



SOS-ZEROPOL2030

D4.2 Overview (report, one for each region) of obstacles and best practices within the current regional and national governance landscape to achieve zero pollution of the selected pollutant case studies.

Emerging PFAS governance in North-East Atlantic and the Black Sea, and TWP's governance in the Mediterranean Sea.

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Executive Summary

This report presents an overview of obstacles and best practices within the European Union's current regional and national governance landscape to achieve zero marine pollution. In line with the wider SOS-ZEROPOL2030 project, the focus is on two pollutants of emerging concern: per- and polyfluoroalkyl substances (PFAS) and tyre wear particles (TWPs). The document includes focused one-pager reports for each regional sea to visualize available information on regional governance efforts.

Our data comes from extensive document analysis, semi-structured expert interviews and personal communications, and the outcomes of the three regional Living Labs with expert stakeholders conducted so far within SOS-ZEROPOL2030. We identify overlaps and disconnects between current EU regulatory developments around zero pollution of PFAS and TWPs and the regional, national, industry and civil society efforts to address production, use and end-of-pipe governance of PFAS in the North-East Atlantic region and the Black Sea region, and TWPs in the Mediterranean Sea region.

Emerging PFAS governance in the North-East Atlantic

The North-East Atlantic region is characterised by high public and political awareness on PFAS and a sense of urgency to address PFAS emissions from source to sea. The OSPAR Convention of the regional sea has classified PFAS as a substance for priority action with legal implications for contracting parties, who are required to implement measures that align with OSPAR recommendations and decisions. National level examples from France and The Netherlands show stricter PFAS regulation than at the wider EU level, as well as sectoral initiatives such as exploring PFAS reductions in medical applications, but are limited by lack of accessible PFAS use data in product supply chains. The PFAS production industry lobbies actively against concerted EU restrictions and regulations, while investors and public-facing brands increasingly move away from PFAS in their products.

Recommendations to strengthen regional and national governance efforts include improving supply chain transparency, amplifying the movement to PFAS-free alternatives and strengthening the implementation of a source-based approach to pollution governance.

Emerging PFAS governance in the Black Sea

The Black Sea region and the national-level examples of Bulgaria and Romania show that available monitoring data is lacking and public and political awareness of PFAS remains low. There is a civil society network around marine pollution but stakeholders do not currently engage much with the issue of PFAS. As a result, PFAS governance at both the regional and national level takes the shape of following EU developments. The progress of the Bucharest Convention of the regional sea has been significantly impacted by the ongoing war in Ukraine. The situation has escalated tensions in the region and has resulted in pollution being deprioritized on the political agenda. However, the Convention continues to facilitate informal learning and interaction when possible. There are intensive pockets of industry along the Danube River contributing to PFAS emissions in the Black Sea, but little is known about their approaches to minimise PFAS emissions beyond generic environmental compliance statements.

Recommendations to strengthen regional and national governance efforts include strengthening the funding and capacity for systematic source-to-sea monitoring,

enhancing regional and cross-regional collaboration, and building on the existing civil society networks to strengthen awareness.

Emerging TWPs governance in the Mediterranean Sea

The Mediterranean Sea region has a strong knowledge and research base regarding microplastics, with emerging awareness around TWPs among all stakeholders. National level examples in France and Italy show that governance of TWPs is currently not in place. Development of robust monitoring methodologies is currently proving to be a challenge. The UNEP/MAP-Barcelona Convention for this regional sea does not currently address TWPs specifically, but addresses microplastics more generally. The tyre producing industry is lobbying against strict TWP thresholds and product transparency regarding chemical composition of vehicle tyres. It is unclear how eco-design requirements will impact the composition and toxicity of tyres, and therefore of TWPs, in the future. Improving wastewater treatment seems challenging in the region, and a focus on improved environmental performance in the design of tyres seems more promising.

Recommendations to strengthen regional and national governance efforts include increasing awareness of TWPs as a form of pollution by building on existing awareness of microplastics pollution in the region, strengthening a source to sea approach by addressing tyre design and recycling, and enhancing regional coordination through multi-stakeholder platforms.

Conclusion

The governance analysis conducted in this report points to distinct regional and national differences for both PFAS and TWPs, especially regarding:

- levels of stakeholder awareness
- methods and capacity for systematic monitoring
- types of industry responses
- extent of political action
- levels of regional collaboration.

Further research needs

Given the emergent nature of the governance efforts for PFAS and TWPs, this report is an early assessment of the challenges and best practices across the European Regional Seas regions. We have identified the need for further research on the interface between knowledge and improved governance, and into the dual role of industry in lobbying power for protecting vested interest versus being a frontrunner in technical innovation. Finally, more research is needed into the interplay between EU, Regional Sea Conventions and national efforts to help achieve the European Union's long-term ambition of 'Zero Pollution' in European seas.

1 Introduction

The Horizon Europe project ‘Source to Seas: Zero Pollution 2030’ (SOSZEROPOL230) aims to co-design, co-produce, and co-deliver a stakeholder led European Seas zero-pollution framework that provides practical guidance from source to sea that addresses shortcomings in the current approaches to marine pollution management and governance. In doing so, the project will contribute to implementing various marine pollution reduction objectives developed under the European Green Deal. Through the European Green Deal, the EU aims to transform into a climate-neutral continent. This ambition is accompanied by a Zero Pollution Action Plan and a Chemicals Strategy for Sustainability. Both include a focus on addressing marine pollutants of increasing concern, i.e. microplastics (including tyre wear particles (TWPs) and tyre-related chemicals) and per- and polyfluoroalkyl substances (PFAS).

Across various regulations and directives, the EU is beginning to address the production, use, and environmental impact of PFAS (Booth et al., 2024; Ruhl et al., 2024). EU policies aim to mitigate the negative effects of PFAS throughout their lifecycle from source to sea. This is currently achieved through (i) chemicals registration and restrictions under REACH¹, (ii) various sector-specific regulations, (iii) setting environmental thresholds in water, soil and air, (iv) establishing thresholds for food and drinking water, and (v) supporting end-of-life and end-of-pipe innovation and governance.

In addition, the EU has developed various regulations and directives to address microplastic pollution and TWP emissions throughout a tyre’s lifecycle. This includes efforts to change tyre design, labelling and use, as well as through the capture and removal of TWPs in wastewater treatment plants (Devriese et al. 2023). These policies include (i) the Ecodesign for Sustainable Products Regulation (ESPR), which sets eco-design requirements, (ii) the Euro 7 regulation, which will introduce tyre abrasion thresholds, and (iii) the revision of the Urban Wastewater Treatment Directive (UWWTD), which establishes monitoring obligations for microplastics.

1.1 SOS-ZEROPOL2030 project context

The holistic approach co-developed within SOS-ZEROPOL2030 is based on best practice, emphasises human behaviour, socioeconomics and governance, and is underpinned by an understanding of current barriers to effective and efficient prevention, reduction, mitigation and monitoring of marine pollution in European Regional Seas. This deliverable report contributes to developing the holistic zero-pollution framework by identifying current governance efforts to reduce and mitigate PFAS and TWPs at the regional and national levels. It builds upon and extends Tasks 2.1 and 2.2, which mapped existing EU regulations for marine pollution (Devriese et al., 2023) and focused on governance arrangements for the selected pollutants across their lifecycle at the EU level (Van Leeuwen et al. 2023). This report summarises the outcomes and results from Task 4.4, exploring how EU policies are transcribed and implemented within the North-East Atlantic (NEA), Black Sea (BS) and Mediterranean Sea (MED) regions. This work has already been utilised as part of the integrated case study assessment presented in D4.1 (Booth et al. 2024; Ruhl et al. 2024), and as input for the 3 regional living labs within WP3 (Van Hulst et al., 2024). Following a

¹ REACH (Registration, Evaluation, Authorisation, and Restriction of Chemicals) is an EU regulation aimed at ensuring the safe use of chemicals by requiring their registration, evaluation, and, where necessary, restrictions within the EU market.

process that involved the project members from WP2, WP3 and WP4, as detailed in the methodology section 2.1, the decision was taken to focus on PFAS for the NEA and BS regions, and on TWPs for the MED region.

1.2 Objective

A preliminary review of governance efforts at the regional and national levels within these three regions showed that limited governance efforts exist at both the regional and national levels for the NEA, BS and MED. Governance arrangements that address PFAS and TWPs within these regions are not yet institutionalised, partly because many pieces of relevant EU legislation are currently being revised. As a result, the transposition and implementation of these laws and regulations has not yet begun. In response, the objective of this work was to focus on **identifying regional differences between emerging governance efforts of PFAS and TWPs by Regional Sea Conventions, EU Member States and industry to address production, use and end-of-pipe of TWPs and PFAS in the MED, NEA and BS**. Based on this overview we identify obstacles, best practices and opportunities for the EU Zero Pollution ambition for PFAS and TWPs.

The following section of this report examines the methodology developed to answer these research questions, including the choice to focus on two EU Member States per region to explore national governance efforts for PFAS and TWPs respectively. Results are presented in Chapter 3 for emerging PFAS governance in the North-East Atlantic and Black Sea regions, and in Chapter 4 for emerging TWPs governance in the Mediterranean Sea region. An overall conclusion is then presented in Chapter 5.

2 Methodology

Given the broad range of sectors and life cycle stages relevant for studying the PFAS and TWP case study pollutants, significant effort was put into scoping out a focus for this task (see section 2.1). Having a clear scope enabled alignment with the three Living Labs organised as part of SOS-ZEROPOL2030 work as well as a more targeted approach for data collection for this report (see section 2.2).

2.1 Scoping three regional case studies

An explorative case study methodology spanning the three regions was chosen that covered the two case study pollutants and the product life cycle associated with each. An explorative case study allows for exploring a phenomenon in context, using one or more data collection methods. In an explorative case study, the phenomenon explored is usually new or not well-known.

The selection of PFAS for the governance analysis in the NEA, BS regions and TWPs in the MED region was aligned with that of other SOS-ZEROPOL2030 work done in parallel, including the organisation of three regional Living Labs (Van Hulst et al., 2024). This allowed findings to be used more broadly and created the possibility of data triangulation. This selection was made at a project consortium meeting in Potsdam in October 2023. PFAS was selected for the NEA because of high stakeholder awareness and emergence of regional and national governance efforts, while the opposite is true for the BS. This allowed exploring two different perspectives for what is required at regional and national level to achieve the zero marine pollution objectives of the EU. TWP pollution was selected for the MED because awareness and insight into microplastic pollution exists, while the issue of TWP pollution is emerging.

The scoping of this assessment in terms of a sectoral and/or life cycle stage focus was finalised at a meeting in Wageningen in January 2024 with project partners. Criteria for identifying a specific sector included:

- salience - covering a significant source of pollution emissions
- geographical - having a tangible link to the regional sea
- life cycle stages - addressing interaction along the product chain
- policy relevance - link to policy developments living labs - the possibility for a constructive dialogue in the Living Labs
- project relevance - the potential broader applicability of lessons from the case study to other pollutants and the project objectives

The medical sector in the NEA region was selected because it would touch on policy debates of 'essential use', has a clear connection to the region and is specific enough to allow stakeholders to make the step from 'challenges' to 'criteria for change' in the living labs. For the BS region, the awareness level of PFAS is very low and there is limited knowledge about the sectors responsible for PFAS emissions in the region, making a sectoral approach difficult. For these reasons, we identified public administration (including monitoring) and the process of implementing revisions of EU directives (including Drinking Water Directive) as a focus. For TWP pollution, there are two stages in the life cycle where significant gains can be made: production of tyres (including design trade-offs and eco-friendly materials) and the end-of-pipe removal of TWPs through improved wastewater treatment facilities. These were both chosen to be able to cover key aspects of the pollutant life cycle.

To understand governance developments at national levels, we selected two EU Member States for each of the three regional seas. The Netherlands and France were chosen for the NEA region, as both countries have been relatively pro-active in their policy response to PFAS pollution and to reflect the Dutch representation in the Living Lab. Bulgaria and Romania were chosen for the BS region, as they are the only EU Member States located at the Black Sea, and to reflect participation in the BS Living Lab. Italy and France were chosen for the MED region, as both are home to significant car making industries and the associated tyre producers. An overview of the three regional case studies is given in Table 1.

Table 1 Overview of the scoping results of the three regional case studies

Region in Focus	Pollutant	Regional Convention	National focuses	Sectoral focus
North-East Atlantic	PFAS	OSPAR Convention	Netherlands & France	Medical
Black Sea	PFAS	Bucharest Convention	Bulgaria & Romania	Public Administration (monitoring & drinking water)
Mediterranean Sea	TWP	Barcelona Convention	France & Italy	Tyre production and wastewater treatment

2.2 Data collection and analysis

This work involved a comprehensive overview of the academic and grey literature on both TWPs and PFAS in the respective regions. The desk study, along with the review of work conducted in WP2, provided the overview of the existing research on the governance of both TWPs and PFAS in Europe (if any). Scholarly databases such as Web of Science and Google Scholar were queried using key words relevant to the research focus (i.e., Governance, Policy, PFAS, Tyre, Tire, Pollution, North-East Atlantic, Mediterranean Sea, Black Sea). In addition, a search of grey literature, including policy documents, news articles, and industry press releases provided another layer of verification as to the state of knowledge that is summarised in this report.

To gain further insight into developments in the 3 regions, we contacted various expert stakeholders for semi-structured interviews or personal communications (see Table 2). In the BS and MED regions especially, the lack of governance efforts for the respective pollutant resulted in difficulties in identifying relevant interviewees or information on the topic. In those instances we either had informal interviews or email-based correspondence where we posed several concrete questions to the individual experts. We refer to this as ‘personal communication’ in Table 2.

The sampling of respondents for personal communications or semi-structured interviews was purposive (i.e. based on the stakeholder/organisation’s expertise), knowledge available on the topic, and region the interviewee was focused on. This was combined with the snowball sampling method where we gained additional key contacts via previously conducted interviews. All interviewees officially consented to take part in the interview and were provided full GDPR compliance information on the project before taking part.

Table 2 Organisations interviewed or contacted for Task 4.4 in relation to the governance of PFAS or TWP

Organisation contacted	Date	Type of contact
PFAS in the North-East Atlantic region		
Dutch Ministry of Health, wellbeing and sport	12.03.2024	Personal communication
OSPAR Convention	22.04.2024	Personal communication
Union of Waterboards, NL	09-03-2024	Personal communication
Chemsec personal communication	20.03.2024	Personal communication
PFAS in the Black Sea region		
Black Sea Commission	29.05.2024	Personal Communication
Black Sea NGO Network	20.03.2024	Personal communication
Green Balkans	28.05.2024	Personal communication
Black Sea Advisory Council	29.05.2024	Personal communication
Danube Delta National Institute	29.05.2024	Personal communication
TWPs in Mediterranean Sea region		
MedWaves	11.03.2024	Personal communication
UNEP/MAP	22.04.2024	Semi-structured interview
	26.04.2024	Semi-structured interview
University of Barcelona	20.03.2024	Personal communication
PlanBleu	14.03.2024	Personal communication
Zero Waste France	09.04.2024	Personal communication
Sub-National Environmental Protection Agency	08.04.2024	Contacted, no response

For data collection, we also relied on three Living Labs held in 2024 in the context of WP3 of the SOSZEROPOL2030 project. Table 2 shows the location and date of the three living labs. A full report of these living labs was published in November 2024 (Van Hulst et al., 2024).

Table 3 Overview of the three Regional Living Labs

Regional sea	Living Lab location and date	Pollutant	Sectoral focus
North-East Atlantic	Utrecht (NL), 04-2024	PFAS	Medical applications
Black Sea	Varna (BG), 05-2024	PFAS	Public Administration (monitoring & drinking water)
Mediterranean Sea	Athens (GR), 11-2024	TWP	Tyre production and Waste Water Treatment

3 Emerging PFAS governance

3.1 Emerging PFAS governance in the EU

The EU has implemented various regulations and directives to address the production, use, and environmental impact of PFAS (for a complete overview see: Devriese et al. 2023; Van Leeuwen et al. 2023). These policies aim to set thresholds, control production, and mitigate the negative effects of some PFAS throughout their lifecycle. Much is currently in motion as the EU Chemicals Strategy for Sustainability (COM(2020) 667) is starting to be implemented to help achieve the aims of the zero pollution ambition for a toxic-free environment of the European Green Deal (European Commission 2020).

The most prominent action stemming from the EU Chemicals Strategy is a PFAS restriction proposal under REACH (Regulation (EC) No 1907/2006) that would restrict the use and placing on the EU market of all PFAS, with derogations for some applications (ECHA 2023). Several PFAS have already been banned and, in addition to the universal restriction proposal, REACH is processing restrictions on PFHxA and PFAS-containing firefighting foam. Moreover, the REACH regulation lists substances of very high concern, which include the commonly used PFAS GenX.

The EU implements a regulation on Persistent Organic Pollutants (POPs regulation) (Regulation (EC) 850/2004), transposing restrictions under the Stockholm convention², the Water Framework Directive (WFD (Directive 2000/60/EC), the Marine Strategy Framework Directive (MSFD) (Directive 2008/56/EC), and the Environmental Quality Standards Directive (EQSD Directive 2008/105/EC, that sets standards for ground-, surface- and seawater levels for priority substances, including some PFAS chemicals. This has implications for the monitoring of water and biota at the national level and for initiating actions when thresholds are passed. The European Food Safety Authority (EFSA) has set the threshold for Tolerable Weekly Intake for a group of PFAS that accumulate in the body to 4.4 nanograms per kilogram of body weight. The Drinking Water Directive (DWD) (Directive (EU) 2020/2184) includes thresholds for the 'sum of PFAS' of 0.1 µg/L for a group of 20 PFAS, or a 'PFAS total' of 0.5 µg/L for all PFAS, which will come into force in 2026. Finally, the Industrial Emissions Directive (IED) (Directive 2010/75/EU) will, following an ongoing revision, regulate some PFAS: i.e. PFOA and PFHxS.

3.2 Emerging PFAS governance in the North-East Atlantic region

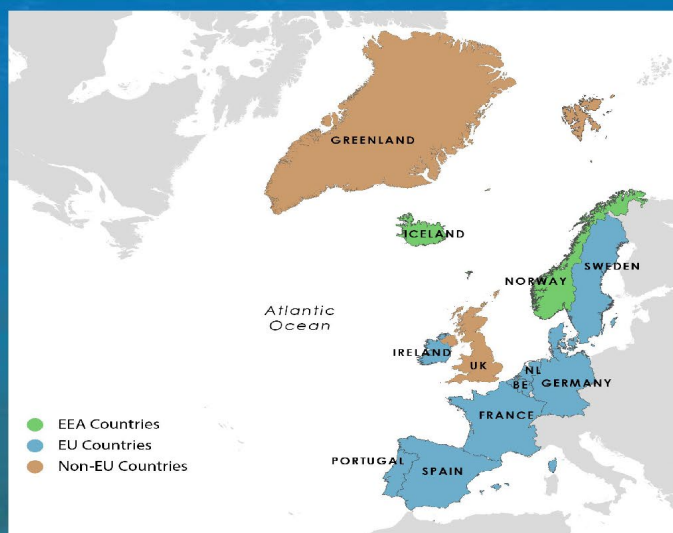
This section first provides a one-pager overview of the governance strategies and efforts related to PFAS in the North-East Atlantic region. This is further elaborated in the subsequent sections.

² Some PFAS are restricted under the Stockholm Convention, including PFOS (since 2009), PFOA (since 2020) and PFHxS (since 2022).

PFAS GOVERNANCE IN THE EU

The European Union, under the **European Green Deal**, aims to transform into a climate-neutral continent, which is accompanied by a **Zero Pollution Action Plan** as well as a **Chemicals Strategy for Sustainability**. Across various regulations and directives, the EU is beginning to address the production, use, and environmental impact of per- and polyfluoroalkyl substances (PFAS) (see also [D2.1](#) and [D2.2](#)).

These policies aim to mitigate the negative effects of PFAS throughout their lifecycle from source to sea through *inter alia* the chemicals registration and restrictions under REACH, various sector regulations including medical products, environmental thresholds in water, soil and air, establishing thresholds for food and drinking water, and supporting end-of-life and end-of-pipe innovation and governance.



NATIONAL LEVEL



- Examples from France and The Netherlands show proactive policy efforts at national level, coupled with strong involvement in EU PFAS restriction proposal and other emerging EU regulations.
- National approaches include: Environmental thresholds for soil and water (Fr, NI), partial manufacturing restriction (Fr), high-level policy objectives (Fr), National coordination across political mandates (NI), various sectoral initiatives (NI).

OBSTACLES



- **Fragmentation of responsibilities:** The scale of the challenge requires all levels of governance to act. Aligning change across these levels is a challenge.
- **Lack of consistent monitoring data:** Systematic monitoring data is absent and there is a reliance on industry data.
- **Limited product chain transparency:** Complexity and lack of transparency in product chain prevents informed and proactive decision-making.

BEST PRACTICES



- **High awareness:** Both at Regional Sea and National levels there is high awareness among stakeholders about risks of PFAS for human health and the environment.
- **Investment in remediation:** Countries in region already investing in remediation technology while working towards preventive interventions.
- **Apparent political will:** Across the various governance levels and stakeholder groups there is an apparent willingness to act with urgency.

Regional Sea: North-East Atlantic



- The **OSPAR Convention** supports PFAS governance through scientific assessments and monitoring, and source-based approach to addressing pollution.
- All PFAS have been added to the substance list for priority action, implying a minimalization obligation for PFAS emitting industries.
- OSPAR convention is characterized by close collaboration with MSFD, WFD and contracting parties.



INDUSTRY

- The organised chemicals, plastics and pharmaceutical industries are lobbying against stricter regulations at EU and National levels alike. Trade organisations cite 'essentiality' of PFAS for the green transition and shift attention from production to end-of-pipe innovation.
- Along specific product chains, often with public-facing brands, there is momentum towards PFAS-free product manufacturing.
- Health sector stakeholders including some manufacturers, hospitals, recycling companies are actively exploring circular and PFAS-free alternative product chains.

3.2.1 Regional sea level: OSPAR Convention

The OSPAR Convention for the protection of the Marine Environment of the North-East Atlantic (Figure 1), serves as a platform for cooperation in marine governance across 15 Governments and the European Union. While the latest Quality Status Report (2023) only makes brief mention of PFAS (OSPAR, 2023), the issue of emerging contaminants and in particular PFAS have received significant attention within OSPAR. Some PFAS are already being monitored: PFOS in coastal waters since 2023 and PFOS in fish and biota since 2018. The current monitoring strategy, however, has been updated to require measurement of 24 PFAS in water, which is in line with EQSD (OSPAR, 2024). For more details on the links between MSFD and OSPAR see Devriese et al. (2023). In November 2024, OSPAR formally decided to add all PFAS to the substance list of chemicals for priority action by the OSPAR Hazardous Substances and Eutrophication Committee. This list has recently been aligned with the priority lists under REACH and the EQSD and the MSFD/WFD (personal communication OSPAR, April 2024). This formal OSPAR Decision imposes legal obligations on the OSPAR Contracting Parties to minimize concentration levels. OSPAR has limited involvement in other EU policies (personal communication OSPAR, April 2024).

OSPAR monitoring is by definition concerned with governing PFAS from the end-of-life stage, but has several feedback mechanisms to individual countries if high concentration levels in the marine environment are found that require action (personal communication OSPAR, April 2024). OSPAR promotes the reduction of production and use of harmful chemicals in support of a more source-based approach, arguing for extending the principle of Extended Producer Responsibility to the marine environment (personal communication OSPAR, April 2024). While OSPAR also aims to engage industry stakeholders, it is unclear to what extent this is resulting in a meaningful reduction of PFAS emissions.

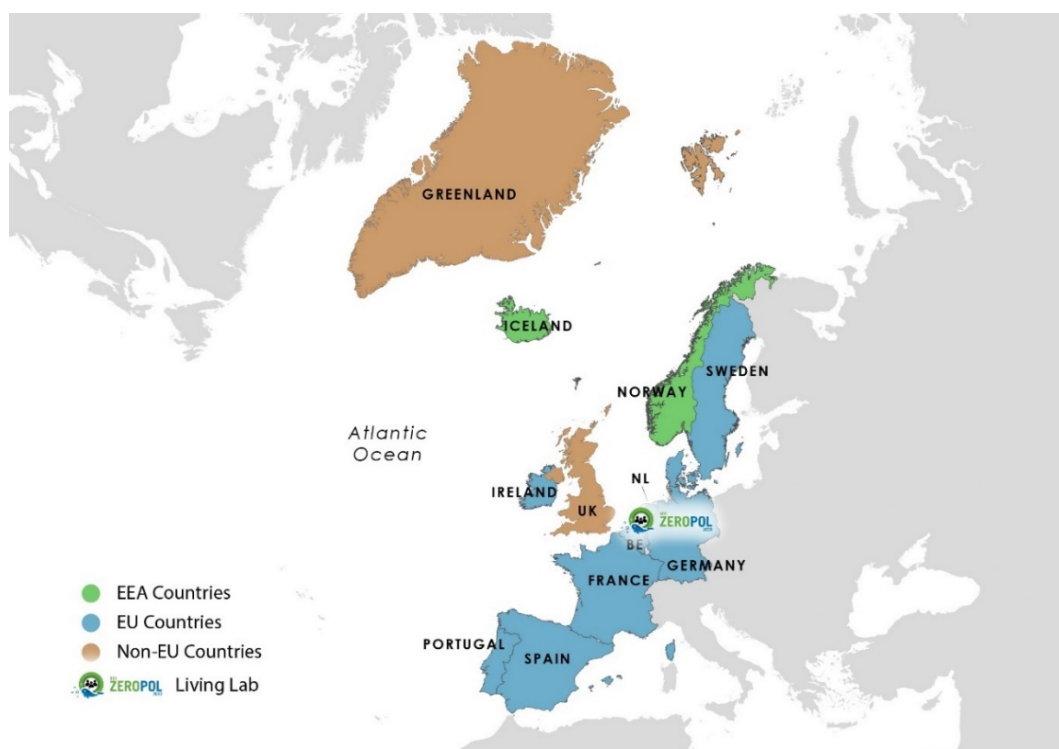


Figure 1 North-East Atlantic Sea, its bordering countries and the location of the NEA Living Lab

3.2.2 National level examples: France and The Netherlands

An analysis of surface water monitoring data in France, as reported by the European Environmental Bureau (Johansson, 2023), showed that PFAS pollution in France is widespread, but that monitoring is inconsistent across regions in the country. The precision of the analytical techniques to analyse PFAS in environmental samples also varied greatly and could be two orders of magnitude higher from one laboratory to another (Générations futures, 2023), indicating that PFAS monitoring is neither standardised across the EU nor across regions of individual EU countries.

In 2023, French authorities published an ambitious high-level strategic action plan against PFAS ('Plan d'actions Ministériel Sur Les PFAS' 2023), which solidifies the aim of setting new norms, strengthen enforcement, and improving monitoring and transparency. These are future-oriented policy ambitions, which in themselves do not introduce new standards or short-term measures.

In 2024, the French Parliament voted for a ban on the manufacture, import and sale of any cosmetic product, wax product (for skis) or clothing textile product containing PFAS substances from 2030, with the exception of protective clothing for safety and civil security professionals. Kitchen utensils, which were initially included in the ban, were removed from the list after MPs cited manufacturers' arguments over risks to employment (France 24, 2024). In addition to the national level measures in France, the government also supports the REACH restriction proposal. This National level restriction covers sectors for which alternative substances are available for most products, and will likely become obsolete if the EU restriction comes into effect.

The Netherlands is one of the five countries who, in 2022, submitted the PFAS restriction proposal under REACH. There are also national-level emerging regulations around PFAS, most of which transpose or implement EU regulations (e.g. PFAS thresholds for drinking water, food and food packaging). The most direct regulation of chemical producers and industrial users is happening through emission permits at council and province level, processes which have come under increased scrutiny following the discovery of high levels of PFAS near Chemours in Dordrecht.

In 2021, the Dutch Ministry for Infrastructure and Water led a multi-stakeholder process that resulted in 'handelingskader voor PFAS houdende grond', which establishes the principle that soil can only be moved to other locations (e.g. for construction work), if it will not increase levels of PFAS in the receiving location (Informatiepunt Leefomgeving, 2024). Previous thresholds set on PFAS in soil proved impractical due to high environmental PFOS and PFOA depositions, leading to a relaxation of the guidelines (Cousins et al., 2022).

In 2024, the Dutch Ministry of Health, Wellbeing and Sports is exploring avenues for a more rapid transition to PFAS alternatives specifically in medical applications, in response to an accepted motion in parliament (Minister for Medical Care, 2024).

The Dutch Regional Water Authorities ('Waterschappen') are a unique administrative layer in The Netherlands consisting of independent governmental organisations responsible for managing water resources. In recent years they are confronted with instances of high, and in some specific locations very high, PFAS pollution in waterways, and are strong advocates for a ban on PFAS and addressing pollution at the source. The Union of Water Authorities has also become stricter in the environmental permits they issue and support research

into removing PFAS from ground- and surface waters (Unie van Waterschappen, 2024b). Their priority, however, remains to address the sources of PFAS and other pollutants, for which they lobby at the relevant government ministries (personal communication Union of Waterboards, April 2024). The Union of Waterboards also sent an open letter to the responsible minister, calling for more urgent action on the issue of PFAS and making the case for a source-based approach to 'turn off the tap' on PFAS (Unie van Waterschappen, 2024a).

3.2.3 Industry examples

In the medical sector, there is a merger of interest between the powerful chemical industry and pharmaceutical industry lobbies at national, EU and global scales. They are joining forces in trying to achieve an exemption for the continued use of PFAS in new EU regulation. Both industry sectors appear very reluctant to take a leading role in any transition away from PFAS. Discourse analysis conducted by Van Leeuwen et al. (2023) demonstrated in detail the industry's power at the EU level and the discourse emphasising primarily the benefits of PFAS use, the technical difficulty of transitioning to alternatives, the essentiality of certain uses (e.g., in medical applications), and the time required for developing alternatives. Trade organisations are also representing national level industry stakeholders, ranging from producers of base chemicals, compounders involving fluoropolymers, industrial users and manufacturers, who lobby the European Commission through public consultations and through sector groups.

For public-facing brands and companies, however, there is an increased marketing incentive to remove PFAS from some of their products (personal communication Chemsec, April 2024). Indeed, an increasing number of brands are making commitments to going or being PFAS free, which is increasingly sought-after by consumers, and providing a competitive advantage (see Figure 2).



Figure 2 Members of the PFAS Movement, illustrating the increasing commitments from public-facing companies to 'go PFAS-free'. Image from Chemsec (<https://chemsec.org/pfas/#members-of-pfas-movement>).

Other industry stakeholders in the medical sector, such as hospitals, recycling companies, and waste treatment organisations, are more actively exploring circular and PFAS-free alternative products. In the PFAS product chain, the interests of producers of PFAS-free and more generally toxic-free products have the potential to align with those of the recycling industry. Both benefit from clear end-of-waste criteria, which are possible if waste products do not contain chemicals of concern³.

3.2.4 Obstacles and best practices / opportunities

The desktop study, interviews and NEA Living Lab resulted in the identification of obstacles and best practices towards prevention and mitigation of PFAS pollution in the NEA region.

Obstacles

Fragmentation of responsibilities

Responsibilities of public authorities in the governance of PFAS are often fragmented across local, national, regional and EU levels. In the case of France, the national-level approaches are already implementing strategies and restrictions that will come into effect ahead of similar interventions at the EU-level. The supra-national nature of chemical emission pathways and the need for a level economic playing field limits the scope of more localised or national governance, resulting in high reliance on, often slower, EU-wide approaches.

Lack of consistent monitoring data on PFAS

The governance of PFAS in the NEA region is made more challenging because of a distinct lack of systematic PFAS monitoring data. The OSPAR Convention has only recently (2024) incorporated systematic PFAS monitoring of the sea and some marine organisms. At the national level, monitoring is also highly variable between countries and shows in-country differences in the number of PFAS being measured, as well as monitoring accuracy and methodologies.

Limited product chain transparency

The investigation of PFAS in the medical product chains highlighted the challenge stakeholders face in identifying PFAS-containing products, and therefore choosing alternatives. The limited transparency across the very complex product chains prevents consumers and policy-makers from making informed decisions. Some also argue that the process of bringing new chemicals on the market is not sufficiently regulated and prioritises economic growth over wider societal and environmental values.

Best practices / opportunities

High awareness and apparent political will

Among all stakeholders in the NEA region, there is a high awareness of PFAS and a sense of urgency to take a position in relation to issue. Environmental and public health scandals have put PFAS firmly on the political agenda, where various ministries and institutions are calling for and exploring options to transition away from PFAS at local, national and international levels. While the industry lobby aims at securing derogations and postponing

³ Living Lab 23-24 April, Utrecht (organized as part of WP3)

stricter legislation, public-facing companies are already going 'PFAS-free' when alternative substances are available.

OSPAR Convention and regional collaboration

In the NEA region, there are various examples of effective regional collaboration. The restriction proposal under REACH is one example, which is a collective effort of ministries and environmental research agencies across five Member States. The OSPAR Convention is aligning monitoring with the EQSD and MSFD, and the source-based approach appears to be having some effect following the listing of all PFAS as substances for priority action. However, the extent to which this will actually contribute to reduced emission sources is uncertain.

3.3 Emerging PFAS governance in the Black Sea region

This section first provides a one-pager overview of the governance strategies and efforts related to PFAS in the Black Sea region. This is further elaborated in the subsequent sections.

PFAS GOVERNANCE IN THE EU

The European Union, under the **European Green Deal**, aims to transform into a climate-neutral continent, which is accompanied by a **Zero Pollution Action Plan** as well as a **Chemicals Strategy for Sustainability**. Across various regulations and directives, the EU is beginning to address the production, use, and environmental impact of per- and polyfluoroalkyl substances (PFAS) (see also [D2.1](#) and [D2.2](#)).

These policies aim to mitigate the negative effects of PFAS throughout their lifecycle from source to sea through *inter alia* the chemicals registration and restrictions under REACH, various sector regulations including medical products, environmental thresholds in water, soil and air, establishing thresholds for food and drinking water, and supporting end-of-life and end-of-pipe innovation and governance.



NATIONAL LEVEL



- Bulgaria and Romania's involvement in shaping EU PFAS policies is limited, potentially due to limited awareness of PFAS contamination in the Black Sea, despite evidence that contamination levels exceed EU standards.
- *National policies focus more on end-of-life measures*, like waste management, rather than PFAS production and use. This may be attributed to the limited understanding of the main sources and pathways of PFAS contamination in the region

OBSTACLES



- **Regional Challenges:** Ongoing geopolitical complexities in non-EU Black Sea countries may divert resources and attention from emerging pollutants like PFAS.
- **Emerging Awareness:** Knowledge about PFAS pollution is still developing among various stakeholders in the Black Sea region.
- **Limited Funding:** Insufficient financial resources for monitoring equipment and research obstruct efforts to address PFAS pollution.



BEST PRACTICES

- **Civil Society Empowerment:** At both national and EU levels could help push PFAS issues onto the political agenda and gain public engagement.
- **Regional Cooperation:** Strengthening the Black Sea Commission's funding and expertise could improve its ability to coordinate policy efforts
- **Cross-Regional Collaboration:** Promoting collaboration and info-sharing between EU Regional Seas can facilitate shared approaches to PFAS management.

Regional Sea: Black Sea



- The **Bucharest Convention** supports PFAS governance through scientific assessments, policymaker guidance, and regional actions to reduce pollutants.
- Collaboration with other European seas and adopting EU approaches are key to improving PFAS management, despite geopolitical challenges.

INDUSTRY



- Industry approaches to PFAS regulation in the Black Sea and Danube regions vary, with some expressing environmental responsibility but lacking transparency.
- Presumptive PFAS sources, including metal treatment and plastics companies, contribute to emissions, though specific data is limited.
- The chemical industry heavily influences EU PFAS policy, often resisting stricter regulations through lobbying.

3.3.1 Regional sea level: Bucharest Convention

The Bucharest Convention, the Regional Sea Convention on the Protection of the BS against pollution, is a framework of agreement between six Contracting Parties. Contrary to the OSPAR Convention, the EU is not a party to the Convention. From 2001 onwards the EU and the Black Sea Commission agreed on granting each other observer status, and accession of the EU as a Contracting Party to the Bucharest Convention is being considered. Through various protocols, the Convention aims to prevent, reduce and control pollution. Although its primary focus has been on preventing and controlling pollution from various sources, including hazardous substances, land-based activities and maritime transport, there is a growing recognition of the need to specifically address chemical pollutants like PFAS.

According to the Bucharest Convention's protocol on the protection of the Black Sea Against Pollution, it can contribute to the mitigation and regulations on PFAS in their region and wider EU by:

- Providing scientific assessments on PFAS contamination levels in the BS region.
- Informing EU and national policymakers about the state of the environment in the BS region.
- Promoting the reduction of harmful pollutants through coordinated regional actions (Black Sea Commission, 1996).

However, the Bucharest Convention faces challenges due to limited funding, lack of adequate human resources, and the diverse membership of Black Sea countries, the majority of which are not EU Member States (Figure 3). While the EU PFAS restriction proposal already creates pressure on EU Member States, the same is not true for non-EU countries bordering the BS. The ongoing invasion of Ukraine is explored as one instance of how a lack of compliance with pollution regulations makes governing a divided region difficult (Svetla Miladinova et al., 2023).



Figure 3 Black Sea region and its bordering countries and the location of the BS Living Lab

3.3.2 National level examples : Bulgaria and Romania

EU Member States, particularly Bulgaria and Romania in the BS region, could play a critical role in influencing EU policies on PFAS in the BS. Studies have shown that PFOS and PFOA are present in the BS, with PFOS levels exceeding the EU's Environmental Quality Standard (EQS) at multiple sampling locations (Lindim, et al., 2016; S. Miladinova et al., 2024). Despite this, NGOs and scientists expressed that they would like to see Bulgaria and Romania having a more prominent role in shaping EU PFAS policies that also put PFAS on the political agenda in these countries (discussion at Living Lab, May 2024).

In the BS region, the focus of national policies has largely been on the end-of-life stage rather than on the production and use of PFAS. This emphasis reflects the broader challenges of implementing comprehensive PFAS regulation, particularly in countries like Bulgaria and Romania, where the regulatory framework and enforcement mechanisms are still evolving. The EU DWD, which was revised in 2020 and expected to be implemented in 2023, is a key policy instrument designed to monitor and reduce PFAS levels in tap water across EU Member States. This Directive mandates that countries set thresholds for PFAS in drinking water, ensuring that the water supply remains safe for public consumption. These new requirements are not yet fully reflected in national regulations (Bulgaria, 2023; Romania, 2023).

In Bulgaria, there is a noticeable information gap regarding the specific steps taken to implement the DWD concerning PFAS. According to the latest updates, detailed information on Bulgaria's actions remains unavailable. However, this issue is expected to be addressed in future project reports, where the SOS-ZEROPOL2030 Living Lab coordinators for the BS region will follow up to provide a clearer picture of the national measures being undertaken. Similarly, Romania lacks detailed publicly available information on its implementation of the DWD in relation to PFAS. The regulatory and monitoring activities specific to PFAS under this Directive have not been comprehensively documented. While Romania's efforts to comply with the Directive's requirements are ongoing, their full scope and effectiveness remain unclear at the time of writing. During the Living Lab on the BS region, an interesting point was raised by the regional stakeholders in attendance, who stated that the countries lack the proper equipment and expertise to properly monitor PFAS drinking water, let alone the environment (Living Lab 28-29 May, plenary discussion).

Both Romania and Bulgaria are also parties to the International Commission for the Protection of the Danube River (ICPDR), which is a transnational body responsible for implementing the Danube River Protection Convention (DRPC). The Convention aims to address flood protection by sustainably managing water and reducing nutrient inputs and pollutant discharges, among others. The Commission harmonises water monitoring across the Danube countries in support of the WFD to achieve good water status. Their 2019 Joint Danube Survey also contains monitoring data for some PFAS (ICPDR, 2019).

While the EU has some established policies at the to manage PFAS, the translation of these policies into national regulations and actions in BS countries like Bulgaria and Romania is yet to materialise.

3.3.3 Industry examples

Industry approaches and initiatives in the BS and Danube regions significantly influence the emissions of PFAS. The Danube River, which creates the border between Bulgaria and Romania makes industry's role complex, involving both known and presumptive sources of PFAS emissions (Figure 4), each adopting varying levels of environmental responsibility and regulatory compliance. Little is known about industry approaches, beyond their generic environmental mission statement that rarely mention PFAS specifically but cite commitments to 'protect nature' and 'comply with laws and regulations' (see e.g. Maceplast, 2021). While these environmental statements create the possibility of some accountability, it has also been shown to have no direct correlation to a reduction in pollution (Dagiliene et al., 2020). Firefighting foam used at military sites in the region is another significant source of PFAS emissions across Europe (Sonne et al., 2023), although specific industry responses or mitigation efforts in the BS region lack concrete examples and require further investigation.

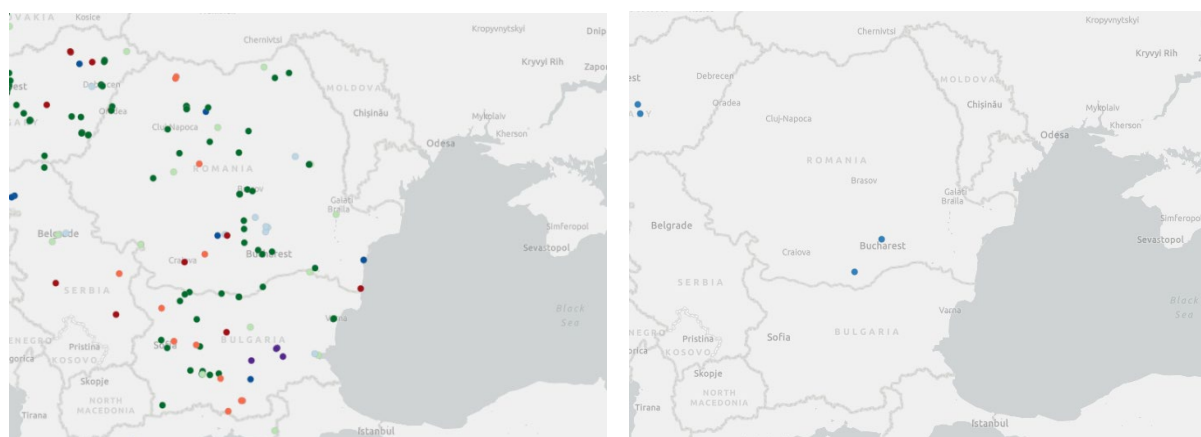


Figure 4 Presumptive (left figure) and known (right figure) industrial PFAS emission sources in the Black Sea region.⁴

Presumptive sources of PFAS emissions along the Danube include various companies engaged in metal treatment, paper manufacturing, and primary plastics production (Arendal, 2024). The manufacturing sites, being industrial users of PFAS chemicals, are likely point-sources of PFAS emissions, although specific data on their emissions and environmental practices are not readily available. Overall, industries in the BS region are characterized by a complex dichotomy, as only EU Member States are required to adhere to regulations limiting PFAS production and discharge.⁵

Similar to the NEA region, the chemical industry in the BS region plays a crucial role in influencing policies related to PFAS, particularly concerning production, use, and end-of-pipe management. Despite growing awareness of the health and environmental risks associated with PFAS, the industry has been criticised for obstructing regulatory

⁴ The dataset from the Forever Pollution Project distinguishes between 'known users', industrial sites with documented evidence of PFAS use, and 'presumptive users', sites where documentation is not available, but performed activities likely use PFAS (Arendal 2024).

⁵ Article 68 of the EU REACH Regulation

interventions (Van Leeuwen et al., 2024). Lobbying efforts are particularly focused on resisting changes to the REACH regulation regarding implementation of an ‘essential use’ principle and opposing universal restrictions on PFAS. The industry's influence on policy has sparked calls for greater transparency and a shift in regulations to prioritize public and environmental health over industrial interests (Gaber et al., 2023).

3.3.4 Obstacles and best practices / opportunities

In conjunction with the desktop study performed above and interviews with Living Lab participants, the following observations were made for the obstacles and best practices / opportunities to prevent and mitigate PFAS pollution in the BS region.

Obstacles

Political tension in the Black Sea region

The BS region comprises both countries inside and outside of EU jurisdiction (Ukraine, Turkey, Georgia and Russia) that do not adhere to EU policies and directives. The ongoing war in Ukraine has made the situation in the BS tense and placed pollution low on the political agenda. As a result, the Black Sea Commission (BSC) is not in a position to make proactive or ambitious monitoring or pollution-reduction interventions. This is true for established and well-documented issues like eutrophication, but even more so for emerging pollutants like PFAS. Nevertheless, the BSC continues to bring stakeholders together informally.

Lack of awareness and political priority

When bringing together NGOs, regional policymakers and academics to a Living Lab focused on PFAS in the BS region, it was found that citizen awareness and knowledge about PFAS and their environmental and health impacts is relatively low or even non-existent. As a result, there was limited national-level engagement. There is a need for capacity-building, and a more integrated approach to managing PFAS across all stages of their lifecycle, including production and use, to effectively mitigate the environmental and health impacts of PFAS in the BS region.

Limited monitoring and funding

Stakeholders indicate a significant lack of funding and institutional capacity for systematic monitoring to trace PFAS emissions and pathways in the BS region. This would require investing in equipment and capacity building of researchers at environmental research institutions to lay the foundation for informed decision-making and effective enforcement of legal environmental thresholds.

Best practices / opportunities

Civil society empowerment

Given the core challenge of limited knowledge and awareness of PFAS sources, pathways and impacts in the BS region, the role of civil society becomes very important. Environmental NGO staff often have strong research backgrounds and are at the forefront of raising awareness about the issue of PFAS. These civil society networks could help bring knowledge to the wider public to create support for interventions, even when they potentially impact important economic stakeholders. Strengthening civil society would require investment at both the national and EU levels to continue work and bring important topics such as PFAS pollution to the top of the political agenda

Regional collaboration

While the BSC is facing very challenging times, it is still an important platform for bringing together stakeholders to improve the environmental quality of the BS region. Supporting and strengthening the BSC would enable the fostering of stronger transnational linkages, both formally and informally, and keep pollution on the political agenda. Monitoring and collaboration in the context of the ICPDR is also a good example of regional collaboration, which could help harmonise source to sea governance. While monitoring is essential, it remains a priority to also address sources of PFAS emissions along product life cycles.

Cross-regional collaboration

Given the ongoing efforts to align agendas and monitor PFAS pollution, even amid challenging circumstances such as the war, there is a significant opportunity to expand collaboration between regional sea commissions/bodies, including the BSC, OSPAR and UNEP/MAP. Despite the geopolitical challenges, informal discussions continue to foster mutual understanding and cooperation. Strengthening cross-regional ties would enhance knowledge sharing, best practices, and harmonization of governance approaches, particularly for pollutants like PFAS.

4 Emerging TWP governance in the Mediterranean Sea region

This section first provides a one-pager overview of the governance strategies and efforts related to TWPs in the Mediterranean Sea region. This is further elaborated in the subsequent sections.

TWPs GOVERNANCE IN THE EU

The EU has developed various regulations and directives to address microplastic pollution and TWPs (Tyre Wear Particles) emissions throughout the tyre's lifecycle, including tyre design and use, as well as through capture and removal of TWPs in wastewater treatment (See D2.1). These policies include the Ecodesign for Sustainable Products Regulation (ESPR), which sets eco-design requirements, the Euro 7 regulation, which will introduce tyre abrasion thresholds, and the revision of the Urban Wastewater Treatment Directive (UWWTD), establishing monitoring obligations for microplastics. Described below is an overview of policies influencing TWPs governance in the Mediterranean Sea.

NATIONAL LEVEL

- France and Italy shape EU policies through participation in EU processes and implementation of the ESPR, Euro 7 regulation and UWWTD.
- *National policies focus more on single-use plastic measures, rather than TWPs production and remediation measures.*

OBSTACLES

- **Multilevel Challenges:** Different regional priorities from EU and non-EU Mediterranean Sea countries reveals divergence in resources and attention on emerging pollutants like TWPs.
- **Emerging Awareness:** While microplastics are well-recognized, knowledge about TWPs pollution is still developing among various stakeholders in the Mediterranean Sea region.
- **Limited Data:** Insufficient data and detection methods for monitoring and research hinder efforts to address TWPs pollution.

BEST PRACTICES

- **Make use of microplastic knowledge and awareness:** The Mediterranean Sea region is one of the most studied regions for microplastics. Building on this, civil society can help push TWPs onto the political agenda, both at national and regional level.
- **Increased Cooperation:** Promoting cooperation and information exchange among the Mediterranean Sea region and between EU Regional Seas to facilitate shared approaches to TWPs management.
- **Focus on Improved Tyre Design and Technical Innovation:** Strategies prioritizing sustainable tyre design and particle retention approaches, as well as technical innovation of wastewater treatment plants present viable options for reducing TWPs.



REGIONAL SEA: MEDITERRANEAN

- **The UNEP/MAP-Barcelona Convention** supports microplastic regulation through scientific assessments, guidance, and regional actions to reduce pollution.
- The legally binding Updated Regional Plan for Marine Litter Management defines TWPs as secondary microplastics.
- Guidelines for monitoring microplastics coming from wastewater treatment plants are underway.

INDUSTRY

- The tyre, car and chemical industry strongly influence the EU policy process, through lobbying at EU level and engaging in developing a tyre abrasion measurement method.
- Industry initiatives include the European Tyre and Road Wear Particles Platform, as well as participation in Horizon Europe Projects, which contribute to the assessment and measurement of TWP emissions.
- Individual tyre manufacturers explore alternative materials and chemical formulations to improve tyre design. While some manufacturers express environmental responsibility, a general and transparent approach for improved tyre design and chemical composition is still lacking.

4.1 EU and regional sea level: Barcelona Convention

The EU has developed different regulations and directives directly or indirectly addressing TWPs, including tyre production and wastewater treatment (Van Leeuwen et al., 2023).

- The Euro 7 regulation (Regulation (EU) 2024/1257) sets thresholds for abrasion limits from tyres (European Commission, 2022a).
- The Industrial Emissions Directive (IED) (Directive 2010/75/EU) sets emission standards on the production of synthetic rubber used in tyre manufacturing processes (European Commission, 2010).
- The Registration, Evaluation, Authorisation and Restriction of Chemicals regulation (REACH) (Regulation (EC) 1907/2006) requires tyre manufacturers and importers to register products and to provide information on substances used in tyre manufacturing processes (European Parliament and Council, 2006).
- The Ecodesign for Sustainable Products Regulation (ESPR) (Regulation (EU) 2024/1781) sets minimum eco-design requirements, which will be developed for tyres under the ESPR first working plan of the European Commission (European Parliament and Council, 2024).
- The Tyre Labelling Regulation (Regulation (EU) 2020/740) sets information requirements to be reflected on tyre labels based on tyre performance standards, including safety and energy-efficiency, which have to be fulfilled by tyre manufacturers when placing a tyre on the market (European Parliament and Council, 2020).
- The end-of-pipe stage includes measures such as monitoring at the inlets and outlets of urban wastewater treatment plants and in sludge as per the revised UWWTD (Directive 91/271/EEC; European Commission, 2022b).
- The Water Framework Directive (WFD) (Directive 2000/60/EC) requires the monitoring of water quality and defining environmental quality standards (European Parliament and Council, 2000).

Regarding the MED regional level (Figure 5), there is currently no regulation explicitly addressing TWPs (Interview UNEP/MAP, April 2024). However, Parties to the 22nd COP of the Barcelona Convention decided to include TWPs under the definition of secondary microplastics in the amendment to the Regional Plan for Marine Litter Management (Barcelona Convention, 2021). Furthermore, guidelines for monitoring microplastics coming from wastewater treatment plants are being developed (Interview UNEP/MAP, April 2024).



Figure 5 Mediterranean Sea, its bordering countries and the location of the Mediterranean Living Lab

4.2 National level examples: France and Italy

Both EU Member States do not have specific regulations addressing TWP in place, nor are TWPs being monitored systematically. Under the EU's Plastics Strategy and its associated legislation, EU Member States are urged to create incentives for the use of energy-efficient and safe tyres. Italy implements the UWWTD and WFD through legislative decree 152/2006. As a consequence, the monitoring of microplastics and the assurance of optimal water quality at the national level are in accordance with EU policy developments pertaining to the incorporation of microplastics into the revised UWWTD and the WFD. The same applies to France, which, in addition, has introduced the 2020 Anti Waste and Circular Economy Law (loi contre le gaspillage et pour l'économie circulaire) as a regulatory framework governing the management of tyre waste. In its revision, the EPR system was applied to the tyre sector and the decree of 2023 specifies the methods for managing tyre waste and the conditions for implementing the EPR obligation for producers concerning the collection, reuse and recycling of tyre waste (Ministry of Ecological Transition and Territorial Cohesion, 2024). The French National Roadmap against Marine Litter "Zero Plastic Reaching the Sea 2020-2023" focuses on preventing plastic pollution from land, in rivers, wastewater, sea and on beaches, as well as raising awareness through educational programmes (World Resources Institute, 2022).

Both Italy and France, together with five other EU countries, initially delayed the implementation of the Euro7 proposal due to negative effects on investments in the automotive sector (Ainger, 2023). In 2023, France was part of a joint statement urging the European Commission to acknowledge that microplastic pollution is a cross-border challenge that requires ambitious EU legislation and measures included in an upcoming United Nations treaty to end plastic pollution. They also recommended TWPs should be incorporated into other EU policies, including eco-design rules, the Waste Framework Directive, the Single-Use Plastics Directive and the Packaging Waste Law.

4.3 Industry examples

Industry involvement is defined by the lobbying of tyre and car manufacturers, who are represented through different trade organisations at the EU level, including the European Tyre and Rubber Manufacturers Association (ETRMA), the European Tyre and Rim Technical Organization (ETRTO), the European Automobile Manufacturers Association (ACEA), the European Council for Automotive R&D (EUCAR). The organisations are actively present in technical groups and public consultations (Van Leeuwen et al., 2023). The tyre industry, represented by the ETRMA at EU level, is actively engaged in developing a tyre abrasion measurement method. Examples of industry initiatives include the European Tyre and Road Wear Particles Platform, Horizon Europe Projects (e.g. LEON-T project), national projects (e.g. Life Blue Lakes in Italy), which contribute to the measurement and mitigation of TWP emissions.

Regarding tyre composition, individual tyre manufacturers or together with Original Equipment Manufacturers and stakeholders, such as startups or engineering companies have explored the use of recycled or renewable raw materials for improved tyre design (Van Leeuwen et al., 2023). This includes innovations, such as enzymatic recycling of plastics and renewable filler materials (ibid.; UPM Biochemicals, 2024). The French tyre manufacturer Michelin developed a system for analysing TWPs that is complementary to the Euro 7 standard (Michelin, 2024).

4.4 Obstacles and best practices / opportunities

Based on the above desktop study, semi-structured interviews and the MED region Living Lab held in Athens 19-20 November 2024, several observations can be made concerning best practices and obstacles to prevent and mitigate TWPs pollution in the MED region. These include technical, regulatory and social factors, and are outlined below.

Obstacles

Multilevel Challenges

The MED region displays differences in regulations, mitigation measures, road infrastructure and the use of vehicle types, all of which represent relevant factors for effectively addressing TWP emissions and pollution. Furthermore, the MED region consists of non-EU and EU members (Figure 5). As such, legal obligations among non-EU and EU Mediterranean Sea countries differ in adhering to EU policies and policy developments on emerging pollutants like TWPs. While there is some momentum in TWP policy processes at the EU level, there are fewer initiatives materialising at the regional or national levels. The ongoing conflict in the Israel-Palestine-Lebanon region of the MED can also be expected to impact the priority setting of emerging pollution issues in the region.

Emerging awareness and limited data

Awareness and knowledge specifically about TWP pollution is currently limited among various stakeholders in this region. In this vein, MED Living Lab participants highlighted the importance of raising the general awareness of TWP emissions and pollution and the need for further research on the topic. There is insufficient data and a lack of robust and

harmonized detection methods for monitoring and research, which hampers understanding the extent of the TWP threat and hinders efforts to effectively address TWP pollution.

Best practices / opportunities

High microplastic knowledge and awareness

There is extensive knowledge and awareness around microplastics in the MED region through existing studies, monitoring, research and policy developments. This includes the definition of microplastics under the legally binding Barcelona Convention Updated Regional Plan for Marine Litter Management in the Mediterranean. Building on this, civil society can help push TWPs onto the political agenda, both at the national and regional levels.

Existing cooperation and alignment

Building on the longstanding cooperation at the UNEP-MAP/Barcelona Convention level among MED countries, promoting cross-regional collaboration and information sharing between Regional Sea Conventions can further facilitate and harmonise approaches for TWP management. Furthermore, using a common language on TWPs can support the alignment of developments at the EU and Barcelona Convention levels. For example, the Barcelona Convention currently considers TWPs as secondary microplastics, while the EU defines TWPs as microplastics that are unintentionally released and as part of primary microplastics.

Focussing on improved tyre design and technical innovation

Strategies prioritizing sustainable tyre design and particle retention technologies were emphasized during the MED Living Lab, including standardization in tyre manufacturing across regions, and a name-and-praise approach by implementing a public reporting system where companies that are leading the way in reducing TWPs emissions or developing sustainable tyre technologies are celebrated and recognized. Furthermore, technical innovation of wastewater treatment plants has the potential to support TWPs removal. Building on this, MED Living Lab participants highlighted the importance of testing mitigation strategies rigorously for potential side effects across different environmental settings and scales before large-scale implementation.

5 Conclusions

This report provides an overview of governance efforts at the EU, regional and national levels, as well as industry and civil society responses to increased concern over PFAS and TWPs. In line with the source to sea approach in the SOS-ZEROPOL2030 project, we consider the various sources and emissions along the life cycle stages of the two products. Given the emergent nature of the governance arrangements of PFAS and TWPs, we provide an early assessment of the challenges and best practices across EU regions that can help to achieve the European Union's long-term ambition of 'Zero Pollution' in European seas.

5.1 Regional differences in emerging governance of PFAS and TWPs

Our governance analysis points to distinct regional and national differences. Below we explore five themes to understand similarities and differences between regional governance efforts of PFAS and TWPs.

The level of stakeholder **awareness** of PFAS and TWPs varied greatly between regions. In the NEA region, high awareness on PFAS is evident across public, private and civil society stakeholders alike. This is partly explained by the fact that the primary PFAS hotspots and major PFAS producers are concentrated in this region (i.e. Denmark, Belgium). In contrast, there was minimal awareness on PFAS exposure, emissions and risks among stakeholders in the BS region. Civil society actors, such as environmental NGO's, will be essential for creating awareness and providing support for political action. In the MED region, microplastics are relatively well studied and microplastics governance is starting to emerge. However, awareness of the emissions and risks of TWPs specifically is currently limited.

The **capacity for systematic monitoring** of pollution requires governmental oversight and policy, as well as significant funding for equipment and human resources that are currently not in place in the BS region. Monitoring programmes in the NEA are typically supported with more resources and already include selected PFAS and microplastics. Monitoring of PFAS and microplastics is also already taking place in the MED region. In both the NEA and MED regions, microplastic monitoring could be further extended to specifically include TWPs and example tyre chemicals.

Industry responses to the emerging issues of PFAS and TWPs are diverse. The more organised primary production components of the product chain are very aware of the potential environmental and human health issues, but are strongly lobbying against regulations to ensure PFAS production and tyre production remain unaffected, focusing instead on remediation solutions. Along the value chain there is limited transparency on chemicals in products, posing challenges to manufacturers, intermediaries and consumers. A growing number of primarily public-facing industries and brands are trying to move away from PFAS in their products, especially as many alternatives already exist for a wide range of consumer products. As methodologies for identifying and quantifying TWPs in environmental samples and labelling requirements for tyres are not yet institutionalised, tyre producers cannot yet position themselves as frontrunners regarding TWPs awareness and product innovation.

Political action in the NEA region can be characterised as polycentric, with a wide range of governance efforts emerging across levels. For example, the countries who submitted the EU PFAS restriction proposal are all from the NEA region. In the BS region, national level political action takes the shape of implementing revisions of EU directives, such as the upcoming DWD monitoring requirements. There is currently no TWP governance at the national and regional levels in the MED, at least partly due to a lack of EU regulation. Regional stakeholders do engage in EU policy processes and indirectly address TWPs under wider microplastics reduction efforts.

The level of **regional coordination** between the Regional Sea Conventions and the emerging governance of PFAS and TWPs at the EU level (e.g., MSFD and WFD) varies considerably. This is linked to the higher proportion of non-EU Contracting Parties for the Barcelona and Bucharest Conventions relative to the OSPAR Convention (Van Leeuwen et al., 2012). Regional governance integration is emerging for the NEA region, where monitoring expertise at the OSPAR Convention level is utilised to establish and update concentration levels and thresholds in EU regulations. The PFAS restriction adopted by the French Parliament can be seen as an example of governance overlap, considering that an EU restriction is currently being discussed. As PFAS governance is emerging at many levels simultaneously, integration through overlaps will likely emerge. For the governance of TWPs in the MED region and PFAS governance in the BS region, we find lower awareness of these pollutants and also less momentum compared to governance developments at the EU level. The ongoing war in Ukraine has severely affected the potential for formal regional coordination through the Bucharest Convention. Nevertheless, informal coordination functions of the BSC continue to play an important role. Furthermore, monitoring and collaboration in the context of the ICPDR is a good example of regional collaboration, which could help harmonise source to sea governance of emerging pollutants.

5.2 Recommendations for strengthening regional governance of PFAS and TWPs

Through our analysis we have identified the following recommendations for strengthening regional governance of PFAS and TWPs to help achieve the European Union's long-term ambition of 'Zero Pollution' in European seas.

Recommendations for regional governance of PFAS in the North-East Atlantic region

While awareness on PFAS is high among most stakeholder groups in the NEA region, improving supply chain transparency is recommended to increase understanding and therefore the ability to address pollutants of emerging concern like PFAS. If manufacturers, retailers, consumers, policymakers and researchers have better insight into which chemicals are present in materials and products, they can make more informed decisions. This requires a new balance between ensuring intellectual property rights and market advantages remain protected, while information about the impacts on human health or the environment become more widely accessible. While PFAS monitoring strategies are being implemented, there is a need to strengthen polluter pays principle and a source-based approach to addressing pollution. In parallel to the various policies, production restrictions and regulations being prepared at the EU level, the EU should encourage the best practices that are already happening at other levels. The example of France shows that Member States can become frontrunners in restricting certain applications of PFAS. The EU should also leverage and amplify the movement of PFAS-free alternatives, already rapidly growing, and seek synergies with industries such as recycling that can accelerate a transition to a pollution-free and circular economy.

Recommendations for regional governance of PFAS in the Black Sea region

There is a need to enhance capacity for systematic source to sea monitoring in the BS region. This is essential for the implementation of updated EU regulations (for example in relation to PFAS thresholds in drinking water). This could also include enhancing cooperation across regional sea conventions, as OSPAR already has more experience in monitoring and addressing land-based sources of pollution. Strengthening the resources of the BSC would also help coordinate governance efforts and best practices in the region. Given the generally low awareness of PFAS in the BS region, there is an opportunity to build on and strengthen the existing network of civil society stakeholders to create awareness, for example through citizen science projects.

Recommendations for regional governance of TWPs in the Mediterranean Sea region

Governance measures to effectively tackle TWP pollution need to consider TWP sources in addition to solely addressing TWP emissions and release. As such, different governance approaches and best practices should be considered, ranging from EU, national, and Regional Sea Convention levels in the design and implementation of TWP-relevant policies that also address tyre design and abrasion. The EU should encourage technical innovation in the tyre producing industry and in start-ups to develop materials that are less polluting, as well as seeking synergies with industries such as recycling that can accelerate a transition to pollution-free and circular economy. Developing a source to sea governance approach that addresses various sources and sites of pollution requires enhanced coordination through actions such as TWP working groups, regular forums or stakeholder platforms for dialogue between EU representatives and Regional Sea Convention bodies. This will provide platforms for sharing TWP updates, conflicting policies, challenges and

best practices, as well as for addressing specific issues affecting different levels of governance.

5.3 Recommendations for research

There is a rapidly growing body of research on TWPs and PFAS (Booth et al. 2024; Ruhl et al. 2024) that helps our understanding of the sources, impacts and pathways of these pollutants. However, it is too early to fully assess the governance arrangements that are evolving in response to this expanding knowledge base and the increasing awareness of the threat posed by marine pollution from these pollutants. It is especially unclear how new scientific insights will affect and shape decision-making processes at the regional and national levels. Therefore, an important research question for future actions is: What type of data and knowledge would support decision-making and how can an improved understanding lead to actual change in production and emission sites ‘turning off the tap’. In addition, there is a need to track development of governance arrangements that are emerging, and the respective roles and power of stakeholders. The dual role of industry needs to be better understood and appreciated in relation to policy levers, as industry is both lobbying very effectively against regulation, but also has leading innovators that are indispensable for the green transitions. Finally, research is needed into how the interplay between EU, Regional Sea Convention and national efforts shapes the way emerging marine pollutants are governed and emissions are reduced.

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