WHY HIGHLY PERSISTENT CHEMICALS ARE ALWAYS A HAZARD

chemsec
INTERNATIONAL CHEMICAL SECRETARIAT

SPEAKERS

- **Prof. Martin Scheringer**, ETH Zurich
- **Oliver Loebel**, Secretary General, Eureau
- Q&A – use the Q&A function
- A recording of the webinar as well as the slides will be distributed to the registrants of the webinar

chemsec
INTERNATIONAL CHEMICAL SECRETARIAT

The Problem of Chemical Persistence

Martin Scheringer
ETH Zürich, Zürich, Switzerland
RECETOX, Masaryk University, Brno, Czech Republic

ChemSec Webinar
June 2, 2026

ETH zürich

The Problem

"Persistent materials, because of this property, will accumulate in the environment for as long as they are released. Since the environment is not effective at cleansing itself of these materials, they will remain for indefinite periods which were not recognized at the time of their original release. The problem could become entirely out of control and it would be extremely difficult if not impossible to do anything about it."

M.E. Stephenson, *Ecotox. Environ. Safety* **1** (1977), 39–48

The Problem

"Persistent materials, because of this property, will accumulate in the environment for as long as they are released. Since the environment is not effective at cleansing itself of these materials, they will remain for indefinite periods which were not recognized at the time of their original release. The problem could become entirely out of control and it would be extremely difficult if not impossible to do anything about it."

This is exactly what has happened with PFASs.

M.E. Stephenson, *Ecotox. Environ. Safety* **1** (1977), 39–48

The Impacts of Persistence

PERSPECTIVES

MARINE ENVIRONMENT

Persistent pollutants, persistent threats

Polychlorinated biphenyls remain a major threat to marine apex predators such as orcas

By **Paul D. Jepson**[1] *and* **Robin J. Law**[1,2]

Persistent organic pollutants (POPs) are chemical substances that persist in the environment, accumulate in the

the Stockholm Convention committed more than 90 signatory countries to phasing out or eliminating large stocks or other sources of POPs, including PCBs (*1*). Yet, PCBs continue to threaten the survival of marine

centrations fell substantially from the 1960s and 1970s to 2010 (*5*, *7*). Most avian marine apex predators, including herons, gulls, ospreys, petrels, and skuas, are no longer listed as threatened on the International Union for

Jepson and Law (2016) *Science* **352**, 1388–1389

The Impacts of Persistence

- Orca whale with 950 mg/kg PCBs in blubbler
- accumulated over **22 years**
- no offspring
- caught in net

source: The Guardian, May 2017

UK killer whale died with extreme levels of toxic pollutants

Adult whale Lulu was one of UK's last resident pod and had never produced a calf, probably because pollutants in her blubber had caused infertility

The Persistence Fallacy

Persistence alone is not a problem.
Persistence indicates the mere presence of a chemical.

The Persistence Fallacy

~~Persistence alone is not a problem.~~

~~Persistence indicates the mere presence of a chemical.~~

Persistence is never “alone”. There are always impacts.

Therefore:
Persistence indicates an impactful causal relationship that extends far into the future.

The Meaning of Persistence

- Persistence makes exposure **higher**, **longer**, and **more widespread**.

- Thereby, persistence directly increases the occurrence of adverse effects.

The Broken Record …

Environmental Science & Technology

pubs.acs.org/est

Perspective

Boundaries, Limits, Global Threats – How Can the Impacts of Global Synthetic Pollutants Be Reduced?

Published as part of Environmental Science & Technology special issue "Safe and Just Earth System Boundaries for Novel Entities".

Martin Scheringer,* Hans Peter H. Arp, and Ian T. Cousins

Cite This: *Environ. Sci. Technol.* 2026, 60, 4499–4505

Read Online

ACCESS | Metrics & More | Article Recommendations

ABSTRACT: The planetary-scale risks posed by "chemicals of global concern" have deep historical roots that predate the literature on the Planetary Boundaries concept. Two largely separate scientific and regulatory tracks emerged from mid-20th-century research: an atmospheric track (exemplified by chlorofluorocarbons and stratospheric ozone depletion) and an aquatic-terrestrial/ecotoxicological track (exemplified by DDT, PCBs and other bioaccumulative organohalogens). Both tracks produced early warnings, scientific consensus, and eventual multilateral environmental agreements (the Montreal Protocol and Stockholm Convention). In this Perspective, we synthesize the historical evidence, link it to the planetary-boundaries and limits-to-growth narratives, highlight why chemical regulation repeatedly failed to prevent widespread contamination, and propose a set of pragmatic policy instruments, including targeted premarket controls such as the application of the Safe and

https://doi.org/10.1021/acs.est.5c13807

ETH zürich

The Broken Record …

ENVIRONMENTAL Science & Technology

Open Access

pubs.acs.org/est

Viewpoint

Is Persistence a Hazard?

Published as part of Environmental Science & Technology special issue "60th Anniversary of Environmental Science and Technology".

Martin Scheringer* and Ian T. Cousins

Cite This: https://doi.org/10.1021/acs.est.6c00770

https://doi.org/10.1021/acs.est.6c00770

The Broken Record …

pubs.acs.org/est

Is Persistence a Hazard?

Published as part of Environmental Science & Technol
Science and Technology".

Martin Scheringer* and Ian T. Cousins

Cite This: https://doi.org/10.1021/acs.est.6c00770

ACCESS | Metrics & More

not alone!

Open Access

Environmental Science
Processes & Impacts

PERSPECTIVE

Check for updates

Cite this: DOI: 10.1039/c8em00515j

Why is high persistence alone a major cause of concern?

Ian T. Cousins,[a] Carla A. Ng,[b] Zhanyun Wang[c] and Martin Scheringer*[d]

Persistence is a hazard criterion for chemicals enshrined in chemical regulation worldwide. In this paper, we argue that the higher the persistence of a chemical, the greater the emphasis that it should be given in chemicals assessment and decision making. We provide case studies for three classes of highly persistent chemicals (chlorofluorocarbons, polychlorinated biphenyls, and per- and polyfluoroalkyl substances) to exemplify problems unique to highly persistent chemicals, despite their otherwise diverse properties. Many well-known historical chemical pollution problems were the result of the release of highly persistent chemicals. Using evaluative modeling calculations, we demonstrate that if a chemical is highly persistent, its continuous release will lead to continuously increasing contamination irrespective of the chemical's physical–chemical properties. We argue that these increasing concentrations will result in increasing probabilities of the occurrence of known and unknown effects and that, once adverse effects are identified, it will take decades, centuries or even longer to reverse contamination and therefore effects. Based on our findings we propose that high persistence alone should be established as a sufficient basis for regulation of a chemical, which we term the "P-sufficient approach". We argue that regulation on high persistence alone is not over-precautionary given the historical and ongoing problems that persistent chemicals have caused. Regulation of highly persistent chemicals, for example by restriction of emissions, would not only be precautionary, but would serve to prevent poorly

Received 5th November 2018
Accepted 28th March 2019

DOI: 10.1039/c8em00515j

https://doi.org/10.1021/acs.est.6c00770 https://doi.org/10.1039/c8em00515j

ETH zürich

The Broken Record …

pubs.acs.org/est

Viewpoint

Stories of Global Chemical Pollution: Will We Ever Understand Environmental Persistence?

Martin Scheringer,* Jana H. Johansson, Matthew E. Salter, Bo Sha, and Ian T. Cousins

Cite This: *Environ. Sci. Technol.* 2022, 56, 17498–17501

Read Online

ACCESS | Metrics & More | Article Recommendations

https://doi.org/10.1021/acs.est.2c06611

ETH zürich

The Broken Record …

Environ. Sci. Technol. **1996**, *30*, 1652−1659

Persistence and Spatial Range as Endpoints of an Exposure-Based Assessment of Organic Chemicals

MARTIN SCHERINGER*

Department of Environmental Sciences, Swiss Federal Institute of Technology, Zürich, Switzerland

An approach to the classification of environmental chemicals in terms of exposure-based quantities is presented. First, the spatial range of environmental chemicals is introduced as the counterpart of the persistence, and mathematical definitions are given for the calculation of both persistence and spatial range from exposure data. Persistence and spatial range serve as proxy measures that reflect the influence of many different transport and degradation mechanisms

There are some important advantages of an exposure-based assessment of chemicals (*7*): First, an exposure-based assessment makes it possible to reduce the complexity the assessment procedure has to deal with because less data have to be recorded, aggregated, and evaluated. Second, it can be performed before the effects resulting from the exposure to the chemical released have become manifest, i.e., it makes possible a preventive assessment by which the precautionary principle can be put into practice. The purpose of this study is to accomplish a description of exposure in terms of two basic quantities related to space and time. To this end, the quantity of spatial range R is introduced as the counterpart of persistence τ that covers the spatial dimension; this quantity has not yet been discussed explicitly in the assessment of environmental chemicals.

An extended unit-world model of environmental transport and degradation is used to calculate exposure patterns of organic pollutants; persistence and spatial range are determined from these exposure patterns. It has to be emphasized that the model is not a simulation model but an evaluative model to be used for the screening of environmental chemicals. The model makes it possible to calculate persistence and spatial range in a straightforward

ETH zürich

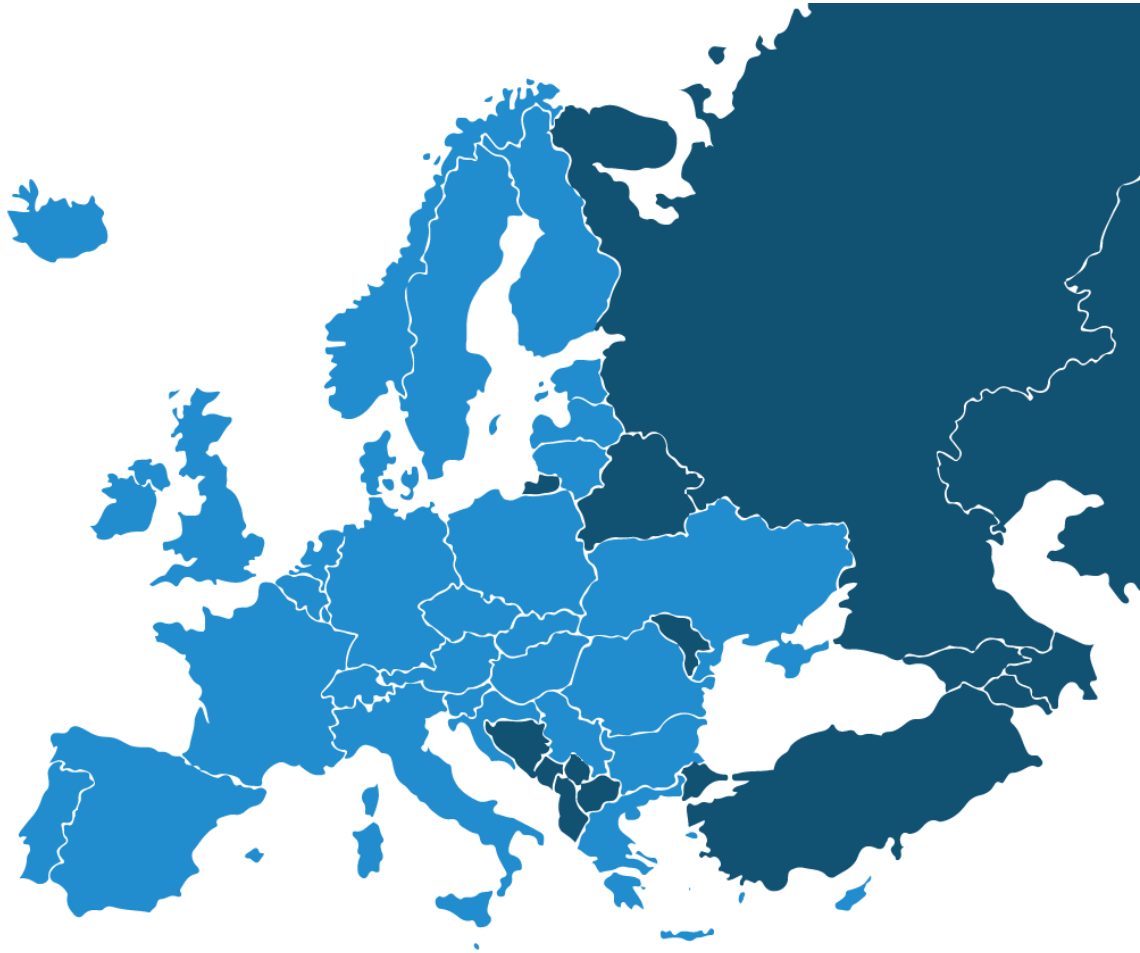
Why highly persistent chemicals are always a hazard

Water resilience at risk – the threat of persistent and mobile substances

Oliver Loebel, EurEau

Who we are

- **European umbrella body for drinking water and wastewater services**
- 38 national organisations from 33 countries
- 550 million customers and 470.000 direct jobs
- Critical infrastructures providing services essential for maintaining vital societal functions



Persistent and mobile substances – Why is the water sector concerned?

The EU Water Resilience Strategy (2025) identified the problem

"Water quality and quantity are two sides of the same coin, and we must continue working on preventing pollution at source.

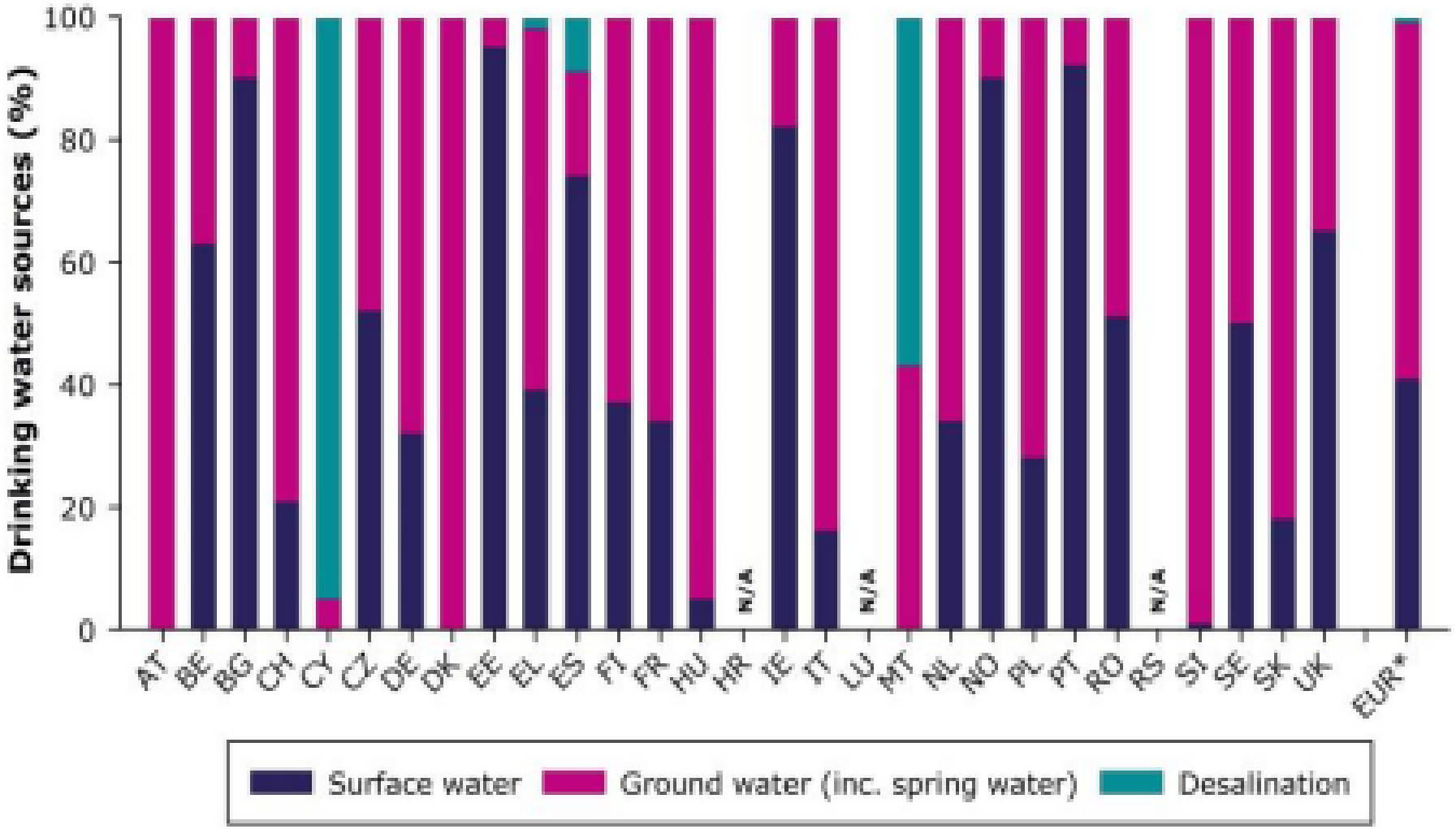
Urgent action is needed to tackle pollutants which pose a risk to our vital sources of drinking water.

Highly persistent pollutants, such as PFAS30, keep accumulating across EU waters and cause health impacts estimated to range between EUR 52 and 84 billion annually. This is also a major source of public concern."

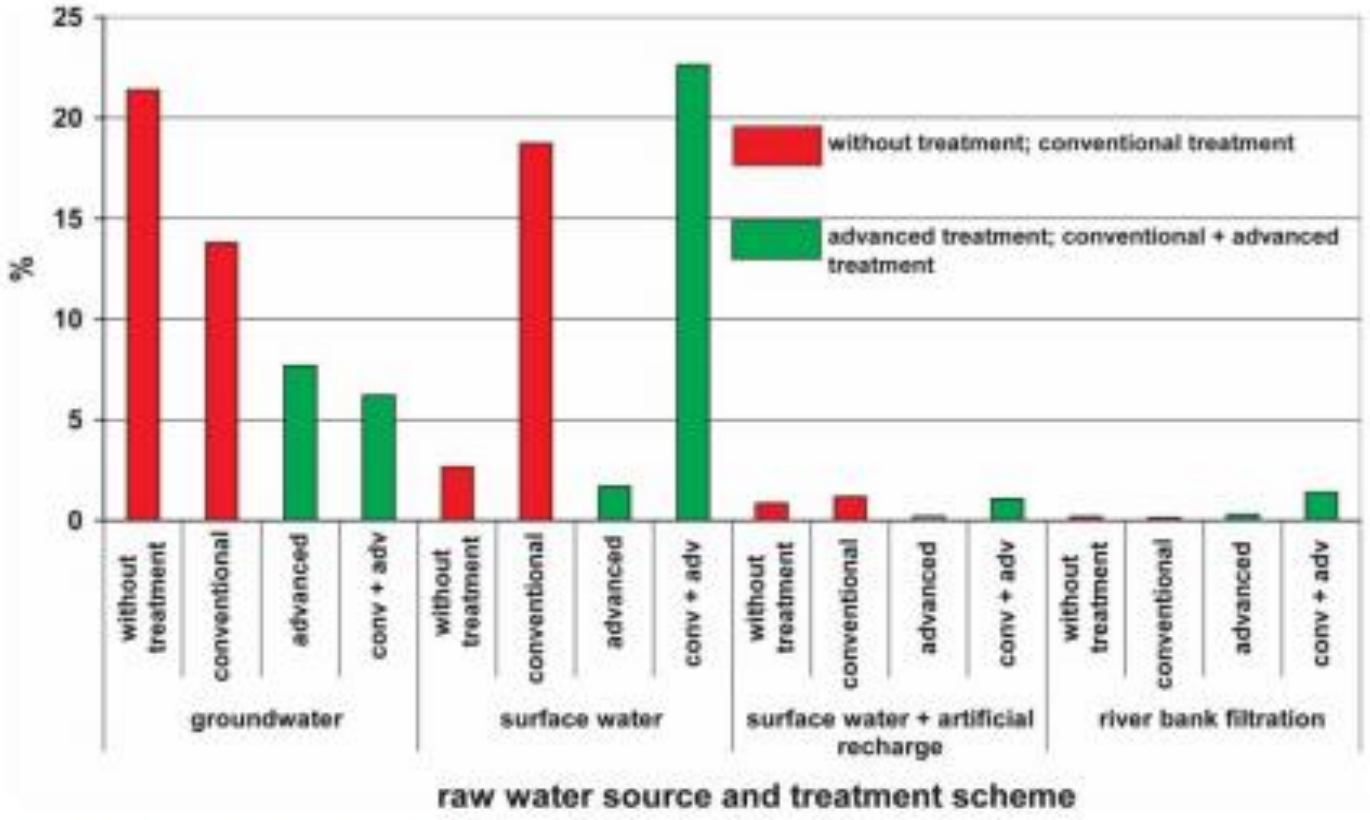
A service for people and the economy depending on a scarce resource

550 million customers

36.6 billion m³ per year



A natural product: 59% of our drinking water without advanced treatment



Groundwater:

- 71% not treated or conventional system

Surface water:

- 47% is not treated or conventional system

Conventional: Aeration, rapid sand filtration, coagulation – sedimentation – filtration, artificial recharge

Drinking water treatment technologies in Europe: state of the art – challenges – research needs

J. P. van der Hoek, C. Bertelkamp, A. R. D. Verliefde and N. Singhal

Water Framework Directice not applied, leading to additional treatment needs

Good chemical status: About 30%

Emission control measures not sufficient

PMT substances accumulate in aquatic environment

WFD article 7.3: reduce treatment needs

What we find: 1,4-dioxane, diisopropylether, EDTA, NTA, pyrazole, TFA, benzotriazole, methenamine, urotropine, MTBE, atrazine) found in surface water at the µg/L range, even above 10 µg/L in rivers such as Meuse and Rhine.

Conventional water treatment ineffective

Mobility	≠	Hydrophobic interactions
Persistence	≠	Biodegradation

Biological treatment does not work for **persistent substances**

AC filtration does not work for **mobile substances**

Most PMT/vPvM substances persistent towards **chemical oxidation**

PFAS – the most concerning PMT/vPvM group

Wide range of uses and hundreds of pathways to the environment

REACH unable to prevent this disaster

Pollution of drinking water resources and food for decades

UPFAS: >880,000 t of emissions over 30y (without pesticides, biocides)

How can we better protect our water resources from PMT/vPvM substances?

Resilience of water services at risk

More PMT/vPvM -> More treatment -> Higher cost

Less:

Leakage reduction
Adaptation to climate change
(Cyber-)security

And/or massive tariff increases

Higher

Energy use
Resource use
Vulnerabilities

Implement control at source

Current system failed for PMT

Classify PMT/vPvM as SVHC

Extend GRA to all chemical substances and their degradation products: Define GRA hazard classes (incl. PMT)

Add ‘fast track’ restriction mechanism for PMT (no full risk assessment)

Implement the polluter-pays principle -> Stimulate innovation

Thank you for your attention

EurEau. Water Matters.

Oliver Loebel oliver.loebel@eureau.org

EurEau

Rue du Luxembourg 47-51,
B-1050 Brussels, Belgium
Tel: +32 (0)2 706 40 80
secretariat@eureau.org

EurEau. Water Matters.
www.eureau.org

IMPORTANT LINKS

- Website: chemsec.org
- The SIN list: sinlist.chemsec.org
- ChemSec Marketplace: marketplace.chemsec.org
- PFAS guide: pfas.chemsec.org
- ChemSec webinars: youtube
- Newsletter: Sign-up page
- LinkedIn: ChemSec

chemsec
INTERNATIONAL CHEMICAL SECRETARIAT

chemsec

INTERNATIONAL CHEMICAL SECRETARIAT