often emitted upon use, while sealings or cable hoses last for decades. The estimations do not include emissions during end-of-life, the lifecycle stage in which solid products are expected to cause emissions.





There are large differences between PFAS in how they move through the environment. Some are relatively volatile and travel long distances through the atmosphere, while others are highly water-soluble, and again others adhere easily to hydrophobic substances such as organic matter or microplastics. Rivers typically bring the highest volumes of PFAS to the sea or lake into which they discharge, and 'legacy' PFAS, which should not be used anymore, still form a significant fraction of these.

Towards minimal PFAS emissions

SOS ZEROPOL 2030

Funded by the European Union's Horizon Europe programme under grant agreement No.101060213.

Incineration or upcoming PFAS destruction technologies cannot avoid emissions from manufacturing and use. Avoiding PFAS where possible is thus the main route to minimize PFAS pollution.

Replacement of PFAS by alternatives is possible in a wide variety of products (e.g. using propane instead of a fluorinated refrigerant in A/C systems, or using a PFAS-free coating to make apparel water-repellent). Sometimes, using a different product or approach is more feasible than replacing PFAS in an existing product. For example, for some patients it is feasible to use a powder inhaler instead of one that contains a fluorinated gas as propellant.

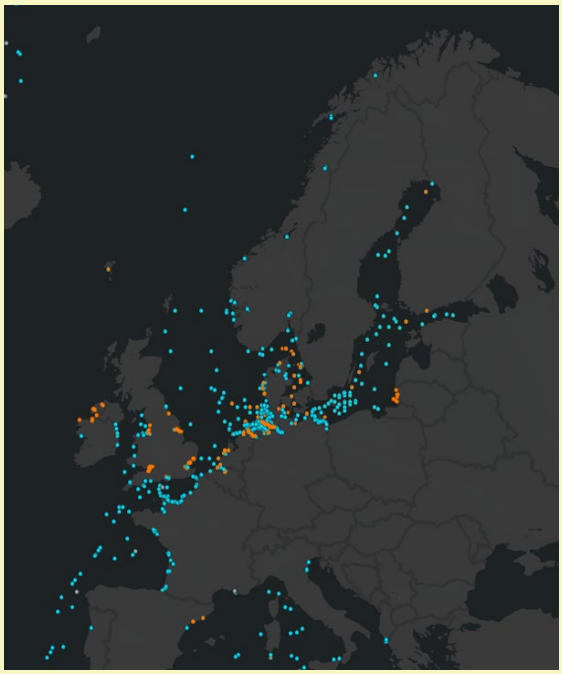
For some PFAS-containing products there is no PFAS-free alternative available yet, emissions associated with production, use and end-of-life of these products should be minimized. In PFAS production, improved wastewater treatment, flue gas scrubbing, and thermal oxidation of byproducts and flue gases can help to minimize emissions.

Working towards zero pollution can be achieved through different strategies. Stakeholder-led participatory workshops (Living Labs) were used to build a holistic overview of strengths and weaknesses of these strategies. In the North-East Atlantic region, the LLs focused on reducing PFAS emissions from the medical sector throughout the product chain. The LLs in the Black Sea region focused on aspects such as future PFAS governance in the region, the role of the EU, and how to improve monitoring in the region.

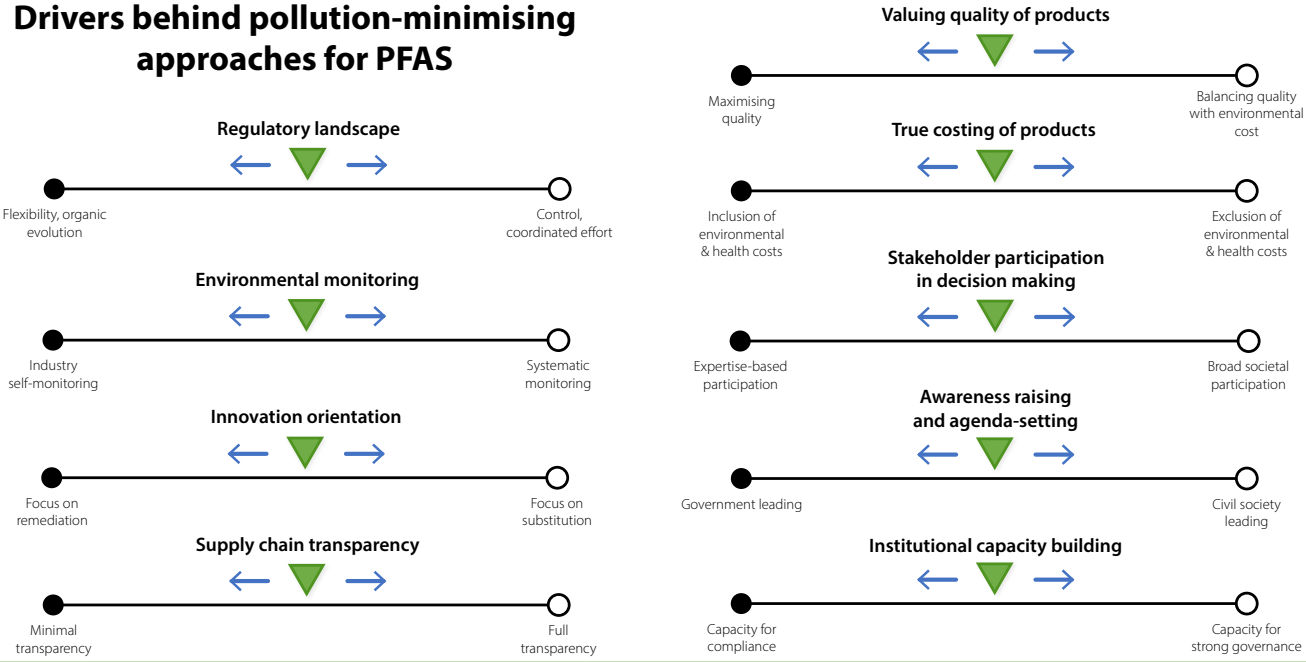
Each LL worked with a specific set of four scenarios, based on the same principles: who takes **responsibility** (public-private or EU-region) and the **approach to minimise pollution** (reactive-proactive). The graph below lists the drivers that formed the basis for the Living Lab scenarios, which are shown on the next two pages.

What data are available for PFAS concentrations in marine matrices?

The Risk Assessment Tool developed within SOS-ZEROPOL2030 shows PFAS concentrations in marine matrices (see image). Concentrations above the Environmental Quality Standard (EQS) for 'other surface waters', 0.03 ng/L are shown in orange.



Drivers behind pollution-minimising approaches for PFAS



Scenarios for reducing PFAS emissions in the North-East Atlantic

SOS ZEROPOL 2030

Funded by the European Union's Horizon Europe programme under grant agreement No.101060213.

Public sector

Responsibility

Reactive

Approach

Proactive

Private sector

Economy of Safety

The **public sector**, at EU and national levels, takes responsibility for **managing the risks** from harmful chemicals by defining acceptable exposure levels. The regulatory landscape aims to **strictly control** the known risks to the environment and health. It implements **systematic, science-based monitoring**. Innovation is orientated towards **remediation** of harmful chemicals from production sites and the environment. **Transparency** of risks throughout the supply chain is required. The quality of healthcare is **maximized** provided the environmental costs are acceptable, primarily reflecting **economic costs** of products. Decisions are made with **broad participation** of diverse stakeholder groups.

Economy of Care

The **public sector**, at EU and national levels, takes responsibility and care for a zero pollution economy based on the **precautionary principle**. The regulatory landscape aims to **strictly prevent** harm to the environment and health. It implements **systematic, science-based monitoring**. Innovation is orientated towards **substitution** of harmful chemicals, and **transparency** of chemicals throughout the supply chain is required. The quality of healthcare is **balanced** with the environmental costs, which is reflected in the **true costing** of products. Decisions are made with participation of **broad participation** of diverse stakeholder groups.

Economy of Compliance

The **industry and private sector** take responsibility for **managing the risks** from harmful chemicals to acceptable levels. The regulatory landscape is characterized by a **high degree of flexibility** within policy driven boundaries, encouraging innovation that is primarily oriented towards **containment and remediation** of harmful chemicals, mainly from production sites and the environment. Sectors implement any statutory self-monitoring, which requires **internal supply-chain transparency**. The quality of healthcare is **maximized** provided the environmental costs are acceptable, primarily reflecting the **economic costs** of products. Decisions are made with selected **expertise- and interest-based** stakeholders.

Economy of Responsibility

The **industry and private sector** take responsibility for a zero pollution economy based on a **proactive approach** towards pollution. The regulatory landscape is characterized by a **high degree of flexibility** within policy driven boundaries, encouraging innovation that is oriented towards the **substitution** of harmful chemicals. Sectors implement a coordinated, statutory **self-monitoring** system, which requires **limited external transparency**. The quality of healthcare is **balanced** with the environmental costs, which is reflected in the **true costing** of products. Decisions are made with selected **expertise- and interest-based** stakeholders.

Scenarios for reducing PFAS emissions in the Black Sea basin

SOS ZEROPOL 2030

Funded by the European Union's Horizon Europe programme under grant agreement No.101060213.

EU driven

Responsibility

Region driven

Reactive

Approach

Proactive

EU Compliance

The Black Sea region **follows EU policy** developments and reacts to these when regulations come into effect. PFAS is **not high on the agenda** and awareness is created by **public authorities** to achieve compliance with regulations. The **regulatory landscape is fragmented** across many EU and regional initiatives. By ensuring the **required supply-chain transparency**, and implementing **EU policy driven monitoring** where possible, more information becomes available. There is **formal consultation of expert stakeholders** in decision-making processes and **capacity building ensures compliance** in response to required pollution governance in the Black Sea basin.

EU Collaboration

The Black Sea region **follows EU policy** developments and implements them swiftly and **proactively**. PFAS is considered a **major priority** and awareness is created by **civil society**. The **regulatory landscape is fragmented** across many EU and regional initiatives. By facilitating **maximum supply-chain transparency**, and stipulating EU policy driven monitoring there is enough information to act. There is active **involvement of stakeholders** in decision-making processes, and **capacity building of all relevant actors** ensures a proactive approach to PFAS pollution governance in the Black Sea basin.

Regional autonomy

The Black Sea region takes control over the implementation of **chemicals governance** to the extent that the region sees this as a priority. PFAS is not high on the political agenda and awareness is created by **public authorities** to achieve compliance with regulations. The **regulatory landscape is integrated** in response to specific regional needs. By ensuring the required **supply-chain transparency**, and implementing **policy driven monitoring** where needed, some information becomes available. There is f**ormal consultation of stakeholders** in decision-making processes and **capacity building** ensures compliance in response to required pollution governance in the Black Sea basin.

Regional leadership

The Black Sea region takes a leading role in the shaping and implementation of **proactive chemicals governance.** PFAS is considered a major priority and awareness is created by **civil society** in close collaboration with regional authorities. **The regulatory landscape is integrated** and tailored to the specific regional context. By facilitating **maximum supply-chain transparency**, and a strategic **science-based monitoring** there is enough information to act. There is active **involvement of stakeholders** in decision-making processes and **capacity building of all relevant actors** ensures a proactive approach to pollution governance in the Black Sea basin.