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D5.8 - Modular recommendations for evaluation and implementation of relevant EU directives, strategies and action plans

Main authors: **Julia Hartmann (RIVM), Petra A.M. Hogervorst (RIVM), Peter Behnisch (BDS), Amélie Cavelan (BRGM), Julie Lions (BRGM), Carme Bosch (EURECAT), Adriana E. Sardi (INERIS), Pierre Boucard (INERIS), Sandrine Andres (INERIS), Valeria Dulio (INERIS), Veronika Zhiteneva (KWB), Steffen Kittlaus (TU WIEN), Matthias Zessner (TU WIEN), Millaray Sierra Olea (DECHEMA), Kaitlyn Carter (DECHEMA)**
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Executive Summary

Persistent, mobile, and potentially toxic (PM(T)) substances, such as many per- and polyfluoroalkyl substances (PFAS), are substances that are not or hardly degraded in the environment, prone to spread across water, soil, and sediment systems, and that may negatively impact human and environmental health. The importance of regulating these substances has first been acknowledged in the amended Classification, Labelling and Packaging (CLP) Regulation (EC) 1272/2008 that came into force on April 20th 2023 and includes PMT and vPvM (very Persistent and very Mobile) as new hazard categories. Furthermore, addressing these substances is a critical component of the European Union's (EU) sustainability agenda, including the Green Deal, Circular Economy Action Plan (CEAP), Zero Pollution Action Plan (ZPAP), Chemicals Strategy for Sustainability (CSS) and the EU Soil Strategy.

However, the current regulatory landscape for PM(T) substances is fragmented and complex, with different environmental compartments – soil, sediment, water, sludge – regulated under separate policies. Given the environmental persistence and mobility of PM(T) substances, no single stakeholder or regulation can address the problem alone: a coordinated, multi-stakeholder approach is essential for achieving effective and sustainable solutions. Examples of current regulatory misalignment are differing or even completely missing threshold values for PM(T) substances across regulations and matrices. Policy updates, improvements of and additions to current regulations are urgently needed to ensure harmonized management of PM(T)s across the soil-sediment-water system and to achieve the EU's circular economy and zero pollution ambitions.

The PROMISCES project aims to develop innovative, systemic solutions to protect health, environment, and natural resources from PM(T) substances by addressing regulatory gaps and promoting circular economy principles. This deliverable, **D5.8 – Modular recommendations for evaluation and implementation of relevant EU directives, strategies and action plans**, in particular seeks to:

- Identify inconsistencies, gaps, and challenges within the existing EU legal and policy framework related to PM(T) substances.
- Promote harmonized regulatory approaches across environmental compartments.
- Provide EU and national policymakers with actionable, evidence-based policy recommendations to improve the management of PMT(s) in the soil-sediment-water system (and beyond).
- Emphasize that updated policy approaches address disparities and technical, financial and social challenges across Member States (MS).

To ensure a structured and actionable approach, PROMISCES formulated nine key recommendations for EU and MS policymakers that are:

Aligned with five key EU policy frameworks to enhance regulatory coherence, namely

1. Circular Economy Action Plan (CEAP)
2. Zero Pollution Action Plan (ZPAP)
3. EU Chemicals Strategy for Sustainability (CSS). This includes the Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation ((EC) No 1907/2006), Industrial and Livestock Rearing Emissions Directive ((EU) 2024/1785) and the Safe and Sustainable by Design (SSbD) framework ((EU) 2022/2510).
4. EU Soil Strategy (EU Soil)
5. EU Water Directives and Regulations (EU WFD). This includes the Water Framework Directive (2000/60/EC) and its daughter directives (the Groundwater Directive (2006/118/EC) and the Priority Substances Directive (2013/39)), as well as related policies, such as the Drinking Water Directive ((EU) 2020/2184), Water Reuse Regulation ((EU) 2020/741), Urban Wastewater

Treatment Directive ((EU) 2024/3019), Sewage Sludge Directive (86/278/EEC) and the Environmental Quality Standards (EQS) Directive (2013/39/EU).

Classified as either overarching or specific recommendations, where

1. Overarching recommendations evaluate the *alignment and coherence* of the various EU policy frameworks and propose suggestions for harmonization.
2. Specific recommendations address the process of *implementation* of existing policy by providing information that is relevant for risk managers, water operators, etc**.**

Mapped to four policy fields to help policymakers identify priority areas for action. These policy fields are

1. Regulating Substances.
2. Circular Resource Management.
3. Technology Performance and Pollution.
4. Tools and Data Management.

Overview of PROMISCES policy recommendations, their classification type, their alignment with the 5 EU policy, legal and regulatory frameworks and the level at which they should be enacted – EU/MS (combination of Table 1 and Table 4 from this report).

#	PROMISCES Policy Recommendation	Type of Recommen-dation	Relevant Policy Framework					Implemen-tation	
			CEAP	ZPAP	CSS	EU Soil	EU WFD	EU	MS
Regulating Substances									
1	Member States Competent Authorities (MSCAs) should prioritize setting emission limit values as low as reasonably achievable for substances that are (potentially) PMT or vPvM and difficult to remove from soil, sewage sludge, sediment and water.	Specific							x
2	The European Chemicals Agency (ECHA) and MSCAs should request users and producers of potentially persistent, mobile, and/or toxic intermediates to provide sufficient comprehensive data on their physicochemical properties and toxicity to ensure these substances are properly assessed and regulated under the PMT/vPvM classification framework established by the CLP Regulation.	Specific						x	x
Circular Resource Management									
3	The EC should align the list of regulated persistent, mobile, and/or toxic compounds between soil, sewage sludge, sediment and water to increase the safe circular use of these resources.	Overarching						x	
4	To ensure the circularity of resources, the EC should coordinate the processes for selecting substances for the Surface Water Watch List and the Groundwater Watch List with Regulation (EC) No 2024/2865 on Classification, Labelling, and Packaging of Substances and Mixtures (CLP) and initiate a watch list for wastewater, soil, and sewage sludge.	Overarching						x	

#	PROMISCES Policy Recommendation	Type of Recommen-dation	Relevant Policy Framework					Implemen-tation	
			CEAP	ZPAP	CSS	EU Soil	EU WFD	EU	MS
5	The EC should require emission modelling of PM(T) and vPvM substances into surface waters on the catchment scale, and modelling of transport via surface water into groundwater, to identify knowledge gaps regarding emission sources and pathways, enable risk assessment on entire river basins, and facilitate scenario evaluation.	Overarching							X
Technology Performance and Pollution									
6	The EC should establish evaluation criteria for technology providers to evaluate treatment technologies for soil, water, sediment and sludge, and require technology providers to report these criteria.	Overarching						x	X
7	To achieve the Green Deal's ambition for a toxic-free environment, the EC should consider non-animal based methods, such as PFAS CALUX, as an information source for risk assessment and management of PFAS.	Overarching						x	
Tools and Data Management									
8	The EC should make PROMISCES tools and information from the PROMISCES Decision Support Framework (DSF) available to industry for the effective implementation of the Safe and Sustainable by Design (SSbD) framework in addition to the SSbD Toolbox.	Specific						x	
9	The European Parliament should support the approval and implementation of proposal COM/2023/779 and ensure interoperability with existing substances data infrastructures developed by the scientific community.	Specific						x	

Beyond these nine recommendations, PROMISCES highlights key challenges that impact the effectiveness of PM(T) management across the EU. These include:

- Disparities among MS in monitoring, analytics, watch lists and risk assessment, leading to gaps in data availability and regulatory implementation. We highlight suggestions and best practices, or "leapfrog recommendations", to address these disparities.
- Boundary conditions that shape the feasibility, implementation, and sustainability of management practices. These conditions include financial considerations, such as the costs of advanced treatment technologies and analytical testing; knowledge sharing aspects, such as mechanisms for sharing data and best practices across MS; and social dimensions, such as public awareness and perception of risks associated with these substances and acceptance of solutions.

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List of Abbreviations

ALARA	As low as reasonably achievable
6:2 FTS	6:2 Fluorotelomer Sulfonic Acid
8:2 FTS	8:2 Fluorotelomer Sulfonic Acid
BATs	Best Available Techniques
BREFs	BAT reference documents
CALUX	Chemical Activated LUciferase gene eXpression
CEAP	Circular Economy Action Plan
CIS	Common Implementation Strategy
CLP	Classification, Labelling, and Packaging of Substances and Mixtures
CS	Case Study
CSRD	Corporate Sustainability Reporting Directive
CSS	Chemicals Strategy for Sustainability
DMSO	Dimethyl Sulfoxide
DSF	Decision Support Framework
DWD	Drinking Water Directive
EAOP	E-Peroxone Based Electrochemical Advanced Oxidation Process
EC	European Commission
ECHA	European Chemicals Agency
EEA	European Economic Area
EFSA	European Food Safety Agency
EQS	Environmental Quality Standards
EU	European Union
FAIR	Findable, Accessible, Interoperable and Reusable
GWD	Groundwater Directive
GWWL	Groundwater Watch List
HBGVs	Health-Based Guidance Values
HRIV	Health-Related Indicator Value
IED 2.0	Industrial and Livestock Rearing Emissions Directive
iPM(T)	Industrial persistent, mobile and potentially toxic
JRC	Joint Research Council
LOQ	Limit of Quantification
MoRE	Modeling of Regionalized Emissions into Water Bodies
MS	Member States
MSCA	Member State Competent Authorities
MSCAs	Member State Competent Authorities
NDS	NORMAN Database System
NAMs	New Approach Methodologies
OS/OA	One Substance, One Assessment Framework
PEQ	PFOA Equivalent
PFAS	Per- and polyfluoroalkyl Substances
PFHxS	Perfluorohexanesulfonic acid
PFNA	Perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PM(T)	Persistent, Mobile and potentially Toxic

QSARs	Quantitative Structure-Activity Relationship Models
REACH	Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals
SSbD	Safe and Sustainable by Design
SSD	Sewage Sludge Directive
SWWL	Surface Water Watch List
TFA	Trifluoroacetic Acid
TRL	Technology Readiness Level
TRVs	Threshold Values
uPBTs	ubiquitous, persistent, bioaccumulative and toxic substances
UWWTD	Urban Wastewater Treatment Directive
vPvM	very Persistent and very Mobile
WFD	Water Framework Directive
WHO	World Health Organization
ZPAP	Zero Pollution Action Plan

List of Relevant EU Directives, Regulations, Policies, Laws

Biocidal Products Directive / Biocides Directive	(EU) 528/2012
Classification, Labelling and Packaging (CLP) Regulation	(EC) No 2024/2865
Corporate Sustainability Reporting Directive (CSRD)	(EU) 2022/2464
Drinking Water Directive (DWD)	(EU) 2020/2184
Environmental Quality Standards (EQS) Directive	2013/39/EU
Groundwater Directive (GWD)	2006/118/EC
High-Value Datasets Regulation (EU) 2023/138 (HVD)	(EU) 2023/138
Industrial and Livestock Rearing Emissions Directive (IED 2.0)	(EU) 2024/1785
Landfill Directive	1999/31/EC
Persistent Organic Pollutants (POPs) Regulation	(EU) 2019/1021
Plant Protection Products (PPP) Regulation	EC 1107/2009
Proposal for a Directive amending Water Framework Directive and its daughter directives on priority substances and groundwater	COM 2022/540 final
Proposal for a Regulation establishing a common data platform on chemicals	COM/2023/779
Registration, Evaluation, Authorisation, and Restriction of Chemicals (REACH) Regulation	(EC) No 1907/2006
Safe and Sustainable by Design (SSbD) Framework	(EU) 2022/2510
Sewage Sludge Directive (SSD)	86/278/EEC
Soil Monitoring Law	COM/2023/416 Final
Urban Wastewater Treatment Directive (UWWTD)	(EU) 2024/3019
Waste Framework Directive	2008/98/EC
Water Framework Directive (WFD)	2000/60/EC
Water Reuse Regulation	(EU) 2020/741

1 Introduction

1.1 PM(T) substances in soil-sediment-water system

Persistent, mobile and potentially toxic (PM(T)) substances are compounds that are persistent in the environment, highly soluble in water, and are therefore easily transported across environmental compartments, including water, soil and sediment, posing risks to human health and the environment. Their physiochemical properties – extended half-life (i.e. persistence) in the environment and high polarity (i.e. mobility), among others – allow them to pass through subsurface environments and conventional drinking and wastewater treatment plants. This makes them ubiquitous in the soil-sediment-water continuum. The continued release of PM(T) chemicals threatens not only the quality of water resources and ecosystems, but also impacts the implementation of a sustainable circular economy in Europe. Addressing these PM(T) substances is challenging not only due to their continuous production, use and emissions, but also because effective technical solutions to replace them and/or reduce their use and emissions and monitoring methods are not fully available yet.

1.2 Working towards EU sustainability ambitions in the face of PM(T)s

PM(T) substances and their physicochemical properties create systemic challenges in implementing the European Union (EU) Green Deal and related initiatives, such as the Circular Economy Action Plan (CEAP), the Chemicals Strategy for Sustainability (CSS), the Zero Pollution Action Plan (ZPAP), and the EU Soil Strategy (Figure 1). While the overarching goal of the EU Green Deal is to achieve climate neutrality by 2050 (Council of the EU and the European Council, 2024), it also established the EU zero-pollution ambition by 2050 and aims to ensure a healthy environment and sustainable use of resources. Each of these initiatives therefore requires, directly or indirectly, the effective and adequate management of PM(T)s.

The CEAP, a major building block of the Green Deal, prioritizes circular approaches to water reuse (European Commission, 2020a), which requires the removal of PMT(s) to prevent their transfer through the water cycle into drinking water, soils, crops, and ultimately humans. To this end, the EU published the CSS and the ZPAP. The CSS targets the most harmful chemicals in the natural environment and consumer products (European Commission, 2020b). With this strategy, the EU stated the aim to classify PM(T) and very persistent and very mobile (vPvM) substances as categories of substances of very high concern, updating hazard classes and criteria to account for environmental toxicity, persistency, mobility and bioaccumulation. Complimenting this, the ZPAP sets a zero pollution ambition – a focus on preventing pollution, establishing monitoring controls and addressing contaminants of emerging concern (European Commission, 2021b; European Environment Agency, 2023).

The EU Soil Strategy for 2030 recognizes the connection between water, soil and a circular economy, stating that “Soil is… arguably the planet’s biggest recycling machine: it recycles water, carbon and nutrients, and can break down and filter pollutants“ (European Commission, 2021a, Section 3.2). Only sustainable management, monitoring and remediation of soil and sediment can ensure that a circular economy can indeed materialize as a sustainable and toxic free reality. However, regulating these various matrices poses a challenge. The nature and behavior of PM(T) substances makes it difficult for policymakers to develop and enforce effective prevention and remediation policies across the entire soil-water-sediment system.

EU Green Deal:
Make the EU climate-neutral by 2050, cut pollution and restore a healthy balance in nature and ecosystems.

Circular Economy Action Plan (CEAP):
Reduce resource use, minimize waste, and promote sustainable growth.

Zero Pollution Action Plan (ZPAP):
Achieve zero pollution in air, water, and soil.

Chemicals Strategy for Sustainability (CSS):
Ensure chemicals are safe and sustainable, protecting health and the environment.

EU Soil Strategy:
Preserve and restore soil health to ensure sustainable land use.

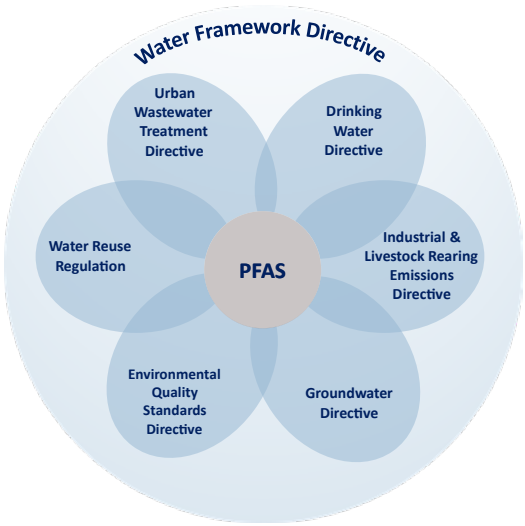
Figure 1. The EU Green Deal includes various action plans and initiatives, such as the CEAP (European Commission, 2020a), ZPAP (European Commission, 2021b), CSS (European Commission, 2020b) and the EU Soil Strategy (European Commission, 2021a). Common to all these action plans is the need for pollution-free water resources.

1.3 Complex regulatory context of the soil-sediment-water system

These interconnected challenges posed by PM(T)s in the soil-sediment-water system place significant demands on regulatory authorities who are tasked with developing, implementing and enforcing effective legislation. This legislation must manage these substances throughout their life cycle, ensuring both environmental protection and alignment with broader sustainability goals. Among the various policy areas affected, water policy is particularly critical, given society's and industry's fundamental dependence on clean, reliable water resources and the pervasive role that water plays across all sectors.

European Union water policy is constituted of several directives and regulations aiming to ensure good water quality and the sustainable management of water resources. Measures such as the Water Framework Directive (WFD; 2000/60/EC) and its daughter directives, the Drinking Water Directive (DWD; (EU) 2020/2184), and the Urban Wastewater Treatment Directive (UWWTD; (EU) 2024/3019) form the backbone of regulatory efforts to protect water bodies, improve wastewater treatment processes, restore water quality where needed, and maintain safe drinking water supplies. However, emerging contaminants like PM(T) substances and per- and polyfluoroalkyl substances (PFAS), pose significant challenges to existing water legislation, which may require updated standards, monitoring protocols, and risk management measures.

Updating processes and establishing political agreements play a critical role in the drafting and acceptance of directives and regulations. Figure 2 provides an overview of the importance of aligning values and standards in regulatory updates, using PFAS as an example. This figure demonstrates that legislative updates do not always achieve the desired outcomes in terms of reduction of emission or aligned regulation of substances classified as PM(T). For instance, while the DWD sets minimum PFAS requirements to be enforced from 2026, the 2024 revision of the UWWTD only includes PFAS monitoring, without clear regulatory action.



Drinking Water Directive (EU) 2020/2184: Ensures safe drinking water, updated in 2020. **Includes minimum requirements and monitoring of PFAS**.

Environmental Quality Standards Directive 2013/39/EU: Sets pollutant limits for surface water. **Includes PFOS, now being updated to address PFAS**.

Groundwater Directive 2006/118/EC: Protects groundwater quality, **updated with PFAS monitoring**.

Urban Wastewater Treatment Directive (EU) 2024/3019 (recast): Targets pollution reduction from urban wastewater. **Revised to address emerging contaminants, includes PFAS monitoring**.

Industrial & Livestock Rearing Emissions Directive (EU) 2024/1785: Limits pollutant emissions from industries. **Recently revised, PFAS not explicitly included**.

Water Reuse Regulation (EU) 2020/741: Establishes standards for treated wastewater reuse in agriculture. **Recent regulation, PFAS not explicitly included**.

Figure 2. EU directives and regulations that manage PFAS in the water cycle. The textboxes explain the differences and inconsistencies in regulation approaches (in orange text).

Many directives and regulations that are not directly related to water – such as those concerning agriculture, industrial production, waste management, or chemical products – can have far-reaching consequences in the soil-sediment-water system. Figure 3 illustrates some of these interconnections between water policies and policies belonging to other frameworks or action plans, highlighting how these cross-cutting policies impact water management practices. Regulations that are especially relevant for PROMISCES include the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) Regulation ((EC) No 1907/2006), the Industrial and Livestock Rearing Emissions Directive (IED 2.0; (EU) 2024/1785), and the Sewage Sludge Directive (86/278/EEC).

For example, agricultural policies promoting the use of sewage sludge as fertilizer or industrial emissions regulations can directly affect soil and water quality, underscoring the need for a coordinated approach across sectors. Given the environmental persistence and mobility of PM(T) substances, no single stakeholder or regulation can address the problem alone: a coordinated, multi-stakeholder approach is essential for achieving effective and sustainable solutions. Policy updates, improvements and additions, including the revision of directives, are urgently needed to ensure harmonized management of PM(T)s across the soil-sediment-water system and to achieve the EU's circular economy and zero pollution ambitions. The urgency was also expressed by various stakeholders of the PROMISCES case studies (CS) CS#2, CS#3 and CS#4 (Narain-Ford et al., 2025; Naus et al., 2025). The CS are about: sources, pathways, fate and transport of PFAS and PM(T)s in the Danube basin (CS #2), water reuse from a wastewater treatment plant with a high share of industrial wastewater (CS#3), and innovative landfill leachate treatment to enable resource recovery from wastewater treatment plants (CS#4).

Figure 3. Within the context of the soil-sediment-water system and the EU's goals of achieving circular economy and zero pollution, there is a broad set of fragmented, matrix-specific approaches that together form the regulatory context that should be considered – not only those that directly regulate water, but also those that regulate other relevant matrices (e.g. REACH, Sewage Sludge Directive, Plant Protection Products (EC 1107/2009) and Biocidal Products Regulation ((EU) 528/2012), Persistent Organic Pollutants (POPs) Regulation ((EU) 2019/1021), Waste Framework Directive (2008/98/EC), Landfill Directive (1999/31/EC), Classification, Labelling, and Packing (CLP) Regulation ((EC) No 2024/2865) and the Soil Monitoring Law (COM/2023/416 final).

2 Definitions and process for determining policy recommendations

2.1 Objective of this deliverable

This report aims to provide policymakers at both the European and national levels with actionable policy recommendations to improve the management of PM(T)s in the soil-water-sediment system. The policy recommendations seek to help policymakers transition from fragmented, matrix-specific approaches towards a more integrated and coordinated effort that better protects human health and the environment when possible, and restores it where needed. A central objective is therefore to identify and address the inconsistencies, gaps, and uncertainties within the existing EU legal and policy framework. To achieve this, we align each of the PROMISCES policy recommendations with the complex web of EU strategies and regulations outlined in Chapter 1, including:

1. **Circular Economy Action Plan (CEAP)**
2. **Zero Pollution Action Plan (ZPAP)**
3. **EU Chemicals Strategy for Sustainability (CSS)**. This includes the REACH regulation, IED2.0 and the Safe and Sustainable by Design (SSbD) framework
4. **EU Soil Strategy (EU Soil)**
5. **EU Water Directives and Regulations (EU WFD)**. This includes the Water Framework Directive and its daughter directives (the Groundwater Directive (2006/118/EC) and the Priority Substances Directive (2013/39)), as well as related policies, such as the Drinking Water Directive ((EU) 2020/2184), the Water Reuse Regulation ((EU) 2020/741), UWWTD, Sewage Sludge Directive, Environmental Quality Standards (EQS) Directive (2013/39/EU).

This alignment to the broader EU strategies and regulations highlights the interdisciplinary nature of the challenge posed by PM(T)s and the need for harmonized approaches to ensure effective management. Additionally, by linking each recommendation to one or more of these policy frameworks, this report highlights the direct relevance of the PROMISCES policy recommendations for advancing the EU's sustainability goals.

In this report, we provide policy recommendations that can be classified in the following two categories:

- **Overarching:** These recommendations evaluate the *alignment and coherence* of the various EU policy frameworks and propose suggestions for harmonization.
- **Specific:** These recommendations address the consistent process of *implementation* of existing policy by providing information that is relevant for risk managers, water operators, etc.

2.2 Identifying PROMISCES policy recommendations

2.2.1 Data collection

The policy recommendations presented in this deliverable are the result of a triangulation of activities used within the PROMISCES project for data collection. These activities ensure that the recommendations were evidence-based, stakeholder-informed and aligned with the broader EU policy context. The following paragraphs provide an overview of the activities that were conducted and considered.

Expert World Café Brainstorming Session

This activity was based on the Decision Support Framework developed by the PROMISCES consortium, which offers decision-makers solutions for managing PM(T)s via five modules:

1. *PMT Assessment*: to verify if a substance is persistent, mobile, and/or toxic according to multiple data sources.
2. *Search Substances*: to explore PM(T) chemicals across various chemical classes and sectors of use.
3. *Diagnosis*: to get a personalized diagnosis for a PM(T) case to support solution assessment.
4. *Solution Assessment*: to find solutions for prevention, assessment, monitoring and treatment of PM(T) substances.
5. *Strategy Creation*: to reference guidance and examples for developing strategies for PMT substances across sectors.

Using the world café format, where groups rotate among topics for focused discussions, PROMISCES examined the four solution types (prevention, risk assessment, monitoring and treatment) to identify pathways to improve the effectiveness of existing regulations and address implementation challenges.

Identifying Boundary Conditions through Local Stakeholder Workshops

Using co-creation processes, PROMISCES organised local stakeholder workshops in conjunction with three project case studies: Case Studies (CS) CS#2, CS#3 and CS#4[1]. The outcomes from these workshops, explained in detail in PROMISCES Deliverables D5.4 and D5.6 (Narain-Ford et al., 2025; Naus et al., 2025), provided insights into barriers and solutions for managing PM(T)s. The stakeholder input informed several policy recommendations and highlighted context-specific challenges and perspectives.

Gathering External Input via the WaterProjectsEurope 2024 Event

In collaboration with two other EU-funded projects, SCENARIOS and LIFE SOuRCE, PROMISCES organised the WaterProjectsEurope event with Water Europe in December 2024. Using an interactive audience survey, we gathered general perspectives on challenges and needs in various Member States (MS) related to PFAS and PMTs. This external input complemented the internal findings and provided important clarifications on the science-policy interface.

PROMISCES' Policy Work

The PROMISCES project contributed to and produced two earlier policy briefs: 1) "Achieving zero pollution by 2050 needs regulatory change: a call for policy support of New Approach Methodologies (NAMs)" (Paparella et al., 2024) and 2) "Deliverable D5.3 - Policy brief on PM(T) concerns and actions in EU" (Wuijts et al., 2024). To ensure compatibility, the recommendations in this deliverable do not overlap with those of the earlier briefs, but instead target additional gaps and challenges identified during the project. As the recommendations from these two policy briefs are also relevant for achieving zero pollution and a circular economy, they are provided in Chapter 3.5 "Endorsement of ongoing policy activities".

2.2.2 Selection and prioritization

Using the input from the various activities explained in the previous section, PROMISCES identified a set of policy recommendations that are both overarching and specific (see definitions in Section 2.1). Additionally, future research needs and "leapfrog recommendations" were identified. The leapfrog

[1] For information on the PROMISCES case studies, visit https://promisces.eu/Project/Case+Studies.html

recommendations address disparities between MS in their management of PM(T)s, providing best practice suggestions to bridge these gaps (see Section 4.1).

To prioritize between the collected recommendations, we established three key criteria that each recommendation should fulfil:

1. **Supported by PROMISCES results.** Each recommendation is supported by findings from the PROMISCES project. While there are numerous policy gaps in the realm of PM(T)s, circular economy and water resource management, this deliverable includes only those policy recommendations that can be explained and justified using PROMISCES research results. In some cases, PROMISCES results not only support a policy recommendation but also reveal future research needs for the effective implementation of that policy recommendation. In those cases, we also include these future research needs in a textbox next to the recommendation. These research needs could be further explored in future funding calls, stakeholder dialogues, or policy update processes.
2. **Scientifically significant and/or innovative.** The recommendations aim to contribute to ongoing discussions surrounding PM(T)s and PFAS by offering new ideas or methods. Widely supported policy suggestions (e.g. PFAS bans) and the recommendations from the two previously published policy briefs are briefly acknowledged in Section 3.5, while this deliverable focuses on those that introduce novel approaches.
3. **Relevant to EU policy frameworks.** Each recommendation is directly relevant for one or more existing EU strategies, regulations and/or directives, highlighting opportunities to improve the alignment or implementation of existing policies.

2.3 Structure of this deliverable

This deliverable is structured to provide a clear and accessible overview of the PROMISCES policy recommendations, ensuring policymakers can easily navigate and consider their impacts within the broader EU regulatory framework. To help policymakers easily identify relevant areas of needed policy action, we have grouped the PROMISCES policy recommendations into four main policy fields:

1. **Regulating Substances (Section 3.1):** Focuses on policies governing the use, restriction, and monitoring of PM(T) substances to ensure environmental and human health protection.
2. **Circular Resource Management (Section 3.2):** Addresses regulatory measures that support resource efficiency, wastewater reuse, and sustainable processes.
3. **Technology Performance and Pollution (Section 3.3):** Covers policies related to the effectiveness of treatment technologies, pollution control strategies, and performance standards for mitigation of environmental impacts.
4. **Tools and Data Management (Section 3.4):** Encompasses frameworks for data collection, monitoring, and decision support tools that enhance policy implementation.

This classification ensures that related recommendations are organized according to their overarching objectives and their role in addressing regulatory gaps. Each policy field reflects a distinct aspect of governance relevant to the soil-sediment-water system. Additionally, to visually demonstrate the alignment of each policy recommendation with broader EU strategies and regulations, the five European policy frameworks listed in Chapter 2.1 are color-coded. An overview of the alignment of each recommendation with these policy frameworks is provided in Table 1, and coloured tabs on the right-hand side of each recommendation remind the reader of this alignment. By structuring the

deliverable in this way, PROMISCES ensures that its recommendations are both actionable and directly relevant to the evolving EU regulatory and policy landscape.

1. **Circular Economy Action Plan (CEAP)**
2. **Zero Pollution Action Plan (ZPAP)**
3. **EU Chemicals Strategy for Sustainability (CSS)**
4. **EU Soil Strategy (EU Soil)**
5. **EU Water Directives and Regulations (EU WFD)**

Additionally, future research needs are highlighted in blue boxes at the end of some of the policy recommendations, where relevant, to identify gaps requiring further research for effective policymaking. As mentioned in Section 2.2.2, widely supported policy suggestions (e.g. PFAS bans) and the recommendations from the two previously published policy briefs)" (Paparella et al. (2024) and (Wuijts et al. (2024)) are briefly acknowledged in Section 3.5

Finally, a dedicated section on broader challenges and key considerations for managing PM(T) substances explores critical aspects that influence the effectiveness of policy implementation across the EU. Specifically, it addresses (i) disparities among MS and their challenges and needs when discussing for instance monitoring strategies, analytical challenges, development of watch lists, and risk assessment as well as their implications for implementing regulations (Section 4.1); and (ii) the boundary conditions necessary for effective PM(T) management, including financial considerations, knowledge sharing aspects and social dimensions (Section 4.2). By outlining these broader challenges, the report provides essential context for understanding the feasibility and impact of the proposed recommendations, ensuring that policy development accounts for both systemic and regional constraints.

3 PROMISCES policy recommendations

Table 1. Overview of PROMISCES policy recommendations, their classification type , and their alignment with the 5 EU policy, legal and regulatory frameworks. CEAP = Circular Economy Action Plan, ZEAP = Zero Pollution Action Plan, CSS = EU Chemicals Strategy for Sustainability, EU Soil = Soil Strategy and EU WFD = EU Water Directives and Regulations.

#	PROMISCES Policy Recommendation	Type of Recommen-dation	Relevant Policy Framework					Page Ref.
			CEAP	ZPAP	CSS	EU Soil	EU WFD	
Regulating Substances								
1	For substances that are (potentially) PMT or vPvM and difficult to remove from soil, sewage sludge, sediment, and water, Member States Competent Authorities (MSCAs) should prioritize setting emission limit values as low as reasonably achievable.	Specific						22
2	The European Chemicals Agency (ECHA) and MSCAs should request users and producers of potentially persistent, mobile, and/or toxic intermediates to provide sufficient comprehensive data on their physicochemical properties and toxicity to ensure these substances are properly assessed and regulated under the PMT/vPvM classification framework established by the CLP Regulation.	Specific						24
Circular Resource Management								
3	The EC should align the list of regulated persistent, mobile, and/or toxic compounds between soil, sewage sludge, sediment and water to increase the safe circular use of these resources.	Overarching						25
4	To ensure the circularity of resources, the EC should coordinate the processes for selecting substances for the Surface Water Watch List and the Groundwater Watch List with Regulation (EC) No 2024/2865 on Classification, Labelling, and Packaging of Substances and Mixtures (CLP) and initiate a watch list for wastewater, soil, and sewage sludge.	Overarching						27
5	The EC should require emission modelling of PM(T) and vPvM substances into surface waters on the catchment scale, and modelling of transport via surface water into groundwater, to identify knowledge gaps regarding emission sources and pathways, enable risk assessment on entire river basins, and facilitate scenario evaluation.	Overarching						29
Technology Performance and Pollution Control								
6	The EC should establish evaluation criteria for technology providers to evaluate treatment technologies for soil, water, sediment and sludge, and require technology providers to report these criteria.	Overarching						31

#	PROMISCES Policy Recommendation	Type of Recommen-dation	Relevant Policy Framework					Page Ref.
			CEAP	ZPAP	CSS	EU Soil	EU WFD	
7	To achieve the Green Deal's ambition for a toxic-free environment, the EC should consider non-animal based methods, such as PFAS CALUX, as an information source for risk assessment and management of PFAS.	Overarching						34
Tools and Data Management								
8	The EC should make PROMISCES tools and information from the PROMISCES Decision Support Framework (DSF) available to industry for the effective implementation of the Safe and Sustainable by Design (SSbD) framework in addition to the SSbD Toolbox.	Specific						35
9	The European Parliament should support the approval and implementation of proposal COM/2023/779 and ensure interoperability with existing substances data infrastructures developed by the scientific community.	Specific						37

3.1 Policy field: Regulating substances

3.1.1 **Recommendation No. 1**

For substances that are (potentially) PMT or vPvM and difficult to remove from soil, sewage sludge, sediment, and water, Member States Competent Authorities (MSCAs) should prioritize setting emission limit values as low as reasonably achievable.

Relevant Policy Context: CLP, IED 2.0, WFD

Article 56 of the IED 2.0 states:

> *When **setting emission limit values** for polluting substances, the **competent authority should consider all substances**, including substances of emerging concern, which may be emitted from the concerned installation and may have a significant impact on the environment or human health. In doing so, the **hazard characteristics, quantity and nature of the substances emitted and their potential to pollute any environmental media should be considered**. The best available technologies (BAT) conclusions, where relevant, are the reference point for selecting the substances for which emission limit values are to be set, although the **competent authority may decide to select additional substances**. […] reference should be made to the list of pollutants in Annex II to Regulation (EC) No 166/2006 of the European Parliament and of the Council.*

To protect the quality and foster the circular use of soil, sewage sludge, sediment, wastewater, surface water and groundwater, MSCAs should prevent the emission of, or – if emission cannot be prevented – prioritize setting emission limit values as low as reasonably achievable (ALARA) for substances that are:

1. PMT or vPvM according to Regulation (EC) No 2024/2865 on Classification, Labelling, and Packaging of Substances and Mixtures (CLP); *or*
2. Potentially PMT or vPvM based on model predictions; *and*
3. Difficult to remove from soil, sewage sludge, sediment and water.

Please consult Hansson (2013) for details on the ALARA concept. When identifying and prioritizing substances using these criteria, MSCAs can use the results from the PROMISCES project. For criteria 1 and 2, MSCAs can consult the PMT assessment module of the Decision Support Framework (DSF). If data to complete the PMT assessment is missing and the substance of interest is an on-site isolated intermediate, please also consult **Recommendation No. 2**.

There are two major sources of information from the PROMISCES project that provide details on remediation yields for different PFAS and industrial PM(T)s (iPM(T)s) from the assessed treatment technologies: 1) the solution module of the PROMISCES DSF and 2) the upcoming CEN Workshop Agreement on "Soil-sediment-water system - Solutions to deal with PMT/vPvM substances"[2]. The information from these two sources can be used for assessing substances according to criterion 3. Based on two types of criteria, compounds of concern can be defined in general as compounds with limited (here: <50%) removal by several treatment technologies (here: >1). Based on PROMISCES results, such a list would, at the time of writing, encompass, but is not limited to compounds such as diuron (biocide, antifouling agent, CAS: 330-54-1), benzotriazole (anti-corrosion agent and an anti-

[2] The CEN Workshop Agreement (CWA) on „Soil-sediment-water system - Solutions to deal with PMT/vPvM substances" is expected to be published online in April 2025 at https://www.cencenelec.eu/news-and-events/news/2023/workshop/2023-12-13-promisces/.

fogging agent, CAS: 95-14-7), triethyl phosphate (industrial catalyst, plasticizer, flame retardant, CAS: 78-40-0) and temazepam (pharmaceutical, CAS: 846-50-4). Limiting the emission of these substances is thus deemed important. This list is not comprehensive, and concerns compounds frequently studied, a complete list would encompass compounds with similar fate behaviour and characteristics.

Table 2. Treatment technologies assessed in PROMISCES, for which information on remediation yields for various PFAS or PM(T)s is available in the upcoming CEN Workshop Agreement on "Soil-sediment-water system - Solutions to deal with PMT/vPvM substances"[3], along with the media in which each technology was tested.

Technology	Target media
In situ non-newtonian fluid flushing	Soil, water
Sediment washing	Sediment
Membrane filtration (nanofiltration, reverse osmosis)	Landfill leachate
Plasma	Landfill leachate, water, sludge
Co-pyrolysis of membrane concentrates and sewage sludge	Landfill leachate sludge and concentrate, sewage sludge
Ultrasonic cavitation	Water
Activated persulfate with ferrate	Water
E-peroxone based electrochemical advanced oxidation process (EAOP)	Water

[3] The CEN Workshop Agreement (CWA) on „Soil-sediment-water system - Solutions to deal with PMT/vPvM substances" is expected to be published online in April 2025 at https://www.cencenelec.eu/news-and-events/news/2023/workshop/2023-12-13-promisces/.

3.1.2 Recommendation No. 2

The European Chemicals Agency (ECHA) and MSCAs should request users and producers of potentially persistent, mobile, and/or toxic intermediates to provide sufficient comprehensive data on their physicochemical properties and toxicity to ensure these substances are properly assessed and regulated under the PMT/vPvM classification framework established by the CLP Regulation.

Relevant Policy Context: REACH, CLP

The Regulation (EC) No 1907/2006 on REACH defines an intermediate as a 'substance that is manufactured for and consumed in or used for chemical processing in order to be transformed into another substance (hereinafter referred to as synthesis)' (Article 3(15)). Different types of intermediates – such as non-isolated, on-site isolated and transported isolated intermediates – are subject to varying requirements under REACH. For further details, see the "Guidance on Intermediates" (European Chemicals Agency, 2023).

The PROMISCES project found that over 90 percent of the REACH registered intermediates studied in the project (n=3298) are potentially (very) persistent and (very) mobile, as determined through modelled data (Sardi, 2025). Despite this, at the time of writing, no experimental information on the physico-chemical properties, toxicity and uses of these substances is required by the European Chemicals Agency (ECHA) to fill out their registration dossiers. To protect the soil-sediment-water system, PROMISCES urges ECHA to review the registered isolated intermediates with PMT and PBT potential listed in Sardi (2025) and request sufficient comprehensive data as needed. These substances should be thoroughly assessed and regulated under the forthcoming mandatory PMT/vPvM classification, as required by the CLP Regulation ((EC) No 2024/2865).

For the on-site isolated intermediates provided in the aforementioned database, which are manufactured and used under strictly controlled conditions, dossier and substance evaluation requirements do not apply under REACH (Article 49). However, the MSCA responsible for the manufacturing site has the authority to request additional information. We ask the relevant MSCA to exercise this power and assess whether these intermediates qualify as PM(T) or vPvM substances and whether their associated risks are properly controlled according to REACH (Article 49).

3.2 Policy field: Circular resource management

3.2.1 **Recommendation No. 3**

The EC should align the list of regulated persistent, mobile, and/or toxic compounds between soil, sewage sludge, sediment and water to increase the safe circular use of these resources.

Relevant Policy Context: DWD, WFD and its daughter directives, UWWTD, Sewage Sludge Directive (SSD), Proposal COM/2023/416, Proposal COM/2022(540), Environmental Quality Standards (EQS) Directive (2013/39/EU)

In Europe, the regulation of PM(T) substances in groundwater, surface water, drinking water, wastewater, sludge, and soil is incoherent and inconsistent. This incoherence and inconsistency appear both in the set of regulated parameters and in the determined threshold values is illustrated with PFAS as an example for PM(T) substances in Table 3. Immediate action is required to harmonize regulations across environmental compartments to prevent further contamination and ensure resource circularity.

Table 3. Overview of European PFAS regulations in groundwater, surface water, drinking water, wastewater, sludge, soil, and sediment.

Matrix	Regulated Parameter(s)	Threshold Value(s)	Respective Regulation
Surface Water, Sediment	Sum of 24 PFAS	4.4 ng/L (as PFOA equivalents)	Proposal COM/2022(540) Amendment of Directive 2000/60/EC on water policy, Directive 2006/118/EC on pollution of groundwater and Directive 2008/105/EC on quality standards in water policy
Drinking Water	Sum of 20 PFAS[A]	100 ng/L	Drinking Water Directive (EU) 2020/2184
	Total PFAS	500 ng/L	
Surface Water	Perfluorooctane sulfonic acid and its derivatives (PFOS)	Annual Average of 0.65 ng/L for inland surface water and 0.13 ng/L for other surface water	Directive (EU) 2013/39 as regards priority substances in the field of water policy
Groundwater	Sum of 20 PFAS[B]	100 ng/L	COM(2022) 540 final
	Sum of 4 PFAS	4.4 ng/L	
Urban Wastewater	Sum of 20 PFAS[A]	NA[C]	Directive (EU) 2024/3019 EU concerning urban wastewater treatment (UWWTD)
	Total PFAS	NA[C]	
Soil	PFAS not specifically mentioned	NA	Proposal COM/2023/416 for a Directive on Soil Monitoring and Resilience (Soil Monitoring Law)
Sludge/ Biosolids	PFAS not specifically mentioned	NA	Directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture

[A] The 20 included PFAS do not completely overlap with the 24 PFAS included in the COM (2022) 540 for surface water, groundwater and sediment.

[B] The 20 PFAS from the Drinking Water Directive (EU) 2020/2184

[C] The UWWTD only mentions monitoring of PFAS in inlet and outlet of wastewater treatment plants.

In addition to these European limit values, certain MS have included other PFAS and thresholds in their national monitoring programmes, making the regulatory context even more complex. For example,

Denmark has implemented a threshold value of 2 ng/L for the sum of PFOA, PFOS, PFNA and PFHxS in drinking water.

The discrepancies between regulated substances in different environmental matrices are unsurprising, given the regulatory process. A substance's physicochemical properties are considered as they determine its tendency to partition into certain compartments. This makes the regulation of, for example, a highly mobile substance more relevant for groundwater than for soil. Also, the intended use or desired protection level of a matrix determines what substances are subject to regulation. For example, water used for human consumption requires regulation of other substances compared to water used for irrigation. Furthermore, the timing of revising and updating directives determines the scientific information that has been considered. For instance, the Proposal COM/2022/540 (2022) for the amendment of the WFD, the GWD and the EQS Directive incorporates the tolerable weekly intake (TWI) of 4.4 nanograms per kilogram of body weight per week for PFOA, PFOS, PFNA, PFHxS, as advised by the European Food Safety Agency (EFSA) on PFAS (EFSA Panel on Contaminants in the Food Chain (EFSA CONTAM Panel) et al., 2020), whereas the revised DWD (revised in 2020) could not include this knowledge. Therefore, the resulting European regulation is based on a complex and time-consuming political dialogue between MS and the Commission that not only considers scientific information on exposure and risk, but also other factors such as technical feasibility and economic costs. There are also discrepancies in the recommended matrices for monitoring substances like PFOS: under the Water WFD, PFOS monitoring should be conducted in biota rather than water (EC: DG Health and Food Safety, 2017), which makes the results difficult to compare.

While such discrepancies are a logical consequence of the availability of knowledge, the political era and the consequent evolution of regulations over time, PROMISCES finds that the incoherent and inconsistent regulation of substances in different matrices, complicates the EU goal of achieving resource circularity, as stated in the CEAP. These regulatory inconsistencies lead to missing data on substances in specific matrices, hindering the safety assessment of water intended for reuse. Therefore, PROMISCES recommends prioritizing the full alignment of regulated PM(T) substances between groundwater, surface water, drinking water, wastewater, sludge, soil, and sediment to allow for the circular use of resources. This does not necessarily mean that all contaminants should be regulated in all matrices, but PROMISCES advocates for assessing regulated substances with the circular use of each matrix in mind. Particularly for sludge, it is crucial to regulate mobile substances in addition to bioaccumulative substances, such as those listed in the study by JRC (2022) on policy development on the Sewage Sludge Directive (86/278/EEC). Regarding the need for threshold values for PM(T) substances in sludge, it is deemed essential to comply with the values mandated in soil and water regulations (see Table 2). Finally, regarding setting threshold values for soil remediation, PROMISCES advises MS to determine first the background levels resulting from diffuse pollution. This is to discriminate the general diffuse pollution from the specific pollution coming from the site and to determine the concentration level to reach by remediation actions.

This recommendation is in line with the One Substance, One Assessment (OS/OA) framework (European Commission, 2023) as it helps to streamline assessments of chemicals across European legislation. It will not only improve resource circularity but also contribute to the harmonization and development of analytical methods and the availability of internal standards. Finally, aligning the list of regulated PM(T) compounds between soil, sewage sludge, sediment and water would be greatly supported by the implementation of **recommendation #9**.

3.2.2 Recommendation No. 4

To ensure the circularity of resources, the EC should coordinate the processes for selecting substances for the Surface Water Watch List and the Groundwater Watch List with Regulation (EC) No 2024/2865 on Classification, Labelling, and Packaging of Substances and Mixtures (CLP) and initiate a watch list for wastewater, soil, and sewage sludge.

Relevant Policy Context: WFD, GWD, CLP

In Europe, the monitoring of emerging contaminants in surface water and groundwater is organized via watch lists. Compliance with the Surface Water Watch List (SWWL, newest version in Decision (EU) 2022/1307) is mandatory for MS under the Water Framework Directive, and specifically the Environmental Quality Standards Directive (2008/105/EC), whereas the Groundwater Watch List (GWWL) is voluntarily enacted. The substances on the SWWL are selected when available information indicates that they may pose a significant risk to or via the aquatic environment, but monitoring data are yet insufficient to determine the actual risk. Highly toxic substances used in many MS and discharged to the aquatic environment but not or rarely monitored, should be considered for inclusion in the watch list. The monitoring of the substances in SWWL should generate high-quality data on their concentrations in the aquatic environment that can assist the identification of priority substances. An environmental quality standard would then also need to be set, which MS would have to meet as part of the implementation of Priority Substances Directive (EU) 2013/39.

After the first review of the Groundwater Directive (GWD) 2006/118/EC in 2014, the European Commission initiated the GWWL to obtain information on additional substances posing potential risks for groundwater. The GWWL facilitates the identification of substances for which groundwater quality standards or threshold values should be set; see Lapworth et al. (2019) for a detailed description of the methodology. Substances assessed will be ranked according to their leaching potential, hazard potential and currently available monitoring data. After sufficient data is gathered, relevant substances move to the list facilitating the Annex I and II review process of the GWD. As of March 2025, the European Parliament is evaluating proposal COM(2022) 540 final. If accepted, this proposal will require MS to monitor substances on the GWWL.

To protect the soil-sediment-water system from PM(T) substances and to ensure the circularity of resources, two suggestions to the current watch list processes can be made based on PROMISCES work. First, the EC is suggested to implement additional watch lists for wastewater, soil, and sewage sludge. This will also support the implementation of Regulation (EU) 2020/741 on minimum requirements for water reuse, specifically the development of water reuse risk management plans and environmental monitoring systems. The selection of substances for watch lists for wastewater, soil, and sewage sludge should be coordinated with the GWWL, the list facilitating the Annex I and II review process of the GWD and the SWWL. Furthermore, in terms of monitoring wastewater, it is important to update ISO 16075-4:2021 (International Organization for Standardization, 2021) by including PM(T) substances. Secondly, a methodology for identifying PM(T) substances to be considered and monitored in industrial emissions should be established for each industrial sector under the IED 2.0.

Furthermore, we propose to align the selection of substances for both the GWWL and the SWWL with CLP Regulation (EC) No 2024/2865. Specifically, for the GWWL, it is suggested to consider the PM(T)/vPvM classification from the CLP regulation to the prioritisation criteria, just as is done for REACH, Annex XIII of the Regulation No 1907/2006 (see Lapworth et al. (2019) for details on the selection criteria for the GWWL). For the SWWL, it is suggested to add “mobility” (as defined in the CLP regulation) as part of the hazard criteria for the selection of substances (see European Commission:

JRC et al. (2022) for more details on the selection criteria). The implementation of **recommendation #9** would be beneficial in realizing these suggestions.

Specific substances to be considered for the GWWL, SWWL, and the proposed watch lists for wastewater, soil, and sewage sludge, based on monitoring results from the PROMISCES project, are 8:2 fluorotelomer sulfonic acid (8:2 FTS) and 6:2 fluorotelomer sulfonic acid (6:2 FTS). Furthermore, based on the *in vitro* toxicity profiling in PROMISCES, ADONA (PFAS CALUX, RPF 0.55), P37DMOA (PFAS CALUX, RPF 2.3), PFOSA (PFAS CALUX RPF 0.75) and GenX (PPARα CALUX 1.0) should also be considered by the EC for the watch lists as there is a need for additional monitoring data (Behnisch et al., 2023).

To protect the life cycle of water and to ensure the circularity of resources, two suggestions to the current process of watch lists can be made based on PROMISCES work: 1) add in vitro toxicity testing for PFAS (such as PFAS CALUX for thyroid-hormone disrupters and PPARα CALUX for metabolic disrupting chemicals) and other PMTs to cover the potential mixture toxicity of regulated and unregulated PFAS and 2) prioritize and analyse the > 100 PFOA-like compounds identified by combined in silico/in vitro profiling in a cost- and time efficient manner (Behnisch et al., 2023; Kowalska et al., 2023; Sosnowska et al., 2025).

Future research needs: To aid decision-making, a cost-benefit analysis of implementing watch lists for wastewater, soil, and sewage sludge, highlighting potential economic and environmental benefits is needed. This will provide policymakers with a clearer understanding of the financial and environmental implications. Furthermore, to achieve the effective implementation of this and the following policy recommendation, PROMISCES identified a specific need for further research for the development of a comprehensive methodology to evaluate the potential release of PFAS and PM(T)s from matrices such as soil, sediment, or sludge. These methodologies should be adapted to the specificity of PFAS and other PM(T) substances. This is crucial for accurately assessing their impacts on the water cycle, as well as human and environmental exposure. Finally, PROMISCES suggests to start an investigation into the added value of a novel integrated European Regulation linking environmental matrices for the sake of water resilience enhancement.

3.2.3 Recommendation No. 5

The EC should require emission modelling of PM(T) and vPvM substances into surface waters on the catchment scale, and transport modelling via surface water into groundwater, to identify knowledge gaps regarding emission sources and pathways, enable risk assessment on entire river basins, and facilitate scenario evaluation.

Relevant Policy Context: WFD, EQS

PM(T) substances pose significant challenges in semi-closed water cycles (anthropogenic emissions – surface water – riverbank filtration/groundwater – drinking water). As their removal by riverbank filtration is difficult or even impossible, the sources of pollution in the catchment are often unknown or their impact is unclear. To tackle these problems, emission modelling at the catchment scale is a valuable tool for gaining a better understanding of the importance of different pathways and sources. The creation of a river basin-wide emission model has many advantages:

- It helps to identify which share of pollution can be attributed to known sources and pathways and which share of unknown pollution exists and needs further investigation.
- In transboundary settings, a jointly developed model provides a common understanding about which country contributes which share of the problem.
- Such an emission model can assess scenarios to predict the outcomes of implementing emission mitigation measures and evaluate how future developments such as climate change, demography shifts may impact pollution.

For priority substances, the WFD (2000/60/EC) already requires MS to set up inventories of emissions and losses, as defined in Article 5 of the Environmental Quality Standards Directive 2008/105/EC. The associated guidance document No. 28 outlines a tiered approach for creating such inventories (EC: DG Environment, 2012). The more advanced tiers rely on emission models based on either a regionalized pathway analysis or a more detailed source-oriented approach. However, PM(T) and vPvM substances – many of which are not currently listed as priority substances under the WFD – are not part of this regulatory emission inventories. PROMISCES recommends that the European Commission mandates the inclusion of emission modelling for PM(T) and vPvM substances into surface waters at the catchment scale. Such models can identify knowledge gaps regarding emission sources and pathways, enable comprehensive risk assessment across entire river basins, and help evaluate scenarios to support the development of mitigation strategies. The focus should be on PM(T) and vPvM substances not (yet) included in the list of priority substances but considered critical for semi-closed water cycles.

In PROMISCES CS#2, the pathway-oriented emission model MoRE by Fuchs et al. (2017) was applied to analyse 10 PFAS compounds in the upper Danube basin, extending down to the riverbank filtration sites in Budapest (Liu et al., 2024; Zessner et al., 2025). It proved valuable for identifying relevant emission pathways and delivering results for scenarios that evaluate the impact of climate change, accidental spills, and pollution mitigation measures.

Since environmental occurrence data for emerging pollutants are often scarce, the development of emission models requires, as a prerequisite, the collection of data on substance application amounts for the source-oriented approach or the monitoring of concentrations in emission pathways for the pathway-oriented approach. Thus, a complementary monitoring program is always necessary to fill these data gaps and accurately model emerging substances. In PROMISCES CS#2, targeted monitoring at 12 river sites and main emission pathways was conducted (Liu, Saracevic, et al., 2025).

In transboundary river basins, improved results on emission attribution, as well as the acceptance of these model results, can be achieved if partners from all countries in the basin are involved and provide

national data and knowledge about relevant sources and pathways. The PROMISCES Case Study 2 only involved partners from Germany, Austria and Hungary, leading to uncertainties regarding data from other countries (e.g. relevant landfill sites for PFAS emissions), which resulted in a coarser modelling approach unable to differentiate between different legacy pollution pathways (Liu, Kittlaus, et al., 2025).

The Danube River Basin can be mentioned as a notable example where emission modelling at the river basin scale has been successfully applied to support water quality management. The Danube River Basin Management Plan includes results of transboundary emission modelling for nutrients (with the pathway-oriented approach) and priority substances (with a combination of pathway and source-oriented approach) (ICPDR, 2021). This application of emission models contributed significantly to identification of data gaps, and consequently transnationally harmonized monitoring activities to close these data gaps.

3.3 Policy field: Technology performance and pollution control

3.3.1 **Recommendation No. 6**

The EC should establish evaluation criteria for technology providers to evaluate treatment technologies for soil, water, sediment and sludge, and require technology providers to report these criteria.

Relevant Policy Context: DWD, UWWTD, SSD, Landfill Directive (1999/31/EC), Water Reuse Directive ((EU) 2020/741), Corporate Sustainability Reporting Directive (CSRD; (EU) 2022/2464), IED 2.0

Treatment technologies (removal or destruction) are essential for the management of contaminated sites and matrices and for complying with European legislation such as (EU) 2020/2184 Drinking Water Directive, (EU) 2000/60/EC Water Framework Directive, Directive (EU) 2024/3019 concerning urban wastewater treatment, Directive 86/278/EEC on the protection of the environment and in particular of the soil, when sewage sludge is used in agriculture, Directive (EU) 2018/850 on the landfill of waste, and Regulation (EU) 2020/741 on minimum requirements for water reuse.

The treatment technologies available for removing or destroying PM(T) substances vary in terms of cost, performance, energy consumption, safety, and sustainability. Objective comparisons must be provided to support informed decision-making by technology users, such as water utilities, industry, and national policymakers. Currently, no harmonized evaluation criteria for assessing treatment technologies are available. Standards exist for treatment technologies for water reuse systems, namely ISO 20468-1:2018 .

Therefore, PROMISCES recommends the EC establish evaluation criteria for treatment technologies for soil, water, sediment, and sludge, and require technology providers to report on these criteria, for example as part of the implementation of IED 2.0 (2024/1785) and/or the Corporate Sustainability Reporting Directive (CSRD, 2022/2464).

In the PROMISCES case studies[4], novel technologies for removing PM(T) substances and PFAS were tested. Information on the evaluation of the technologies developed in the PROMISCES project will be available as part of the upcoming CWA[5] , via the DSF and in various PROMISCES deliverables: D3.4 (Institut de Physique du Globe de Paris (IPGP), 2025), D3.6 (Jou-Claus et al., 2025), D4.1 (Rückbeil et al., 2025), D4.2 (Rückbeil et al., 2024), D4.3 (Meijide Fernández et al., 2025), D4.5 (Lancioni et al., 2024), D4.6 (UNISOFIA, 2025). Based on this work, PROMISCES proposes the following **evaluation criteria** for treatment technologies for soil, water, sediment, and sludge:

- **Type of treatment:** Specify whether the technology removes, separates, destroys or fully mineralizes the targeted contaminants, and define these parameters.
- **Type of technology**: Specify whether the technology is a stand-alone technology or it can be combined with other technologies.
- **Performance:** The performance can be assessed by the mass PFAS or PMT removed/degraded per mass/volume unit of treated product. Treated product means the output product/produced material, not accounting for the mass/volume of the concentrated/rejected stream. In the case of PFAS, efficiency should be broken down for

[4] For information on the PROMISCES case studies, visit https://promisces.eu/Project/Case+Studies.html.
[5] The CWA on „Soil-sediment-water system - Solutions to deal with PMT/vPvM substances“ is expected to be published online in April 2025 at https://www.cencenelec.eu/news-and-events/news/2023/workshop/2023-12-13-promisces/.

ultra-short chain PFAS (2-3 carbon atoms), short chain PFAS (4-6 carbon atoms) or long chain PFAS (> 6-8 carbon atoms).[6]

- **The nature and quantity of matrices to be processed at output:** Some techniques result in the production of concentrated matrices (e.g. water, activated carbon, concentrated PFAS/PM(T) waste stream), which must then be treated.
- **Safety and environmental impact:** Ensure that the chosen technology does not aggravate existing environmental problems and is not harmful to human and environmental health, also in the long term. Remediation processes must guarantee the safety of workers and the population. Sub-criteria to consider here are for instance, the release of unwanted byproducts into the environment (e.g. new pollutants such as TFA, suspended particles), and unwanted effects on the physicochemical properties of the environment (e.g. pH, temperature).
- **Technological maturity:** Technology Readiness Level (TRL), including current research gaps to overcome.
- **Economic cost**: Both operational and capital expenditures, including maintenance, waste management, and costs of energy consumption.
- **Sustainability**: Energy demand in kWh/m^3 product, carbon footprint in emissions of CO_2 equivalents per m^3 product, water footprint in m^3 H_20 required per m^3 product generated, regeneration of the media, and waste generation.
- **Regulatory compliance:** Ensure that the technique meets current standards and complies with legal requirements (e.g. material/membrane complies with national drinking water treatment regulations).

It is recommended that these evaluation criteria be integrated into the list of criteria already used for evaluating Best Available Techniques (BATs) in the BAT Reference documents (BREFs) under the IED 2.0.

To ensure the reliability of the information provided, PROMISCES recommends that technology providers test their technology under real-world conditions for specific contaminants and a range of concentrations in various types of waters/matrices. Evaluating these criteria for PFAS remediation may be more complicated, due to the complexity of PFAS and the associated technical challenges.

Aligned with the current procedures as part of IED 2.0, these harmonized evaluation criteria enable comparison of different types of technologies as well as their effects. By streamlining this information, companies, utilities, and regulators can make faster, more informed decisions about the suitability of specific technologies for their use cases. This is especially important as the number of stakeholders addressing PFAS and PMT contamination is expected to grow significantly in the coming years. Similarly, information on the impact of the treatment on the receiving environments tied with the characteristics of the output matrices and the specific features of the generated byproducts should be clearly communicated. This is to inform potential end users on what to expect. It will also help to reduce risk and costs by avoiding unnecessary expenditure on ineffective solutions.

Future research needs: To realize the effective implementation of this policy recommendation, PROMISCES identified a specific need for further research on developing a methodology to evaluate the PFAS mass balance during treatment correctly. PFAS mass balance is based on the idea that in a closed system, the total quantity of a substance entering the system (the contaminated matrix) should

[6] A need for further research on the development of a methodology to correctly evaluate the PFAS mass balance during treatment was identified in the PROMISCES project. To assess technologies based on these criteria, a validation test protocol needs to be followed.

be equal to the quantity leaving it (removed or mineralized), plus the quantity which is accumulated or not degraded in the matrix during treatment. For PFAS, this approach is crucial, as these substances are persistent and may not be completely degraded or removed. It enables the quantification of the elimination and losses of PFAS in a specific environment, such as a contaminated site or a treatment process. The aim is to ensure no substance is overlooked in the overall mass balance. Establishing a methodology to assess the PFAS mass balance could involve a revisable list of specific parameters or compounds to be monitored, along with recommendations on the quantification limits per parameter/compound.

3.3.2 Recommendation No. 7

To achieve the Green Deal's ambition for a toxic-free environment, the EC should consider non-animal based methods, such as PFAS CALUX, as an information source for risk assessment and management of PFAS.

Relevant Policy Context: DWD, WFD

PFAS is a large group of man-made chemical substances that do not occur naturally in the environment. These substances are associated with adverse health effects, such as liver damage, reduced birth weight and a decreased immune response in epidemiological studies. The effect on the immune system was observed at the lowest levels of exposure to PFAS (EFSA, 2020). The Organisation for Economic Co-operation and Development (OECD) has identified more than 4,000 PFAS, but there may even be more. Only a limited number of PFAS are well-studied. This presents a challenge for risk assessment and for aligning with the EU Green Deal's goal of achieving a toxic-free environment.

In this regard, bioassays, present a relevant source of information. In PROMISCES, various modes of action of PFAS were examined using cell-based bioassays, supplemented by *in silico* modelling, to include a broad range of PFAS (Behnisch et al., 2023). The results demonstrate that PFAS trigger endocrine mechanisms of action, particularly receptor binding and inhibition. These effects were primarily observed in the competition of up to 8000 PFAS with the thyroid transport hormone protein transthyretin.

A potential way of using this knowledge to help with the EU Green Deal's goal of achieving a toxic-free environment, is via trigger values derived using non-animal-based *in vitro* bioassays (such as PFAS CALUX). A study by Behnisch et al. (2021) published trigger values for water, which have been applied in several studies (Behnisch et al., 2023; de Schepper et al., 2023). PROMISCES has also implemented this toxic-free assessment approach using semi-quantitative *in vitro* toxicity bioanalysis tools in several case studies (e.g., CS#2 Danube River monitoring). If the observed activity measured by PFAS CALUX falls below this trigger value, it suggests that up to 8,000 PFAS are – considering current limits of quantification (LOQ), observed exposure levels and hazard characteristics – not present in the sample above critical levels (on a per-compound basis) for public health and the environment (Kowalska et al., 2023; Sosnowska et al., 2025). Furthermore, the results can be used for grouping of PFAS for the same molecular target and for prioritizing PFAS for further study. Kuckelkorn and Mittag (2024) showed a potential way of using trigger values for setting health-related indicator values for drinking water.

Therefore, to achieve the EU Green Deal's goal of a toxic-free environment, PROMISCES suggests that the EC considers non-animal based methods, such as PFAS CALUX, as information source for risk assessment and management of PFAS. By integrating the comprehensive database from PROMISCES, the EU could establish a more protective and adaptive regulatory approach to PFAS in (drinking) water.

Future research needs: To support the implementation of this policy recommendation, a relevant future research direction would be establishing an effect-based trigger value for total PFAS based on a large data set of PFAS CALUX analyses in different kinds of water, such as surface water, drinking water and wastewater. The trigger value should be in bioanalytical equivalent concentrations following the example in Schepper et al. (2023).

3.4 Policy field: Tools and data management

3.4.1 **Recommendation No. 8**

The EC should make PROMISCES tools and information from the PROMISCES Decision Support Framework (DSF) available to industry for the effective implementation of the Safe and Sustainable by Design (SSbD) framework in addition to the SSbD Toolbox.

Relevant Policy Context: REACH

The 'safe and sustainable by design' (SSbD) framework is a pro-active, voluntary approach aimed at integrating safety, sustainability and, although indirectly, circularity into the innovation process for chemicals and materials, announced via the Commission Recommendation (EU) 2022/2510. To assist users in implementing the assessment framework, the JRC published methodological guidance documents, and the European Partnership for the Assessment of Risks from Chemicals (PARC) established an SSbD Toolbox that collects tools and models for each stage of the framework (European Commission: Joint Research Centre, Caldeira, et al., 2022; European Commission: Joint Research Centre et al., 2024; European Partnership for the Assessment of Risks from Chemicals (PARC), n.d.).

The EC intends to continuously improve the methods, tools, and data availability for SSbD chemicals and materials, as well as to refine the framework and make it applicable to a wide variety of substances. The PROMISCES project has developed tools and delivered information complementary to the tools in the SSbD Toolbox, which are included in the PROMISCES Decision Support Framework (DSF). Relevant parts of the DSF in this regard are:

- The *PMT Assessment and Diagnosis modules.* These modules can be used as a fit-for-purpose tool to identify (potential) PMT and vPvM substances and their sector of use. This is deemed important as the first step of the SSbD approach is to focus on the intrinsic properties of chemicals and materials and identify those that are inherently hazardous. PMT and vPvM substances are included in the category of the 'most harmful substances' (according to the Chemical Strategy for Sustainability) that should be prioritized for substitution, re-designed to reduce their adverse effects, or allowed only in uses proven essential to society. Furthermore, the SSbD framework acknowledges that available information could be limited and recommends using diverse information sources, like New Approach Methodologies (NAMs), to get data and generate knowledge. In the Diagnosis and PMT Assessment modules, different types of information sources are used (such as QSARs, etc.), which allow evaluation of whether the PMT/vPvM endpoint is likely to be fulfilled or not.
- The *Solution Assessment module* and specifically the information related to *Prevention.* This module offers different measures that can be implemented to prevent the release of PM(T) substances into the environment. It provides information on PM(T) identification, substitution, and additional scientific and technical solutions for preventing contaminants. It also refers to Deliverable D1.5 (Behnisch et al., 2023), which describes a set of novel QSAR, grouping, read-across, and in vitro bioassay approaches for predicting relevant toxicological endpoints for PFAS/PM(T) chemicals, and Deliverable D2.1 (Sosnowska et al., 2024), which reports on publicly available in silico models for the identification of PMT properties of PFAS.

To achieve the goals set out in the CSS, the ZPAP and the CEAP, the tools and information provided in the DSF should be made easily accessible to the industry. They are essential for applying the SSbD framework in a more effective and informed manner, helping to identify substances with potential PM(T) characteristics and prevent their use and/or emission into the environment. One way to do this would be to add the PROMISCES DSF link to the list of supporting information provided on the SSbD

webpage: Safe and sustainable by design - European Commission or directly in the SSbD Toolbox. The DSF will be integrated into the NORMAN Database System (NDS) of the NORMAN Network, ensuring the DSF's long-term maintenance and accessibility. Additionally, the mentioned PROMISCES models by Behnisch et al. (2023) and Sosnowska et al. (2024) could be directly added to the tools in the SSbD Toolbox.

3.4.2 Recommendation No. 9

The European Parliament should support the approval and implementation of proposal COM/2023/779 and ensure interoperability with existing substances data infrastructures developed by the scientific community.

Relevant Policy Context: Proposal COM/2023/779, REACH

The European Parliament is currently assessing a proposal by the Commission to establish "*a common data platform on chemicals, laying down rules to ensure data* that are *in it*, *are findable, accessible, interoperable and reusable (FAIR) and* to *establish a monitoring and outlook framework for chemicals*" (COM/2023/779). This common data platform aims to introduce a 'one-stop shop' to access data on chemicals held by the European agencies and the Commission, compiled under EU legislation. Types of data include data on hazards, physicochemical properties, presence in the environment, emissions, uses, environmental sustainability of chemical substances, and ongoing regulatory processes.

Currently, there is no common data platform widely recognized by scientists and policymakers enabling secure collaboration and integration of different types of data from multiple sources and databases. Gathering data from several sources and curating their formatting was a bottleneck during the development of the DSF in the PROMISCES project. The integration of data from different sources was time-consuming and difficult, since, for instance, substances are named differently depending on language, can have multiple identifiers, and there is no common protocol for comparing them. Therefore, PROMISCES strongly supports the approval and implementation of COM/2023/779.

During the project, the NDS of the NORMAN Network served as a platform for retrieving data from relevant existing data sources as well as a repository for new data generated by PROMISCES. The NDS provides a comprehensive FAIR infrastructure for chemical substances data, facilitating stakeholders collaboration and data exchange. We recommend that the common data platform aimed for COM/2023/779 should be designed with interoperability as a core principle, ensuring it integrates effectively with existing infrastructures, such as the NDS. This close connection would enable streamlined access to scientific data housed in these platforms, serving as an interim repository for ongoing research and fostering better collaboration between regulatory and scientific communities.

The objective is to enable seamless data exchange between the common data platform, primarily intended for substance regulation and other scientific databases continuously updated with the latest research. This approach emphasizes the importance of interoperability, which provides mutual benefits for both regulatory and scientific communities, creating a mutually advantageous framework. Finally, implementation of this recommendation could benefit the realisation of recommendations #3 and #4.

3.5 Endorsement of ongoing policy activities

3.5.1 Supporting regulatory and policy efforts at the EU level

The PROMISCES project endorses all ongoing policy activities aimed at preventing the emission of PM(T) substances to the soil-sediment-water system and improving their removal. Several key EU-level initiatives are particularly relevant to PROMISCES' objectives, including the proposed PFAS restriction under REACH (ECHA, 2023) and the Common Implementation Strategy (CIS) Work Programme (2025-2027) for the WFD (van der Hulst, 2024).

PROMISCES fully supports the REACH-Annex XV Restriction Report for manufacturing, placing on the market and using PFAS prepared by the national authorities of Germany, the Netherlands, Denmark, Norway, and Sweden (ECHA, 2023). The importance of a PFAS restriction is also underlined by the results of a tiered in silico and in vitro testing strategy for up to 12,000 PFAS compounds applied in PROMISCES. The in silico predictions indicated that more than 7,500 compounds were identified as active, and over 100 PFAS compounds may cause even greater adverse effects than PFOA (Sosnowska et al., 2025).

PROMISCES also acknowledges the recently published draft Common Implementation Strategy (CIS) Work Programme, which aims to strengthen the implementation of the WFD and related policies. PROMISCES findings can support several key CIS actions, including:

- **Revising priority substance and surface water and groundwater watch lists by 2027.** This aligns with PROMISCES **Recommendations No. 3 and 4**, which suggest updates to the existing watch list selection processes as well as the implementation of additional watch lists for wastewater, soil, and sewage sludge. Further, PROMISCES results provide information on specific substances to be considered for the GWWL and SWWL and the proposed additional watch lists (Behnisch et al., 2023; Kowalska et al., 2023; Sosnowska et al., 2025).
- **Gathering data on hazard/toxicity of substances of potential concern to facilitate the prioritisation of candidate substances for the GWD Annex I and II review process by mid-2026.** This relates to **Recommendations No. 2, 4 and 7**, which call for improved data collection on PM(T) substance properties including physico-chemical properties and toxicity. PROMISCES supports integrating toxicological data with regulatory processes to ensure better prioritization of harmful substances.
- **Sharing experience of monitoring methods for PFAS by mid-2026.** This aligns with **Recommendations No. 3 and 4,** which emphasize harmonized monitoring strategies for PFAS and other PM(T)s across environmental compartments.
- **Promoting water reuse in agriculture and other sectors/applications, provide support for risk management via guidelines, best practices and experience sharing by mid-2026.** This aligns specifically with **Recommendation No. 5**, which showcases the use of emission modelling for risk management. Further, barriers to implementing water reuse and circular economy were identified in PROMISCES Deliverables 5.4 (Narain-Ford et al., 2025) and 5.6 (Naus et al., 2025) through co-creation stakeholder workshops and are highlighted in Chapter 4.

3.5.2 Endorsing policy briefs on PM(T) management

PROMISCES also endorses the recommendations outlined in two PROMISCES policy briefs. The recommendations included in the policy brief published in July 2024 with sister projects from the Green Deal are deemed essential to achieve zero pollution in Europe (Paparella et al., 2024). The recommendations are:

1. Support using exposure, non-standard data, and chemical grouping for regulatory action.
2. Support the improvement and the validation process of NAMs.
3. Support leveraging uncertainty assessment for NAM recognition.
4. Provide support for the evolution of a NAM based next-generation regulation.
5. Support for the initiative to develop a European roadmap to an animal-free regulatory system.

PROMISCES published a second policy brief on PM(T) concerns and actions in Europe (Wuijts et al., 2024), highlighting needed policy actions to achieve zero pollution and circularity:

1. The development of adequate strategies for enabling circular economy routes involving PM(T) substances strongly relies on the availability of accurate data on substance characteristics, tonnage, and type of use. With those data available, it is feasible to prioritize PM(T) compounds regarding hazards and risks on a per-compound and a (preferably) per-use basis and thus provide input to policy makers and other actors for developing adequate risk assessment and prioritization strategies.
2. However, in the current registration procedures under REACH and other regulatory frameworks like the Biocidal Products Regulation (528/2012/EC), and Pesticides Directive (2009/128/EC), the lack of detailed and accurate information on uses, especially downstream uses as well as confidentiality and the registration of substances as intermediates, obscures the identification of sectors of most concern regarding their use of PM(T) substances.
3. To achieve a comprehensive assessment of the impact of PM(T) substances throughout their lifecycle, it is essential to expand quantitative exposure data requirements, such as tonnage bands, beyond the scope of the REACH regulation. This extension should encompass other regulatory domains, including pharmaceuticals, biocides, cosmetics, in accordance to the One Substance-One Assessment (OSOA) approach as recently proposed by the European Commission.
4. Identifying substances with intrinsic PMT/vPvM properties and implementing the related CLP Regulation is essential to protect human health and the environment. Furthermore, it will be necessary to amend the nearly 20 EU regulations that rely on one or more CLP criteria, to incorporate the new hazard classes related to PMT/vPvM properties.
5. PM(T)s should be included as Safe and Sustainable by Design (SSbD) criteria and communicated to stakeholders, including through sectorial regulations. Policy development in a circular economy at the European, national, and regional levels should include the prevention of PM(T) substances in the environment as the basic design principle, as this is the most effective type of solution. To support this principle, PROMISCES is developing and applying tools, such as the PMT-assessment tool, to help identify PM(T).
6. Local stakeholders stress the need for tangible objectives and clear policies from the EU or from national governments on PM(T) substances. In addition, strong local partnerships with all stakeholders and authorities involved in the circular economy route and its context are needed to find the optimal (combination of) solutions.

Recommendations No. 2, 8, and 9 from this deliverable specifically support policy actions #1, #2, #3 and #5 from Wuijts et al. (2024), while #6 from the same policy brief underscores the need for stronger stakeholder involvement at the MS level for adequate management of PM(T)s. While these ongoing policy efforts represent progress, several challenges and boundary conditions must still be addressed to ensure the successful implementation of these policies at the MS level. Differences in resource constraints, technical capacities and public engagement create disparities in PM(T) management across Europe. The following chapter discusses these gaps and boundary conditions, emphasizing the need for coordinated action at the EU and national levels.

Broader challenges and considerations for managing PM(T)s Beyond the specific policy recommendations presented in Chapter 3, broader challenges and contextual factors play a critical role in the effective management of PM(T)s. These include disparities among EU MS in addressing these substances, economic and technical constraints, and the need for public awareness and collaboration. This chapter provides a brief overview of these considerations to frame the implementation of the recommendations in a practical context.

4 Broader challenges and considerations for managing PM(T)s

4.1 Addressing member state disparities

The capacity of European MS to manage and address PM(T)s varies widely due to differences in regulatory frameworks, monitoring programs and infrastructure, technical know-how, and available resources. While the entire EU is affected by these pollutants, progress in regulating and managing PM(T)s and PFAS has been uneven across MS. For example, a few MS have enacted stricter threshold values for PFAS beyond those established in the various EU directives. One such country is Denmark, which has imposed a stricter limit of 2 ng/L for the sum of 4 PFAS (PFOA, PFOS, PFNA and PFHxS) in drinking water, whereas the EU limit for drinking water is 100 ng/L for the sum of 20 PFAS (DWD). Figure 4 illustrates this disparity within the EU and the European Economic Area (EEA) using the regulation of PFAS in drinking water as an example (Malarkey & De Kervenoael, 2024).

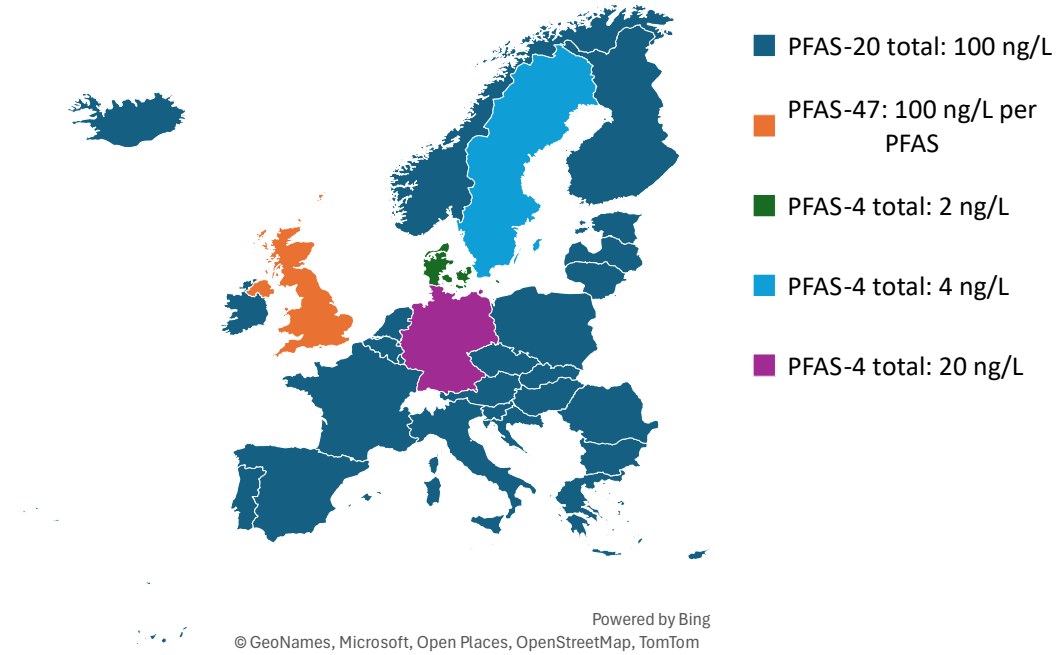


Figure 4. Overview of PFAS drinking water limits across the EU and the EEA. Based on Malarkey and De Kervenoael (2024).

While some countries have developed advanced systems for identifying and mitigating PMTs and PFAS – such as the Netherlands, where all PFAS have been classified as substances of very high concern (Pascoe, 2024) – others are still in the early stages of establishing comprehensive management approaches. To strengthen the management of PM(T)s across Europe, a first step is to understand the general needs of MS and identify what challenges they face in implementing EU directives. To begin this, PROMISCES conducted two surveys, internally at a project meeting and externally at a joint public event with Water Europe. In both surveys, we asked participants what needs exist in their respective countries regarding approaches and awareness for addressing PM(T)s in the soil-sediment-water system.

The respondents answered questions related to identifying MS needs as well as provided ideas for solutions. These solutions can largely be classified as “leapfrog recommendations”. Solutions proposed to address the disparities across MS can include regulatory actions, knowledge-sharing platforms, development of best practices or guidance, and communication needs. Some of the identified MS

needs may be addressed by the PROMISCES policy recommendations provided in Chapter 3. For others, there may already be examples to learn from or concrete suggestions for improvement.

Overview of survey responses

It is important to note that the survey respondents included stakeholders from Austria, Finland, France, Germany, Ireland, Italy, the Netherlands, Poland and Spain. The responses do not, in any way, represent the entire country's status, nor do they represent more than the experience of each individual respondent. Therefore, in summarizing the MS needs, we do not refer directly to any specific country. Instead, the responses were summarized into the overarching categories of **monitoring, analytics, watch lists and risk assessment**. The following paragraphs list the main findings from this survey, generalizing the needs at the MS-level to adequately address and manage PM(T)s. Section 4.2 then presents leapfrog recommendations to be followed in the context of wider boundary conditions.

Monitoring challenges and needs:
Monitoring PFAS and other contaminants in surface waters, soils, sediments, and groundwater varies significantly across countries. Some countries report adequate groundwater monitoring but limited coverage for surface waters, soils, and sediments. Other countries do not perform systematic monitoring and rely on isolated projects that have detected point source contamination. Several countries highlight the difficulty of monitoring large geographic areas.

To address these gaps, there is a clear need to improve the understanding of contamination levels across various environmental compartments and to address both point and diffuse pollution sources. One suggested approach was to establish background soil values at both national and EU levels to enhance data comparability and support policy development. The creation and maintenance of an international knowledge platform, where countries are obligated to upload monitoring information, could ensure consistent data sharing, facilitate collaboration, and improve overall transparency in monitoring efforts. This also relates to the high-value datasets Regulation (EU) 2023/138.

➔ See PROMISCES **Recommendation No. 3**. This recommendation highlights the need for a coordinated and comprehensive list of regulated PM(T) substances across environmental compartments, which includes establishing threshold values and defining background soil values to improve systematic monitoring efforts.

Analytical challenges and needs:
PFAS analysis currently faces several significant challenges. There is a pressing need for the development of new analytical methods to enable real-time monitoring. Additionally, the number of accredited laboratories capable of performing certified measurements on a significant number of PFAS (beyond the 20 regulated in DWD) is insufficient, and many existing labs struggle to reach the quantification limits required for certain applications.

To address these issues, it is crucial to propose comparable analytical methods across all environmental compartments, including water, soil, and sediment and an extended list of PFAS. To this end, it is crucial that technical specifications for chemical analysis and monitoring of PFAS in all matrices are implemented, as is done for water in Directive 2009/90/EC. This will also help in the selection of laboratories able of performing PFAS chemical or toxicological analysis, categorized by analysis type (e.g., target, total oxidizable precursor (TOP), total organic fluorine (TOF)) and media with corresponding detection and quantification limits. Supervised interlaboratory testing should also be implemented to ensure the accuracy and comparability of results. The analytical challenges faced by MS are also recognized by the EC. A potential way forward would be the establishment of a joint monitoring facility, as proposed in COM(2022) 540 or, related to one of the objectives in WFD CIS, to compile a list of accredited laboratories to which MS may send samples for analysis. Finally, advancing

the development of sensors can enable the creation of a reliable database, enhancing monitoring and analysis efforts across all environmental compartments.

➔ See PROMISCES **Recommendations No. 3** and **No. 4**. The analytical challenges in detecting and quantifying PFAS highlight the need for methods with comparable results across environmental compartments, a key aspect of both Recommendations No. 3 and No. 4. Recommendation No. 3 calls for aligning the regulation of PM(T) substances across environmental compartments – soil, sewage sludge, sediment, and water – which would facilitate the development of uniform analytical methods and ensure comparability of monitoring data across MS. Similarly, Recommendation No. 4 proposes expanding watch lists for wastewater, soil, and sewage sludge, making it essential to establish consistent detection and quantification limits.

Watch list challenges and needs:
The absence of an EU-wide watch list for PFAS and specific quality targets for reuse practices poses significant challenges to the implementation of not only a circular economy but also to the Zero Pollution Action Plan and the EU Soil Strategy. While some countries are actively conducting monitoring campaigns to prepare for future watch lists, many EU MS remain inactive, resulting in uneven data availability and gaps in understanding contamination trends.

In addition to creating a watch list, there is a need to define clear guidance on how to interpret and act upon monitoring results. The upcoming revision of the Water Framework Directive (WFD) plans to introduce a mandatory GWWL, aligning with the existing mechanism for surface water (COM(2022) 540 final). However, standardized testing protocols, a challenge for analytical methods, and equitable contributions from all MS are essential to addressing disparities and improving PFAS management across the EU. Additionally, extending the watch list concept beyond groundwater to include wastewater, soil and sewage sludge could further enhance contamination assessment and management across environmental compartments. Finally, while monitoring efforts for various compounds are planned or underway, there is uncertainty about how to utilize the findings effectively to inform policy and practice.

➔ See PROMISCES **Recommendation No. 4** for suggestions on establishing comprehensive watch lists for the soil-sediment-water system.

Risk assessment challenges and needs:
The lack of threshold values for PFAS presents significant challenges for effective risk assessment and management. Specifically, the absence of defined PFAS target values for remediation purposes forces stakeholders to rely on maximal-effort approaches, which may be inefficient or overly conservative. Establishing clear and practical risk thresholds, for PM(T)s as well as PFAS, is essential to guide remediation efforts, prioritize resources, and ensure consistent and effective management of contamination across various environmental compartments. Developing a standard methodology for risk assessment and addressing risks to both ecosystems and public health while ensuring a comprehensive approach to PFAS risk management, is a critical step to achieve these goals.

➔ See PROMISCES **Recommendation No. 7** for one suggestion on how to establish sufficiently protective thresholds for PFAS.

4.2 Boundary conditions for effective management

Addressing PM(T) substances and PFAS in the soil-sediment-water system requires more than targeted policies and technical solutions. The effectiveness of any management strategy is influenced by a range of 'boundary conditions' – factors that shape the feasibility, implementation, and sustainability of management practices. These conditions include **financial considerations**, such as the costs of advanced treatment technologies and analytical testing; **knowledge-sharing aspects**, such as mechanisms for sharing data and best practices across MS; and **social dimensions**, such as public awareness and perception of risks associated with these substances and acceptance of solutions.

This section highlights key boundary conditions that emerged during the PROMISCES project as critical to successfully managing PM(T) substances, including PFAS (Narain-Ford et al., 2025; Naus et al., 2025). While these factors are not the primary focus of our specific policy recommendations in Chapter 3, they represent essential boundary conditions that policymakers and stakeholders must address to ensure that the proposed measures can be effectively implemented and maintained across Europe. In addition to framing these boundary conditions, we provide some best practice suggestions, or "leapfrog recommendations" that can help bridge the gap between MS in their approaches to managing PM(T)s.

Financial considerations:
The financial burden of effectively managing PM(T) substances across the soil-sediment-water system remains a critical barrier to progress, particularly in the absence of enforceable legislative requirements. Some MS highlighted that unclear timelines for regulatory enforcement hinder the willingness to invest in treatment technologies and monitoring programs. In other countries, high analytical costs make testing challenging, especially for smaller water operators who need to meet monitoring and advanced treatment costs. Without addressing these gaps in financial resources and infrastructure, the disparities at the MS level will be exacerbated, preventing adequate management of the transboundary challenge posed by PM(T) substances.

To overcome these challenges, a combination of EU-level and MS national policies could provide much-needed financial support and incentives. One potential approach is to establish subsidies, tax credits, or grants that encourage early adoption of proven PM(T) and PFAS remediation technologies, fostering innovation and accelerating uptake. Several EU funding programs, such as NextGenerationEU or the EU Innovation Fund, provide financial support for solutions that work towards the EU's green transition. Regulations pertaining to expanding extended producer responsibility (EPR) systems to cover not only treatment costs but also monitoring and research could alleviate the financial burden on smaller operators. These measures, collectively, could help to create a more equitable financial framework in which resources are distributed efficiently to manage PM(T)s effectively across Europe.

➔ See PROMISCES **Recommendation No. 6**, which proposes evaluation criteria for treatment technologies. These criteria, such as "safety and environmental impact" or "sustainability", can help identify technologies that support the EU's green transition and could therefore be eligible for funding support.

Knowledge sharing:
The absence of robust systems for monitoring data sharing across environmental compartments hinders the ability to understand and manage PFAS contamination effectively. Establishing a centralized EU-wide platform for knowledge exchange is essential to address this gap. Such a platform should consolidate regulations, methods, and data from MS, ensuring accessibility, transparency, and comparability. To make such a platform effective, transparency regarding participation – who contributes, how data is shared, and how stakeholders can engage – must be prioritized. Expert

member groups at both state and EU levels could oversee and guide this process, ensuring harmonization and inclusivity.

Equally critical is raising awareness of existing solutions and their practical application to real-life scenarios. Creating a data hub of available solutions for monitoring, analysis, risk assessment and treatment could streamline efforts to tackle PM(T)s and ensure harmonization of evaluation. Practical tools, including user-friendly decision support frameworks, like the PROMISCES DSF, can empower stakeholders to select suitable solutions. Another recommendation would be to create an EU-wide technological marketplace or expand existing platforms, such as the Water Europe Marketplace and the European Innovation Centre for Industrial Transformation and Emissions (INCITE), to offer risk managers concrete solutions and examples of applying advanced technologies.

Workshops, APEX organisations and targeted events can facilitate collaboration, allowing stakeholders to share results, methods, and best practices while also fostering partnerships to strengthen capacity across the EU. By fostering collaboration through workshops, case study groups, and round tables, and promoting partnerships with organizations like Water Europe, knowledge sharing can drive the adoption and scaling of innovative technologies. Together, these efforts could help ensure a consistent approach across all EU MS.

➔ See PROMISCES **Recommendations No. 6** (p. 27) and **No. 9** (p. 32). The criteria provided in Recommendation No. 6 can be provided via a technological marketplace, for example, to aid practitioners in selecting appropriate technical solutions. Recommendation No. 9 provides a suggestion for a common data platform.

Social dimensions:
Raising public awareness and fostering community involvement are essential for addressing PFAS contamination effectively. Many individuals remain unaware of what PFAS are, their widespread presence, and the potential risks they pose. Public outreach efforts, such as consumer-focused materials and educational initiatives, can bridge this gap by explaining the implications of PFAS use and contamination. Here, EU-funded projects, such as PROMISCES, can help develop messaging, and lessons learned from past EU awareness campaigns, such as #WaterWiseEU, could be leveraged to better inform the public. An informed public can lead to political change by placing pressure on policymakers to enact legislation or allocate funding for PFAS-management efforts.

Consumers may also not be aware of the pervasiveness of PFAS in products. Clear labeling of products, such as “PFAS-free” or, alternatively, “containing PFAS,” even at low concentrations, can further empower individuals to make informed choices. Integrating education on PFAS into programs for different age groups, including schools, can build a more informed and engaged public over time. Efforts like mapping contaminated sites or creating accessible databases can improve understanding and foster collaboration among stakeholders. The Forever Pollution Project, led by European journalists, is a leading example of such consolidated communication efforts. Incorporating diverse perspectives, including those of consumers and communities, will support the development of inclusive and actionable approaches to managing PFAS and similar pollutants.

5 Outlook

This deliverable provides nine actionable policy recommendations to improve the prevention and management of PM(T)s in the soil-sediment-water system at both the EU and MS levels. Each recommendation has been aligned with existing policy frameworks, including the CEAP, ZPAP, EU CSS, the EU Soil Strategy, as well as relevant directives and regulations, highlighting the interdisciplinary nature of the challenge posed by PM(T)s. The five overarching recommendations (No. 3-7, see Table 4) focus on aligning current directives and regulations across the soil-sediment-water system, fostering a comprehensive, more effective management of PM(T)s. The four specific recommendations (No. 1, 2, 8 and 9, see Table 4) focus on improving the implementation of existing policies, offering guidance for national authorities, the industry, risk managers, researchers and other stakeholders.

Implementing the proposed policy recommendations effectively requires follow-up actions at both the EU and MS levels. In Table 4, we have identified the relevant governance level(s) for each policy recommendation, defining the main target audience (EU or MS) of each recommendation, who should therefore be responsible for its implementation. This is based on the structures, processes, mandates and capabilities available at the EU and MS governance levels.

It is important to note that Table 4 focuses specifically on the implementation level of each policy recommendation rather than identifying the key actors impacted by its execution. In a circular economy, actors along the entire value chain – including industry, water operators, final customers (i.e. farmers) and society – can be affected by a proposed policy recommendation depending on its aim. This information is detailed within each policy recommendation in Chapter 3, while Table 4 is intended to indicate primary governance responsibility rather than capture the full range of involved actors.

Table 44. Levels at which the PROMISCES policy recommendations should be enacted.

#	PROMISCES Policy Recommendation	Type of Recommendation	EU	MS
Regulating Substances				
1	For substances that are (potentially) PMT or vPvM and difficult to remove from soil, sewage sludge, sediment, and water, Member States Competent Authorities (MSCAs) should prioritize setting emission limit values as low as reasonably achievable.	Specific		x
2	The European Chemicals Agency (ECHA) and MSCAs should request users and producers of potentially persistent, mobile, and/or toxic intermediates to provide sufficient comprehensive data on their physicochemical properties and toxicity to ensure these substances are properly assessed and regulated under the PMT/vPvM classification framework established by the CLP Regulation.	Specific	x	x
Circular Resource Management				
3	The EC should align the list of regulated persistent, mobile, and/or toxic compounds between soil, sewage sludge, sediment and water to increase the safe circular use of these resources.	Overarching	x	
4	To ensure the circularity of resources, the EC should coordinate the processes for selecting substances for the Surface Water Watch List and the Groundwater Watch List with Regulation (EC) No 2024/2865 on Classification, Labelling, and Packaging of Substances and Mixtures (CLP) and initiate a watch list for wastewater, soil, and sewage sludge.	Overarching	x	

#	PROMISCES Policy Recommendation	Type of Recommendation	EU	MS
5	The EC should require emission modelling of PM(T) and vPvM substances into surface waters on the catchment scale, and modelling of transport via surface water into groundwater, to identify knowledge gaps regarding emission sources and pathways, enable risk assessment on entire river basins, and facilitate scenario evaluation.	Overarching		x
Technology Performance and Pollution Control				
6	The EC should establish evaluation criteria for technology providers to evaluate treatment technologies for soil, water, sediment and sludge, and require technology providers to report these criteria.	Overarching	x	x
7	To achieve the Green Deal's ambition for a toxic-free environment, the EC should consider non-animal based methods, such as PFAS CALUX, as an information source for risk assessment and management of PFAS.	Overarching	x	
Tools and Data Management				
8	The EC should make PROMISCES tools and information from the PROMISCES Decision Support Framework (DSF) available to industry for the effective implementation of the Safe and Sustainably by Design (SSbD) framework in addition to the SSbD Toolbox.	Specific	x	
9	The European Parliament should support the approval and implementation of proposal COM/2023/779 and ensure interoperability with existing substances data infrastructures developed by the scientific community.	Specific	x	

This report also identified key areas where MS face challenges, such as monitoring, analytics, watch lists, prevention, and risk assessment. Considering survey results and stakeholder perspectives, we highlight broad leapfrog recommendations to address disparities among MS, showcasing best practices that can close the gap towards more effective PM(T) management.

Additionally, PROMISCES highlights key research needs which are critical for advancing PM(T) management:

1. **Developing methodologies to evaluate PFAS and PM(T) release from matrices (e.g. soil, sediment, sludge):** This could include adapting leaching/lixiviation tests to the specificity of PFAS and other PM(T) substances, enabling more accurate assessments of their impacts on the water cycle, as well as human and environmental exposure.
2. **Developing a methodology to evaluate PFAS mass balance during treatment:** A comprehensive methodology is needed to quantify amount of PFAS removed, degraded and retained in treatment systems. This would ensure that no substance is overlooked in the overall balance.
3. **Performing a cost-benefit analysis of implementing watch lists for wastewater, soil, and sewage sludge**: this analysis should highlight potential economic and environmental benefits. This will provide policymakers with a clearer understanding of the financial and environmental implications.
4. **Investigating the added value of an integrated European Regulation linking environmental matrices**: this could be useful for the sake of water resilience enhancement.
5. **Establish effect-based trigger value for total PFAS on a large data set of PFAS CALUX analyses in different kinds of water**: this can aid the implementation of recommendation No. 7.

These research needs align with PROMISCES policy recommendations No. 4, No. 6 and No.7 and highlight areas for future EU research funding calls. Other relevant areas for research calls would be

the analysis of implementation strategies for the presented policy recommendations as the development of a policy implementation road map was outside the scope of this deliverable. Another suggestion would be to direct funding towards the maintenance of the DSF on the NORMAN website.

By addressing the proposed research gaps and indicated needs for funding, the EU can enhance its scientific understanding of PM(T)s and ensure that future policies are grounded in scientific evidence. Future research projects can build on the PROMISCES findings reported in this deliverable, addressing open questions and strengthening the science-policy interface further.

This deliverable provides guidance on how to address the complex regulatory landscape surrounding PM(T)s with a particular focus on PFAS. We urge all stakeholders - policymakers, industry leaders, researchers, and the public - to work together to implement these recommendations and achieve a toxic-free environment. By implementing these recommendations, the EU can achieve its zero pollution and circular economy goals, safeguarding human health and the environment for future generations

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