Extended Producer Responsibility (EPR) Schemes in Europe:

Lessons and recommendations for their application in the wastewater sector

Final Report

WAREG
European Water Regulators

ref.

May 15th, 2026

Authors: Paolo Azzurro, Donato Berardi, Letizia Danesi, Giulia Gadani, Andrea Sbandati

TABLE OF CONTENTS

LIST OF TABLES, FIGURES AND BOXES

Tables

Figures

Boxes

GLOSSARY AND ABBREVIATIONS

Glossary of key terms

The glossary explains selected terms that may not be familiar to readers without specialised knowledge of the topics discussed. This limited and intentionally non-exhaustive collection is intended solely to facilitate reading of the report and does not aim to replace encyclopaedic sources or legal definitions.

Collective Producer Responsibility (CPR): Collective Producer Responsibility refers to an organisational model within Extended Producer Responsibility in which producers jointly fulfil their legal obligations, such as financing, organising, or ensuring the proper treatment of products at end-of-life, through a shared system, typically a Producer Responsibility Organisation. Instead of each producer managing its responsibilities individually, they pool resources and coordinate actions collectively to achieve compliance more efficiently and cost-effectively.

Competitive model: In the context of Extended Producer Responsibility, competitive models refer to systems in which multiple Producer Responsibility Organisations compete in the market to provide compliance services to obligated producers.

Concession-based model: This refers to an approach in which the government grants a concession to a private company, for a defined period, to carry out the operational activities required to meet legally established waste management targets and entrusts it with collecting the fees paid by obligated producers.

Dual systems: A dual system is a compliance model, originating in Germany's packaging EPR ("Duales System Deutschland"), in which producer-financed schemes operate in parallel to municipal waste management, allowing multiple competing PROs to organise the collection and recycling of regulated products under a common legal framework.

Eco-modulation: Eco-modulation refers to the practice of modulating producer fees within an Extended Producer Responsibility scheme based on the environmental performance of products. Under eco-modulation, producers pay lower fees for products that are easier to reuse, repair, recycle, or that contain fewer hazardous substances, and higher fees for products with poorer environmental characteristics. The aim is to incentivise eco-design and reduce the overall environmental impact of products throughout their life cycle.

EPR fee: The EPR fee is the financial contribution paid by producers to a Producer Responsibility Organisation or to a public authority under an Extended Producer Responsibility scheme, intended to cover the costs of managing the products at the end of their life, in accordance with the "polluter-pays" principle.

Extended Producer Responsibility Scheme (EPR scheme): An Extended Producer Responsibility scheme is a regulatory framework under which economic operators are assigned financial and/or organisational responsibility for preventing, reducing, and managing pollution or waste arising from their activities, products, or substances placed on the market, in accordance with the polluter-pays principle.

Financial responsibility: Financial responsibility refers to the obligation of producers to cover the costs associated with managing their products at end of life. In the waste sector

this typically includes the expenses for collection, sorting, treatment, recycling or disposal, as well as related administrative, monitoring, reporting and communication activities.

Individual Producer Responsibility (IPR): Individual Producer Responsibility refers to an organisational model within Extended Producer Responsibility in which producers assume responsibility for meeting their own legal obligations such as financing or arranging the end-of-life management of the products it places on the market on a standalone basis. Unlike Collective Producer Responsibility, producers do not pool resources or delegate tasks to a shared organisation; instead, they manage and fulfil their obligations independently.

Industry-led model: This refers to an EPR model in which producers, and the organisations representing them, take the primary role in designing, governing and operating the system. In an industry-led model, producers make key decisions on system organisation, financing, contracting waste operators and performance strategies, while public authorities focus mainly on oversight, enforcement and setting regulatory requirements.

Monopolistic model: In the context of Extended Producer Responsibility, monopolistic models are characterised by the existence of a single Producer Responsibility Organisation holding exclusive rights or obligations to organise and manage producer compliance for a specific product category or territory.

Organizational responsibility: Organizational responsibility refers to the obligation of producers to ensure that the systems and arrangements needed for the proper end-of-life management of their products are effectively established. This may involve contracting waste or wastewater treatment operators, waste sorting facilities, monitoring activities (waste composition/wastewater analysis), coordinating logistics and the valorisation of waste on the market.

Polluter-Pays Principle (PPP): The Polluter-Pays Principle is a guiding principle of EU environmental policy, enshrined in Article 191(2) TFEU, whereby the polluter is required to bear the costs of measures taken to prevent, reduce, and remedy environmental harm.

Producer Responsibility Organisation (PRO): A Producer Responsibility Organisation is a legal entity established or authorised to organise, on behalf of producers, the fulfilment of obligations arising from an Extended Producer Responsibility scheme.

Shared model: This refers to an EPR model in which responsibility for the operational management of waste is shared between producers, typically acting through one or more PROs, and public authorities (e.g. municipalities). Under this model, tasks such as collection, sorting, and treatment may be allocated between the parties based on legal provisions or contractual arrangements, with corresponding cost-sharing mechanisms.

State-led model: This refers to an approach in which the government plays the central role in organising, governing, and overseeing the EPR system. In a state-led model, the government typically defines how collection and treatment systems must operate, sets fees or fee-setting rules, manages or designates the operator of the scheme, and maintains strong control over compliance and financial flows. Producers still finance end-of-life management, but the strategic and operational decisions are primarily driven by the state rather than by industry.

List of Abbreviations

CAPEX: Capital expenditure
CPR: Collective Producer Responsibility
DRS: Deposit Return System
EEA: European Environmental Agency
EC: European Commission
EEE: Electrical & Electronic Equipment
ELVs: End of Life Vehicles
EPR: Extended Producer Responsibility
EU: European Union
EurEau: the European federation of national associations of water services
EXPRA: Extended Producer Responsibility Alliance
GAC: Granular activated carbon
IA: Impact Assessment
IFRS: International Financial Reporting Standards
IPR: Individual Producer Responsibility
IPRs: Intellectual Property Rights
JRC: Joint Research Centre
MS: Member State
MPs: Micropollutants
NIP: National Implementation Programme
OECD: Organisation for Economic Co-operation and Development
OPEX: Operational Expenditure
P.E.: Population equivalent
PAC: Powdered activated carbon
PPP: Polluter Pays Principle
PPW: Packaging and Packaging Waste
PRO: Producer Responsibility Organisation
R&D: Research and Development
SUP: Single-Use Plastic
TFEU: Treaty on the Functioning of the European Union
UWWTP: Urban Wastewater Treatment Plant
UWWTD: Urban Wastewater Treatment Directive
WAFD: Water Framework Directive
WAREG: Association of European Water Regulators
WEEE: Waste from Electrical and Electronic Equipment
WFD: Waste Framework Directive
WWTUs: Wastewater Treatment Utilities

EXECUTIVE SUMMARY

The revision of the Urban Wastewater Treatment Directive (UWWTD[1]) introduces, for the first time, an Extended Producer Responsibility (EPR) scheme dedicated exclusively to funding quaternary treatment for the removal of micropollutants (MPs) from urban wastewater. This mechanism requires manufacturers of pharmaceuticals and cosmetics to cover at least 80% of the total costs – including investment, operational management and monitoring activities – necessary to ensure compliance with the Directive's technical and environmental requirements. In this context, WAREG has commissioned REF to conduct a comparative analysis of European EPR experiences in the waste sector to assess the extent to which these may be useful for designing a similar system in the water sector, considering the technical, regulatory and institutional specificities that characterise wastewater treatment services.

The study opens with **a comprehensive mapping of existing EPR schemes in the waste sector across 16 Member States**, supplemented by a review of the scientific literature, regulatory and policy documents, as well as interviews with producer responsibility organisations (PROs), water operators, producer representatives, regulators and other stakeholders. This approach enables a clear identification of the structural limitations underlying the similarities between the two sectors, while simultaneously highlighting the conceptual elements that can be adapted for the implementation of EPR within the framework of the UWWTD.

A review of existing systems in the **waste sector reveals that EPR models** in this sector can be categorised into **three main groups**.

1. The first comprises systems in which there are **no producer organisations made up of the economic operators concerned**: the obligated parties (the producers) are required to pay a financial contribution into a centralised fund, which may be managed directly by the State, through a public agency (e.g. Croatia), or by a private entity on the basis of a state concession (e.g. Hungary).
2. The second broad category comprises **models with a single national PRO**, almost always a non-profit organisation, to which obligated parties - if they do not independently ensure compliance with the obligations under EPR - are required to register and pay the required financial contribution. Responsibility for the operational management of waste covered by EPR is generally shared between the PRO and the local authorities/waste service operators. The financial resources derived from the contribution paid by obligated parties are managed by the PRO to support its own waste management activities and to cover (in whole or in part) the costs incurred by the local authorities/operators.
3. The third model, on the other hand, involves a competitive structure in **which several PROs compete** with one another to provide EPR 'compliance' services to obligated parties: producers may fulfil their EPR obligations by selecting among the various PROs operating in their market segment. Depending on the system design, operational responsibility for waste management may lie entirely with

[1] *Directive (EU) 2024/3019 of the European Parliament and of the Council of 27 November 2024 concerning urban wastewater treatment*

PROs or be shared with public authorities, which are remunerated for the services provided under specific agreements between the parties.

There are, of course, also hybrid systems (e.g. Latvia), in which producers can choose between paying a financial contribution (eco-tax) to a State fund, or joining a recognised PRO which assumes responsibility for the collection and recycling of waste covered by EPR.

However, **the experience of the waste sector cannot be mechanically transferred to the water sector**. The latter is a regulated natural monopoly, characterised by a fundamentally different industrial structure and lacking the key conditions required for competitive EPR systems to operate effectively. By its very nature, wastewater management does not generate streams of marketable materials or contestable operational activities. Wastewater treatment plants are subject to national planning, authorisation requirements and governance structures that typically provide for a single management entity per optimal area (river basin or other management perimeter), which is incompatible with the assignment of operational tasks to PROs. Furthermore, the UWWTD itself unequivocally assigns responsibility for achieving environmental outcomes to Member States, and through them to plant operators, whilst limiting PROs to a strictly financial and administrative role. This means that it is not possible to assign operational or performance responsibilities to PROs, nor to envisage models of competition based on the PROs' ability to achieve better results on a purely administrative level.

Similarly, a model based on direct negotiations between PROs and utilities for the financing of investments would be inconsistent with the existence of economic regulators and national implementation programmes provided for by the Directive, and would create negotiating imbalances, particularly to the detriment of smaller operators or those with less financial capacity.

The table below presents an interpretation of the roles and responsibilities of the main actors involved in the potential EPR scheme, based on the Impact Assessment (IA) accompanying the Commission proposal for a recast of the UWWTD, as well as on our proposed implementation of the scheme. The following figure, based on the table, presents the economic flows, cost pass-through and distributional mechanisms

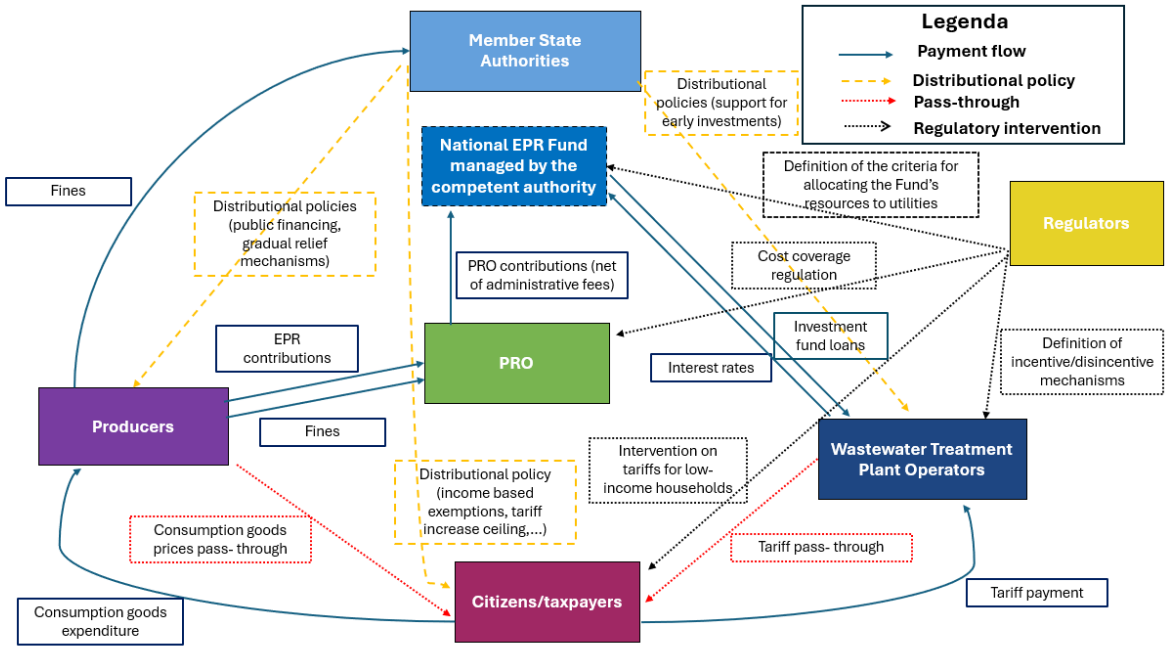
Table 1: UWWTD - main roles and responsibilities of the different actors involved in the EPR schemes

Main actors	Main role and responsibilities of the actors
EU	The EU defines minimum objectives, the scope and common principles for the EPR scheme to be complied with Member States, in line with the generic principles of an EPR defined in the WFD (including modulation on fees, full cost coverage, transparency).
MS	▪ MS are mainly responsible for overseeing the detailed and proper implementation of EPR (transposition compliance) ▪ More specifically, MS should ensure that: ○ a reporting system is in place to collect data on products placed on the market and on wastewater treatment;

Main actors	Main role and responsibilities of the actors
	○ PRO(s) have the financial and organisational means to meet the EPR obligations (procedure to recognise the PRO's) and proper self-control mechanisms (regular independent audits for financial management and quality of data collected and reported); ○ Fee modulation is applied by the PRO(s); • MS puts in place a control system to ensure that all importers/producers are fulfilling their obligations by being member of a PRO(s); • They collect fines from non-compliant producers; • MS design and implement distributional policies (towards citizens/taxpayers, producers and WWTOs).
Producers/ Importers	• They will have to adhere (have a contract) to PRO(s), declare what they are placing on the EU market and pay fees to PRO(s) depending on the quantities and toxicity of the products they place on the market; They will take decisions on cost allocation (either product cost increase or reduce profit margins) and on product composition (less toxic if possible); • They pay fines to PRO(s) and/or the MS, if not compliant with the obligations of the UWWTD; • They sell pharmaceutical and cosmetic products to citizens/taxpayers.
PRO(s)	• PRO(s) implement the financial responsibility for the treatment of micropollutants for their members; • PRO(s) collect statistics on products placed on the EU market by their members, and collect their financial contributions according to fees to be established by the PRO(s); • The funds collected will be used to finance additional treatment (quaternary treatment) according to the deadlines and the objectives fixed in the Directive; • PRO(s) inform consumers about waste prevention, take-back schemes, and awareness measures, shall this role be assigned to them by Member States; • They collect fines from non-compliant producers; • PROs transfer the collected contributions to a central fund managed by a designated public authority, after retaining the amounts necessary to cover their administrative costs and other legally mandated activities, including consumer information, reporting and data management, and transparency obligations.
National EPR Fund managed by the competent authority	• Collects the EPR contributions from the PRO(s) • They provide investment fund loans to WWTOs; • They collect the interests on the funds lent to WWTOs.

Main actors	Main role and responsibilities of the actors
WWTOs	• They will have to progressively install additional treatment for micropollutants in line with the deadlines included in the Directive and with the financial support of the PRO(s); • They will report on the performances met to PRO(s) and competent authorities; • They collect tariff payments from citizens/taxpayers. • They receive investment funds borrowing from the public fund national concessionaire; • They pay interests to the public fund national concessionaire on the funds received.
Auditing Companies	• External control by independent auditing companies will concern the quality of the reported statistics on products placed on the EU market and on financial streams; • Results of the audits should be made available to MS competent authorities.
Citizens/taxpayers	• They presumably pay the remaining 20% of the quaternary treatment costs in the water tariff; • They consume pharmaceutical and cosmetic products.
Economic regulators	Depending on the role assigned by national authorities, where present, economic regulators may be involved in two main groups of functions: 1. Core functions of the economic regulator • Strengthening of planning instruments; • Strengthening of accounting unbundling; • Control of operating costs; • Control of capital costs; • Strengthening of technical quality regulation; • Strengthening of affordability instruments. 2. Functions related to EPR system governance and PRO oversight • Definition (or collaboration in) of administrative procedures; • Definition (or collaboration in) of the financial flow arrangements; • Definition (or collaboration in) of the overall system governance; • Design (or collaboration in) of monitoring and reporting systems; • Definition (or collaboration in) of PRO audit arrangements; • Control (or collaboration in) of the financial and operational functioning of PROs; • Verification (or collaboration in) of PRO compliance with EPR obligations.

Figure 1: Economic flows, cost pass-through and distributional mechanisms under the UWWTD Extended Producer Responsibility: a suggested framework[2]



In addition to the management model, **cost allocation** is another crucial element. The Commission's updated estimates indicate an annual requirement, once fully operational, of between €1.48 and €1.80 billion, of which at least 80% must be covered by producers. The remaining 20% will fall on water systems, through tariffs or, where applicable, on national or European public funds. The design of the EPR system must therefore incorporate measures to safeguard affordability, as water services are essential and universally consumed. This implies a **strengthening of redistributive instruments** (such as water subsidies, social tariffs, targeted public contributions) – which are already in place in many countries – and the need to monitor the potential impact on pharmaceutical markets, where EPR costs could be partially passed on to healthcare systems.

A cross-cutting issue that emerged in the interviews and of significant operational relevance, concerns **the management of non-payment**. In the water sector, where the amounts to be collected are expected to be substantial, **it is essential to establish financial guarantee instruments, effective penalty mechanisms and clear compliance management protocols**.

The Directive also requires a robust governance framework, based on licences, independent audits, performance indicators and transparency rules. **The role of economic regulatory authorities**, where they exist, may prove decisive, particularly with

[2] Figure illustrates the main economic and financial flows that could be generated by the implementation of the UWWTD EPR framework, highlighting how costs may be allocated and potentially passed through across stakeholders. It is based on the assumption that Member States have opted for a national EPR Fund managed by the competent authority and the presence of a single PRO. In this context, "regulators" refers specifically to economic regulators.

regard to the **integration of EPR flows into tariff systems, the definition of eligible costs, the verification of the proper allocation of resources, the measurement of the extent to which new plant performance targets are met, and consumer protection**. This role cannot be taken for granted: it requires an explicit regulatory choice and a clear definition of the scope of intervention, as the current governance structure of PRO in waste often operates outside the scope of economic regulation. This is the direction in which **WAREG's advocacy efforts should be directed**, particularly at the level of individual Member States, **to ensure that, during the transposition phase, a central role is recognised for economic regulation**, avoiding centrifugal pressures which could, on the one hand, accentuate the fragmentation of the service – for example, by assigning the development and management of quaternary treatment plants to third parties – and, on the other hand, generate increased costs for the service that are unsustainable for end-users.

However, where it proves necessary to draw on external technical expertise and financial resources to meet the environmental targets set by the Directive, water service concessionaires could make use of specific **project finance** solutions designed to temporarily entrust the design and management of quaternary treatment plants to specialist entities, without prejudice to the principle of integrated management. To this end, **WAREG could promote, among its members, tariff methodologies that recognise the contribution of project finance**, as well as the related costs (fees, service charges) arising from the outsourcing of the aforementioned activities to third parties.

It is precisely **within the area of regulatory action** that water authorities should implement a set of significant measures. These measures are intended to strengthen planning and monitoring tools and simultaneously incentivise management, whilst ensuring cost transparency, technical quality in line with the new regulatory requirements and the establishment of adequate mechanisms to safeguard affordability for end users. If implemented in a coordinated manner, these measures can foster the efficient and sustainable development of the sector in the coming years.

The table below summarises some of the possible courses of action for national regulators.

Table 2: Regulatory measures resulting from the Directive.

Actions	Description
Enhancement of planning tools	*Define clear rules for the identification and planning of the investments required for WWTUs to comply with the targets and requirements laid down in the UWWTD and other relevant legal frameworks and ensure that enforcement measures are applied where plans are deemed inadequate.*
Strengthening of accounting unbundling	*Establish clear rules and procedures for accounting unbundling, including activities within each individual segment of the supply chain, in order to enable the reporting of operating and capital costs relating to the quaternary treatment, to be allocated on a pro rata basis to the EPR system.*

Actions	Description
Definition of administrative procedures	*Establishment of administrative procedures for the collection of revenues from PROs and their distribution to individual operators, based on costs reported on a regular basis.*
Control of operating costs	*Introduction or strengthening of regulatory measures designed to promote efficiency in operating costs (e.g. price caps, benchmarking…).*
Capital cost control	*Introduction or strengthening of regulatory measures designed to promote compliance with investment plans (e.g. penalties where the difference between the planned and actual figures exceeds a certain threshold).* *Introduction or strengthening of regulatory measures designed to prevent inefficiencies in the execution of works (e.g. caps on the total costs reimbursed to the operator, benchmarking, standard costs).*
Strengthening technical quality control	*Introduction or strengthening of the technical quality control system, aimed at setting targets for operators regarding the quality of discharged wastewater, in line with the requirements of the Directive for advanced treatment plants. This includes the possibility of linking these targets to a system of rewards and penalties, thereby establishing an effective incentive mechanism.*
Enhancing affordability tools for households	*In light of the growing pressure on tariff systems, resulting from the ambitious targets set out in the legislation, there is a need to strengthen affordability measures – i.e. social subsidies – which should also be extended to cover the costs of sewerage and wastewater treatment services.*

Finally, the implementation of EPR requires a tight schedule. By 31/12/2028, Member States must have transposed the Directive (specific deadline: 31/07/2027), established or recognised the PRO, defined data collection procedures, drawn up national investment plans and launched collection mechanisms. It is foreseen that the first contribution cycle will begin not before 2029 and will be followed by a period of monitoring and gradual refinement of processes. The system's full effectiveness will depend on the ability to plan technical design in advance, test information flows and precisely define costs, responsibilities and financial flows.

The implementation of the UWWTD must be planned by analysing the activities to be carried out within the main scheduled deadlines.

Figure 2: UWWTD – Timeline (deadlines indicated in the Directive)

Given that, as of today (May 2026), regulatory responsibilities are not yet clearly defined, meeting this timeline appears particularly challenging and potentially no longer realistic.

Overall, the study highlights that the EPR envisaged by the UWWTD represents a significant transformation in the way environmental investments in the water sector are financed. Its success will depend on the ability of Member States and regulators to design a system that is simple, clear and consistent with the industrial structure of water services, avoiding the replication of mechanisms devised for completely different technical and economic contexts, such as those of waste management.

Based on the analysis conducted in this study, **the most coherent model for implementing EPR in the water sector is considered to be one based on a single national PRO, potentially structured into two distinct sub-sections, one for pharmaceuticals and one for cosmetics, operating on a not-for-profit basis and supported by a public fund or a centralised allocation mechanism managed by a competent public authority**.

Under this scheme, the PRO would be responsible for collecting contributions, managing data, eco-modulation and consumer information obligations, whilst the distribution of resources to water operators would take place according to criteria that are transparent, stable and harmonised at national level. This model would drastically reduce administrative complexity, facilitate financial risk management and allow the State or the regulator to integrate EPR in an orderly manner into tariff systems and investment planning.

The competent public authority could be designated as the economic regulator, given its established functions in tariff regulation and cost recovery within the water sector.

The designation of the competent authority should be assessed on a case-by-case basis at national level, considering the specific existing institutional structures, the

competences already assigned to different public authorities, and the degree of development of regulatory and administrative infrastructures in each country.

OBJECTIVES OF THE STUDY AND METHODOLOGY

Abstract

This document was prepared in response to the WAREG call (*Research Proposal: Institutional Architectures and Effectiveness of EPR Systems in Municipal Waste and Urban Wastewater Management*). It presents an analysis of EPR schemes currently applied in the municipal waste sector, with the aim of assessing the applicability and transferability of their core design features to the context of urban wastewater management. The objective is to contribute to the definition of guidelines and operational criteria useful for the design and implementation of EPR mechanisms foreseen by the new UWWTD.

Materials & Methods

To address the research questions identified by WAREG, a cross-country comparative analysis of EPR schemes applied to municipal waste in 16 EU Member States was first conducted. The investigation was based on a systematic review of scientific literature, technical reports, policy papers, legislative and regulatory acts, and sector publications, complemented by a documentary analysis of official reports and public data on the performance of EPR systems.

Through the mapping of institutional architectures, the main governance models were identified and the allocation of responsibilities was detailed.

A normative and policy analysis was carried out through an in-depth review of the UWWTD, its accompanying impact assessment, and related background studies.

In addition to the documentary analysis, the project included direct stakeholder engagement, carried out through interviews with representatives of PROs, water sector regulatory authorities, producer organizations, environmental NGOs, and researchers[3]. This approach allowed for testing and refining key recommendations regarding EPR models applicable to the wastewater sector. Within each paragraph, where relevant, a box is provided summarising the perspectives of stakeholders.

Stakeholder engagement enabled the identification of costs, benefits, and potential implementation barriers associated with each model. The resulting analysis supports the selection of the most appropriate solutions, by providing a set of recommendations for the implementation of EPR in the wastewater sector, while defining an operational roadmap.

[3] The subject interviewed are Aqua Publica Europea, Assolombarda, EFPIA – European Federation of Pharmaceutical Industries and Associations, Erion, EurEau, European Investment Bank, EXPRA – Extended Producer Responsibility Alliance, Federchimica, Hungarian regulatory authority (MEKH).

1 MODELS OF EXTENDED PRODUCER RESPONSIBILITY (EPR) IN THE WASTE SECTOR: AN ANALYSIS OF INSTITUTIONAL FRAMEWORKS AND ENVIRONMENTAL AND SOCIO-ECONOMIC OUTCOMES

1.1 A brief introduction to EPR in the EU

The principle of Extended Producer Responsibility (EPR) is widely recognised as one of the most effective policy instruments for improving the management of materials, resources, and waste within a circular economy framework (OECD, 2001). Over time, EPR has evolved into a cornerstone of European Union waste policy (Buclet, 2002; Fischer, 2011; Marques & Ferreira da Cruz, 2018), demonstrating strong performance in downstream waste management. In particular, EPR schemes have contributed to the expansion of separate collection systems, increased recycling rates, and the financing of end-of-life waste management.

The concept of EPR was first formally articulated by Thomas Lindhqvist in a 1990 report to the Swedish Ministry of the Environment (Lindhqvist et al., 1990). In later reports prepared for the Ministry, EPR was defined as follows:

"*Extended Producer Responsibility is an environmental protection strategy to reach an environmental objective of a decreased total environmental impact from a product, by making the manufacturer of the product responsible for the entire life-cycle of the product and especially for the take-back, recycling and final disposal of the product*."[4]

Lindhqvist framed EPR as a policy grounded in the Polluter Pays Principle (PPP), intended to promote environmental improvements across the entire life cycle of a product, rather than merely as a mechanism for product take-back.

Extended producer responsibility was first implemented in the 1990s in countries such as Germany, Sweden and France (OECD, 2014). Since that time, EPR schemes have progressively expanded across Europe, with an increasing number of countries adopting legally binding frameworks.

At EU level the EPR concept was first formally introduced in 2008 by the Waste Framework Directive (WFD, 2008/98/CE). The WFD defines EPR as "*a set of measures taken by Member States to ensure that producers of products bear financial, or financial and organisational responsibility for the management of the waste stage of a product's life cycle*" (cfr. art.3, par. 21).

It requires that "*in accordance with the PPP, the costs of waste management, **including for the necessary infrastructure and its operation**, shall be borne by the original waste producer or by the current or previous waste holders*" (cfr. art.14, par. 1). The 2018 revision of the WFD (Directive 2018/851/EU) introduced Article 8a, which set out **mandatory EU-wide minimum requirements for EPR schemes**. These provisions were

[4] The definition was first published in English in Thomas Lindhqvist, "Extended Producer Responsibility," in the proceedings of the invitational seminar held at Trolleholm Castle on 4–5 May 1992.

designed to enhance harmonisation across existing and future systems, while strengthening their transparency, governance, and cost-efficiency.

EPR in the waste sector can therefore take both financial and operational forms. Financial responsibility represents the minimum requirement under EU law and is a core feature of virtually all EPR systems. Where operational tasks needed to meet legal targets are carried out by public authorities, producers are required to cover, fully or partially, the associated costs of managing waste arising from their products placed on the market. Conversely, where PROs assume operational responsibility, they are involved in the design, organisation, and financing of the system. In practice, most EPR schemes combine these approaches, with operational responsibilities shared, often to varying degrees, between public authorities and PROs.

1.2 Institutional frameworks, allocation of responsibilities and economic and financial models in EPR schemes for waste

The mapping of existing EPR schemes in the waste sector shows that several waste streams are already subject to mandatory EU EPR obligations. Packaging, waste electrical and electronic equipment (WEEE), batteries, and end-of-life vehicles (ELVs) represent "historical" streams regulated under specific EU legislation, including EPR requirements. By contrast, other product groups**,** such as certain single-use plastic products, including fishing gear, and textiles**,** have only recently been addressed at EU level.

As a result, EPR obligations for packaging, WEEE, batteries and ELVs are generally already embedded in the national legislation of all Member States, albeit with significant differences in design and implementation. By contrast, EPR schemes for single-use plastics and textiles remain at an early stage of development in many countries.

For other waste streams not currently covered by EU-level EPR obligations, the introduction of such schemes remains at the discretion of individual Member States.

To date, around 130 EPR schemes are active across the 16 countries covered by this study,[5] spanning approximately 30 product categories.[6] Their scope, institutional arrangements, economic and financial models, levels of cost recovery, and socio-economic and environmental outcomes vary considerably across countries and waste streams (Ahlers, J. et al., 2021; Pruess, J. T. et al., 2025; ISWA, 2019). This variability also reflects the fact that the EU minimum requirements for EPR schemes, introduced in 2018, have not yet been fully implemented across all Member States and waste streams.

5 Belgium, Greece, Hungary, Italy, Lithuania, Latvia, Portugal, Romania, Germany, France, The Netherland, Poland, Slovenia, Spain, Sweden, Ireland.

6 Advertising and office paper, agricultural plastics, batteries, boats for pleasure or sport, building construction products and materials, ELVs, cooking oil and fat, disposable nappies, DIY and gardening items, environmentally harmful goods, flat glass, furniture, grave candles, household chemicals, mattresses, medicines, mineral oils, non-packaging plastic products, packaging, plant protection products containing hazardous substances, polyethylene goods, sanitary textiles, sharp self-administration medical devices, solar panels, sports and leisure items, SUPs (tobacco products, chewing gum, wet wipes, balloons, plastic bottles), fishing gear, textiles & footware, toys, tyres, WEEE, wooden furniture

However, comparative studies (e.g. OECD, 2016; Colelli et al., 2022; Ahlers et al., 2021, Facco et al., 2025), show that mandatory EPR schemes tend to cluster around a small number of governance archetypes as briefly outlined below:

1.2.1 Model 1: Centralised, without industry-led PROs

In this model[7] producer fees are paid directly into a central public fund (e.g. Croatia) or to a state-mandated concessionaire (e.g. Hungary), which then allocates resources to waste collection and treatment services and infrastructure in accordance with rules defined by law or regulation. Producers have limited or no organisational responsibility; their role is largely financial and declarative.

Key features:

- There are no industry-led PROs;
- EPR fees are collected centrally;
- A public agency or a private concessionary coordinates contract with waste operators and/or municipalities;
- Producers' influence over operational decisions is limited (or absent).

1.2.2 Model 2: Single-PRO (monopolistic)

In this model, a single, often non-profit, PRO is approved or accredited at national level to manage EPR for a given waste stream. Municipalities typically retain responsibility for waste collection/sorting, while the PRO:

- finances (partially or fully) the cost of separate collection and sorting;
- manages contracts with waste treatment plants and recyclers;
- runs communication and eco-design incentives;
- define eco-modulation criteria for EPR fees, sometimes (e.g. in France), within the framework set by legislation and competent authorities;
- reports performance to authorities.

This is the dominant model in many packaging EPR systems with "shared responsibility" between municipalities and producers. The PRO remains primarily industry-owned, but public authorities and additional private and public stakeholders can participate formally in governance, either through advisory roles, supervisory functions, or structured stakeholder engagement mechanisms.

Public participation in PRO internal governance can take multiple forms, including:

- **Observer seats** on the Board (e.g. Belgium);
- **Consultative committees** representing municipalities, NGOs, recyclers, consumers, and regulators (e.g. France);
- **Scientific or technical advisory bodies**;

[7] Sometimes referred to in the literature as "state fund" or "ecotax" models.

- **Mandatory multi-stakeholder governance instances** established by law (e.g. under the French AGEC Law[8]).

1.2.3 Model 3: Multi-PRO (competitive)

In competitive EPR systems, several PROs operate in parallel and compete for producers as clients. Producers may fulfil their EPR obligations by selecting among the various PROs operating in their market segment. Depending on the system design, operational responsibility for waste management may lie entirely with PROs or be shared with public authorities, which are remunerated for the services provided on the basis of specific agreements between the parties.

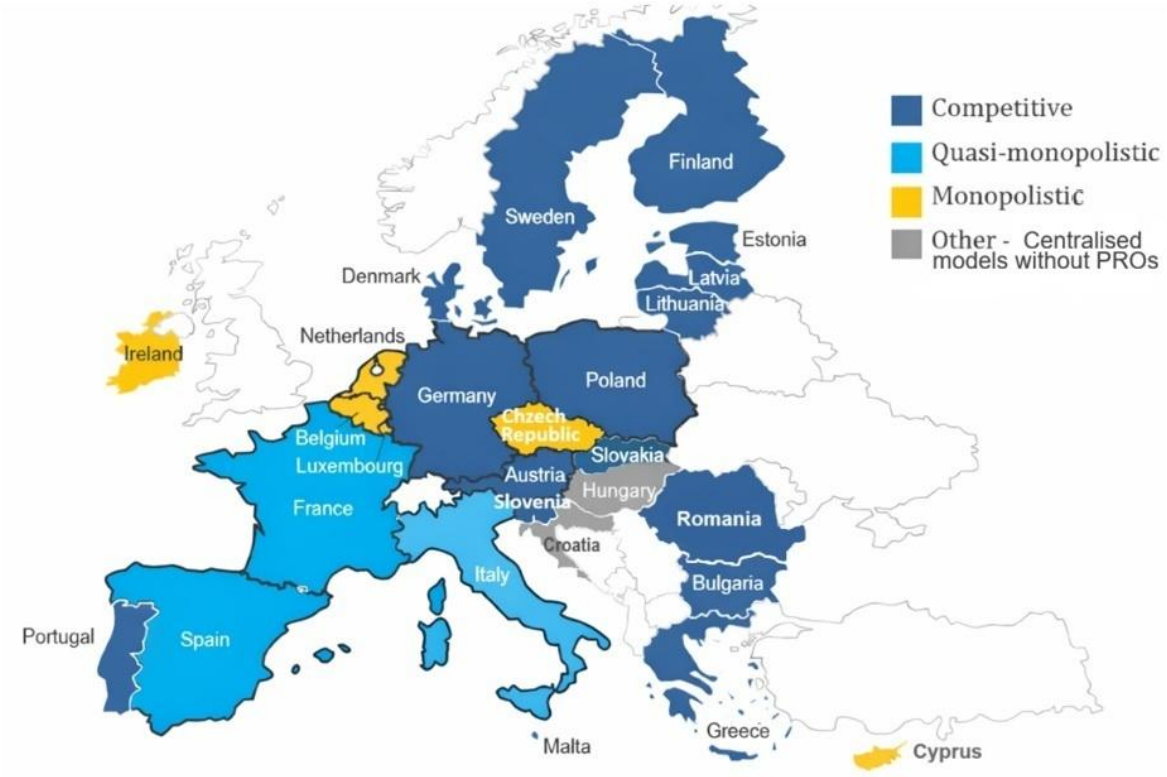
They are usually characterised by:

- producers choosing a PRO and paying fees according to that PRO's tariff;
- PROs organising or financing collection and treatment;
- a clearing house or coordination body to ensure fair sharing of obligations and prevent cherry-picking of profitable areas;
- regulators focusing strongly on competition, market access and anti-free-riding measures.

Looking at the case of packaging, most EPR schemes in the EU operate in competitive environments, although a significant number of Member States maintain monopolistic or quasi-monopolistic models, as illustrated in the figure.

[8] La loi anti-gaspillage pour une économie circulaire.

Figure 3: EU EPR Systems - Market Design for Packaging



1.2.4 Allocating responsibilities

A clear allocation of responsibilities among the actors involved is a cornerstone of any EPR system. EPR can only function effectively when the duties, rights, and interfaces of all actors are precisely defined, legally enforceable, and supported by transparent governance mechanisms.

Under the WFD (as amended by Directive 2018/851), this principle is codified in Article 8a(1)(a), which requires that:

"*Member States shall define in a clear way the roles and responsibilities of all relevant actors involved, including producers of products placing products on the market of the Member State, organisations implementing extended producer responsibility obligations on their behalf, private or public waste operators, local authorities and, where appropriate, re-use and preparing-for-re-use operators and social economy enterprises*."

Similarly, Article 9(4)(a) of the UWWTD provides that:

"*Member States shall ensure that the roles and responsibilities of all relevant actors involved, including the producers referred to in paragraph 1, producer responsibility organisations, private or public operators of urban wastewater treatment plants and local competent authorities, are clearly defined*."

In both policy domains, this requirement is intended to ensure accountability, coordination, and financial transparency, while preventing duplication of tasks or gaps in responsibility that could compromise environmental and economic outcomes.

Across EU Member States, where compliance to EPR rules is fulfilled collectively through a single or multiple PROs, the distribution of roles and responsibilities of the actors involved can be schematically summarised as follows:

1.2.4.1 Role of individual producers

Key roles and responsibilities include:

- **Registering with a recognised PRO**

Producers must join a PRO that has been officially approved or accredited by the competent authority. The PRO acts on behalf of its members to finance and/or organise the collection, sorting, recycling of waste, as well as to report performance data and ensure compliance with regulatory targets.

- **Registering in the national EPR register**

Producers are also required to register in the national register of companies subject to the EPR regime (where such a register exists and is operational). This registration ensures transparency, enables regulatory oversight, and helps prevent free-riding by identifying all companies placing products on the market.

- **Reporting data on products placed on the market**

On a regular basis, typically annually or quarterly, producers must provide accurate data to the PRO and/or the competent authority on the quantities and types of products they place on the national market. This information forms the basis for calculating their financial contribution and for national reporting to the European Commission.

- **Paying the environmental contribution (EPR fee)**

Producers must pay the EPR fee to their chosen PRO. The amount is generally calculated according to transparent criteria such as weight, material composition, recyclability, and other design features of the products linked to their environmental performances. These fees finance the collection, treatment, and recycling of waste, as well as communication, monitoring, and administrative activities related to the EPR scheme.

1.2.4.2 Role of PROs in "dual systems"

Examples: Germany, Austria, Sweden, others in Northern Europe

The expression "dual systems" refers to a packaging EPR model in which multiple competing PROs operate in parallel alongside the municipal waste management system. Producers are free to choose a PRO to fulfil their obligations, and PROs organise the collection, sorting, and recycling of packaging waste, often by contracting with private operators. The model is characterised by the coexistence of two waste management systems: one dedicated to packaging, managed by PROs, and one for the remaining municipal waste, managed by local authorities

Core Features

- Producers (through PROs) assume full operational and financial control over the management of post-consumer packaging waste.

- Local authorities are responsible for managing the remaining municipal waste streams, including the residual fraction.
- Competition between PROs is allowed under licensing and compliance rules.
- A clearing house ensures the fair allocation of collection areas, responsibilities, and costs among competing PROs, and helps align obligations with performance within a shared system

Key roles and responsibilities include:

- **System design & operation:** PROs organise and finance the entire system for collection, sorting, and recycling of waste, often through competitive contracts with private waste operators.
- **Contracts & logistics:** PROs tender, procure, and oversee collection and sorting services (curbside, bring points, sorting facilities), ensuring efficiency and compliance with national performance targets.
- **Financial responsibility**: PROs bear 100% of the costs associated with separate collection, transport, treatment, recycling, and reporting, financed through producer fees.
- **Data & reporting**: PROs collect and report detailed data on quantities placed on the market, collected, and recycled to the competent authority.
- **Consumer awareness & communication**: PROs develop and finance national or regional information campaigns on correct sorting and recycling behaviour.
- **Governance & supervision**: PROs operate under authorisation by the competent authority, with strict transparency and performance monitoring obligations.

1.2.4.3 Role of PROs in "shared models"

Examples: France, Spain, Belgium, The Netherlands, Italy, Czech Republic, Slovenia, etc.

The expression "shared models" refers to an EPR model in which operational responsibility for managing waste covered by EPR is shared between producers and public authorities.

Core Features

- Municipalities (or local public operators) retain the operational role in waste collection since waste is part of the broader municipal waste stream.
- Industry (through PROs) assumes (full or partial) financial responsibility for activities carried out by municipalities, often through negotiated agreements or national framework contracts defining cost coverage, service standards, and performance targets. PROs may retain both financial and operational responsibility for managing waste generated (or collected) by specific user groups (e.g. commercial activities) or for the post-collection stages of waste collected by local authorities.

Key roles and responsibilities include:

- **Financial contribution:** PROs reimburse municipalities (fully or partially) for the costs of collection, sorting, and treatment of waste collected through municipal systems.
- **System coordination:** PROs negotiate national or regional framework agreements with associations of local authorities to define cost coverage, performance criteria, and reporting obligations.
- **Operational roles:** Depending on the legal framework, PROs may assume operational roles that complement those performed by public authorities.
- **Data management & verification:** PROs consolidate data from municipalities and recyclers to ensure compliance with collection and recycling targets, and report aggregated results to authorities.
- **Tendering (when applicable):** In some cases (e.g. Italy, France), PROs tender out treatment/recycling operations (e.g. for plastic waste sorting) or coordinate downstream logistics and market valorisation (e.g. through auction mechanisms) of collected waste.
- **Consumer awareness & communication:** PROs finance or co-finance communication, awareness rising campaigns, eco-design, and prevention programmes, often in collaboration with public bodies.
- **Monitoring & compliance:** PROs ensure transparency on their operations and results achieved and that funds are used in accordance with EPR principles and cost-coverage methodologies.

In both cases, PROs:

- operate under authorisation or accreditation granted by the competent authority, which usually include performance and reporting obligations;
- act on behalf of producers to meet all legal obligations related to waste management and EPR compliance;
- ensure that all producers affiliated with the PRO are registered, compliant, and up to date with reporting and financial contributions;
- serve as the main interface between producers and public authorities, representing members in regulatory discussions and reporting activities;
- collect EPR fees from their members and use them exclusively for the purposes defined by law (collection, treatment, awareness, administration);
- ensure cost transparency and financial equilibrium, in compliance with the polluter-pays principle;
- maintain audited accounts and submit annual financial statements and cost breakdowns to competent authorities;
- where required, apply eco-modulated fees reflecting the environmental performance or recyclability of products.

1.2.4.4 Role of waste management companies in "dual systems"

General characteristics

In dual systems, waste management operators work directly for PROs. The entire system, from collection to recycling, is industry-driven and financed by producer contributions. Municipalities have only a marginal or coordinating role.

Key roles and responsibilities of waste management companies include:

Table 3: Key roles and responsibilities of waste management companies in "Dual Systems"

Function	Description
Collection and transport	Carry out door-to-door or bring-point collection of packaging waste and other EPR materials under contracts with PROs. Operators follow collection frequencies, routes, and performance standards defined by the PRO.
Sorting and pre-treatment	Operate sorting facilities to separate collected materials by polymer, colour, or recyclability grade. Sorting criteria, purity standards, and output specifications are established by the PRO or national coordination body.
Recycling and recovery	In some cases, integrated operators also perform mechanical recycling (e.g., PET or film) or forward sorted materials to accredited recyclers selected through PRO tenders.
Data collection and reporting	Record quantities collected, sorted, and dispatched for recycling; provide auditable data to the contracting PRO for reporting to the competent authority.
Compliance and quality assurance	Must comply with environmental permits, technical standards, and service-quality indicators (e.g., contamination rates, collection coverage). Non-compliance can lead to contract termination or penalties.
Innovation and efficiency	Compete through tenders that reward efficiency, innovation (e.g., route optimisation, digital tracking), and environmental performance.

1.2.4.5 Role of waste management companies in "shared models"

Examples: France, Spain, Belgium, Italy, The Netherlands, Czech Republic, Slovenia

General characteristics

In shared systems, municipalities retain responsibility for collection, often using their own public service operators or contracting private waste management companies. PROs finance part or all of the system and coordinate with municipalities through framework agreements.

Key roles and responsibilities of waste management companies include:

Table 4: Key roles and responsibilities of waste management companies in "shared models"

Function	Description
Collection on behalf of municipalities	Operate under contracts with municipalities (or with local regulatory Authority), not with PROs directly. Follow service specifications set by the public authority (frequency, coverage, performance standards).
Sorting and treatment	Manage, operate or contract sorting centres (e.g. for sorting packaging waste from multi-material collection) or pre-treatment facilities (e.g. to remove contaminants to improve the quality of collected waste) before delivering the collected waste to the PROs.
Interface with PROs	Provide information and data on cost/revenues/performance indicators to municipalities and local economic regulators.
Financial flow	Costs for the waste management services are paid by municipalities (including costs for managing waste covered by EPR); these costs are then (partially or fully) reimbursed by PROs according to agreed criteria considering contamination levels. In some cases (e.g. Italy), waste management operators receive payments directly from PROs. These revenues are then accounted for within the tariff regulatory exercise.
Performance monitoring	Subject to municipal control (or to the control of the local regulatory Authority) and, indirectly, to regional or national performance audits.
Public communication support	Deliver or assist municipalities in awareness and communication campaigns (e.g., correct sorting, contamination reduction) often co-funded by PROs.

1.3 Eco-modulation

Under the WFD, eco-modulation is among the *"General minimum requirements for extended producer responsibility schemes"* (cfr. Art. 8a) introduced by Directive (EU) 2018/851.

According to Art. 8a, par.4, in the case of collective fulfilment of extended producer responsibility obligations, the producers' financial contributions must be modulated "*by taking into account their durability, reparability, re-usability and recyclability and the presence of hazardous substances [...], and where available, based on harmonised criteria in order to ensure a smooth functioning of the internal market*".

Over time, both before and after Directive (EU) 2018/851, several European and international organisations, as well as researchers, supported efforts to introduce eco-modulation of EPR fees across waste streams through guidance and analytical work (Monier et al., 2014; OECD, 2016; Eunomia, 2020; Laubinger et al., 2021; Sachdeva et al., 2021; Lifset et al., 2023; Mallick et al., 2024).

The magnitude of eco-modulation can vary widely across EPR schemes, ranging from full fee exemptions to substantial penalties. In some cases, a 100% bonus is applied, resulting in the complete waiver of the EPR fee, as observed for reusable packaging in Estonia or re-treaded tyres in Portugal. At the other end of the spectrum, eco-modulation may take the form of a 100% malus, effectively doubling the standard EPR contribution,

for example in France, where higher fees are applied to WEEE containing plastic components with brominated flame retardants. However, the literature suggests that, since baseline EPR fees are usually minimal, compared to the price of the product, even substantial eco-modulation on top of a relatively minuscule EPR fee, is unlikely to meaningfully affect product design or material selection.

Origins: flat-rate cost-sharing (1990s–2010s)

When EPR systems were first introduced in the 1990s and early 2000s (e.g., packaging in Germany, France, and Italy; WEEE and batteries later), producer contributions were typically flat-rate fees based on:

- The quantity (weight or units) of products or packaging placed on the market, and
- Sometimes, the material type (e.g. plastic, paper, glass, metal, wood).

These early systems focused primarily on cost recovery, ensuring that producers collectively financed the collection, sorting, and recycling of waste. In other words, the goal was to make producers pay for waste, not yet to design out waste. Fee structures therefore reflected average collection/treatment costs, not environmental performance or product design characteristics. This phase corresponds to what the OECD (OECD, 2016) calls *"cost-based EPR"*, designed for financial fairness and system stability, not as an eco-design instrument.

Policy shift: the Circular Economy Package (2015–2018)

A major policy transformation came with the EU Circular Economy Package (2015) and, in particular, Directive (EU) 2018/851, which amended the WFD.

For the first time, Article 8a(4)(b) of the WFD required that: "*The financial contributions paid by producers shall be modulated, where possible, for individual products or groups of similar products, notably taking into account their durability, reparability, re-usability, recyclability and the presence of hazardous substances*". This provision introduced eco-modulation as a binding concept in EU law, turning EPR from a cost-distribution mechanism into a circular design policy tool. The legislative intent was clear: producers should not only pay for the quantity of waste they generate, but also according to how well their products perform environmentally throughout their life cycle.

Implementation phase: early pilots and national experimentation (2018–2022)

Following the adoption of Directive 2018/851, Member States and PROs began to experiment with eco-modulation in different sectors: France emerged as the most advanced country integrating eco-modulated fees across multiple EPR streams like Packaging (bonuses and penalties for recyclability, use of recycled materials, or inclusion of disruptive components) and textiles, furniture, and WEEE, where eco-modulation is linked to durability, reparability, or recyclability (Micheaux et al. 2021). The *"Bonus-Malus System"* became a central feature of French EPR policy, codified by the *Loi Anti-Gaspillage pour une Économie Circulaire (AGEC, 2020)*[9].

Later, Italy (CONAI) and Spain (ECOEMBES) began applying eco-modulation to plastic packaging and then to paper/cardboard packaging, differentiating fees according to an

[9] https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000041553759/

evolving set of recyclability criteria; Germany and Austria introduced limited eco-modulation mechanisms through fee differentiation by material recyclability, often linked to technical recyclability assessments.

The following table, based on Mallick et al. (2024), presents some of eco-modulation criteria identified in the literature.

Table 5: Eco-modulation criteria covered in the literature

Objective	Application	Eco-modulation criteria		Country	Bonus/ Malus	Reference
Material focussed criteria						
Mono materialisation	Furniture	1	Furniture made > 95 % of certified solid wood or > 95 % of metal	France	-16 %	(Joltreau, 2018)
Increase recycled content use	WEEE	2	New PCs, dishwashers, washing machines, and laptops contain at least 10 % of post-consumer recycled plastics	France	-20 %	(Magalini et al., 2022)
Use-phase criteria						
Durability	Furniture	5	The furniture's lifetime can be extended by adapting its dimensions	France	-16 %	(Joltreau, 2018)
Repairability	WEEE	7	The provision of spare parts, tools, and information for the repair of a camera	Canada	-10 %	(Magalini et al., 2022)
Availability of spare parts	WEEE	9	Failure to provide essential spare parts for refrigerators for at least ten years, dishwashers and washing machines for at least 11 years	France	+20 %	Magalini et al., 2022)
Reusability	Packaging	10	Reusable packaging does not need to be declared if it is reused	Estonia	-100 %	(Frithjof et al., 2021)
	Tyres	11	Tyres placed on the market from the national re-treading program	Portugal	-100 %	(Frithjof et al., 2021)
Upgradability	WEEE	12	Upgradability of PCs and laptops with standard tools like new memory drives, chips, and cards	France	-20 %	(Magalini et al., 2022)
Standardising connections	WEEE	13	Lack of standardised connections (e.g. charger) or compatible software updates for smartphones	France	+100 %	(Sachdeva et al., 2021)
End of Life criteria						
Recyclability	WEEE	14	Presence of paints and coatings incompatible with recycling in quantities over 100g in PCs and laptops	France	+20 %	(Magalini et al., 2022)
Hazardous Substances	WEEE	18	Bromine in plastic parts containing flame retardants for vacuum cleaners,	France	+100 %	(Magalini et al., 2022)

Objective	Application	Eco-modulation criteria		Country	Bonus/ Malus	Reference
			tablets, portable game consoles			
Disassembly	WEEE	19	Products that can be disassembled (5 % for printers, 13 % for laptops, 15 % for LED displays)	Taiwan	-15 %	(Magalini et al., 2022)
Consumer awareness	Packaging	20	Awareness bonuses on-pack, ranging from 5-8 %	France	-8 %	(Frithjof et al., 2021)

1.4 Environmental and socio-economic outcomes of EPR schemes

Since its inception, the goal of EPR has been twofold:

a) **Downstream goals**, which apply once a product has reached the end of its lifespan and focus on waste management aspects such as collection, sorting and recycling; and
b) **Upstream goals**, which concern the product design phase and material choices, aiming to prevent waste generation, improve durability, reduce hazardousness, and enhance recyclability (Compagnoni, 2022; Massarutto, 2014; Pouikli, 2020).

Up to now, the most tangible and quantifiable impact of EPR schemes has been observed **downstream**, with notable improvements in separate collection and recycling rates across Member States (Mallick et al., 2024). These gains have been strongly reinforced by increasing **legally binding targets established under EU waste legislation.**

At the same time, the legislative framework on waste management has revealed the **limitations of EPR's upstream influence**: on the upstream side indeed, EPR's influence on product design and business models has been limited and often indirect. While in theory financial responsibility for end-of-life management should push producers to internalise waste costs and rethink product design and business models, empirical evidence suggests these effects have been very weak and difficult to demonstrate (Lifset et al., 2023; OECD, 2016). Several barriers, such as shared producer responsibility within collective schemes, limited fee differentiation, and, above all, **the absence of upstream-oriented targets,** have diluted the design incentives originally envisioned.

Strengthening the upstream dimension of EPR remains one of the key challenges for policymakers seeking to align waste policy with circular economy ambitions.

The next table presents, for the different countries included in our study (Romania information is not available), the market structure and the recycling rate for the packaging waste flow (year 2023). The market structure referred to here concerns "traditional" EPR systems, as deposit return schemes (DRS) in the EU[10] typically follow a single-operator model, whereby one designated, usually not-for-profit organisation manages the system infrastructure and clearing functions under regulatory oversight.

[10] As of 2026, deposit return schemes are operational in approximately 18 European countries (Norway, Iceland, Denmark, Ireland, the Netherlands, Germany, Austria, Malta, Croatia, Sweden, Finland, Estonia, Latvia, Slovakia, Hungary, Romania), with widespread adoption across Northern, Baltic and Central Europe and rapid expansion in recent years. Several additional Member States, including Portugal, Greece, Spain and Czech Republic are expected to introduce national systems by 2026–2027, reflecting the growing role of DRS in achieving EU collection targets for beverage packaging.

The recycling rate is calculated as a percentage, defined as the total quantity of recycled packaging waste divided by the total quantity of generated packaging waste. From a descriptive perspective, the top-performing countries for this specific waste stream appear to be those characterised by a monopolistic or quasi-monopolistic market structure, namely Belgium (79.7%), the Netherlands (75.8%), and Italy (75.6%). At the lower end of the performance distribution are Lithuania (60.7%), Greece (48%), and Hungary (42.8%). Among these, Greece and Lithuania operate under a competitive EPR model, whereas data for Hungary reflect the fragmented system that existed prior to the introduction of a centralised, concession-based system on 1 July 2023.

Considering the EU target of recycling 65% of all packaging waste by 2025, in 2023 few countries appear to be still far from achieving this goal, in particular Hungary, Greece, Lithuania, Ireland, and Portugal.

Table 6: The packaging EPR scheme institutional architecture and the packaging 2023 recycling rate

THE PACKAGING EPR SCHEME INSTITUTIONAL ARCHITECTURE AND THE PACKAGING 2023 RECYCLING RATE

Country	Market structure	Recycling rate (%)*
Belgium	Monopolistic	79.7
Netherlands	Monopolistic	75.8
Italy	Quasi-monopolistic	75.6
Slovenia	Competitive	73.6
Spain	Quasi-monopolistic	70.5
Germany	Competitive	69.4
France	Quasi-monopolistic	69.0
Sweden	Competitive	68.5
Poland	Competitive	67.4
Latvia	Competitive	63.1
Portugal	Competitive	61.8
Ireland	Monopolistic	61.0
Lithuania	Competitive	60.7
Greece	Competitive	48.0
Hungary	Other - Centralised model without PROs	42.8

* The recycling rate is calculated in percentage i.e. the total quantity of recycled packaging waste divided by the quantity of generated packaging. Infomation for Romania is not available.

Source: REF elaborations based on EUROSTAT and Facco and Berner (2025)

Table 7: The Waste from Electric and Electronic Equipment (WEEE) EPR scheme institutional architecture and the WEEE 2018 collection rate

THE WASTE FROM ELECTRIC AND ELECTRONIC EQUIPMENT (WEEE) EPR SCHEME INSTITUTIONAL ARCHITECTURE AND THE WEEE 2018 COLLECTION RATE

Country	Market structure	Collection rate (%)*
Ireland	Competing organisation model	64.6
Hungary	Centralised EPR models without industry-led PROs	59.3
Sweden	Competing organisation model	54.5
Portugal	Competing organisation model	51.9
Spain	Competing organisation model	50.7
Latvia	Competing organisation model with eco-tax back-up	49.5
Belgium	Single organisation model	49.4
Netherlands	Competing organisation model	48.9
France	Competing organisation model with coordination centre	46.1
Poland	Competing organisation model with eco-tax back-up	44.7
Greece	Competing organisation model	44.6
Lithuania	Competing organisation model	44.1
Germany	Other model with producer funding	43.1
Slovenia	Competing organisation model	40.2
Romania	Competing organisation model with eco-tax back-up	31.5

* Eurostat calculates the collection rate based on the total weight of WEEE collected in a given year in the Member State concerned, expressed as a percentage of the average weight of EEE placed on the market in the three preceding years in that Member State. Information on Italy is not available.

Source: REF elaborations based on EUROSTAT and Favot et al. (2022)

However, focusing solely on this single design feature (market structure) is not sufficient to conclude that monopolistic EPR systems in the waste field deliver superior environmental performance (or vice-versa). Each EPR scheme is the outcome of a complex combination of design features, including economic and legal arrangements, administrative structures, and monitoring and enforcement mechanisms, which together make each system unique. As a result, drawing policy lessons based on a single characteristic, such as market structure, offers only limited explanatory power in terms of performance outcomes.

Moreover, contextual and external factors, such as the existing market structure of waste management operators, the degree of competition, pre-existing environmental regulations, and the country's industrial structure, may interact with EPR system characteristics and jointly influence recycling performance.

Looking at the literature on the matter, several studies tried to investigate critical performance determinants in waste-related EPR schemes; however, their findings do not provide meaningful insights that can be readily transferred to the water sector.

According to the comparative analysis carried out in (Facco P. and Berner R. 2025), focused on packaging EPR schemes, a limited set of critical design factors largely explains performance outcomes:

Figure 4: EPR: Critical design factors, in (Facco P., Berner R. 2025)

The study's findings indicate that "*both market structure and operational responsibility are critical performance determinants, with their interaction creating distinct performance patterns rather than either factor alone driving outcomes*".

Also, the project "*Screening the efficiency of packaging waste in Europe*" (Colelli, P.F. et al., 2022), promoted by the Italian PRO CONAI with the support of EXPRA, performed an econometric analysis and an indicator-based assessment to provide a quantitative analysis of the **cost efficiency** and effectiveness of 25 Member States' EPR systems and 21 PROs. It concludes that "*EPR systems do not benefit from the establishment of competition on efficiency grounds, as we find that systems based on a unique PRO or that prevent multiple PROs to operate for-profit in competition* ***are more effective and cost efficient****. Furthermore, EPR systems are more effective when legislators have maintained substantial operational responsibilities for the collection of packaging on local authorities*."

2 TRANSFERABILITY AND ADAPTATION OF THE CHARACTERISTICS OF EPR WASTE SCHEMES TO THE WASTEWATER SECTOR

2.1 Governance models, roles and responsibilities

The EPR scheme design features in the waste sector cannot be directly applied to emerging EPR schemes under the recast UWWTD, given the fundamental differences between the two sectors.

In the wastewater domain, MPs removal takes place at UWWTPs, which serve entire populations and operate as natural monopolies subject to strict public service obligations and regulation. Responsibility for meeting treatment and effluent requirements lies with Member States and wastewater treatment utilities (WWTUs), not with producers or PROs. There are no waste flows to collect or trade on secondary markets, no competitive procurement of recycling services, and no scope for securing lower water treatment costs through market mechanisms.

As a result, PROs are expected to have no or only very limited operational roles in building, contracting or operating quaternary treatment systems, leaving no operational dimension over which competition could meaningfully occur.

While the UWWTD does not formally impose a single-PRO model, it explicitly recognises the appropriateness of centralised arrangements, noting that producers should join a centralised organisation to fulfil their obligations (Recital 23).

In waste-related EPR schemes competition among PROs is usually linked to some degree of operational responsibility. Debates about whether a system should allow multiple PROs or rely on a single, centralised PRO are meaningful in contexts where competition can in principle promote cost efficiency, innovation, and service quality. Although the literature provides no conclusive evidence that competitive PRO environments consistently outperform monopolistic ones - or vice versa - in terms of cost-effectiveness, achievement of environmental targets, or innovation, the question remains relevant when designing EPR schemes for waste streams. The appropriateness of competition depends heavily on country-specific factors (e.g., regulatory capacity, governance structure, population density etc...) and on the characteristics of the waste stream in question (e.g., heterogeneity of products in scope, number and type of obligated actors, maturity of treatment technologies, market value of output materials to name a few).

The rationale for competition in traditional waste EPR frameworks is that multiple PROs, operating under a common regulatory framework, compete to attract producers by offering lower fees. These fee reductions are assumed to arise from greater operational efficiency, such as improved logistics, better contracting with treatment facilities, enhanced technology deployment, or more effective valorisation of collected waste. This model is feasible because waste flows (e.g., packaging, WEEE, textiles, batteries) are discrete, measurable, and tradable commodities; waste recycling and treatment facilities operate in competitive markets and PROs are free to contract with different operators in pursuit of efficiency gains. Under such conditions, competition can be expected, at least in theory, to lead to better performance at lower cost.

However, when we shift to the water domain, and specifically to the removal of MPs under the UWWTD, it becomes necessary to ask whether competition among PROs is meaningful or even feasible. Here, the EPR concept is being applied to an entirely new field. As previously discussed, responsibility for achieving the removal performance required by the UWWTD must remain strictly with Member States and WWTUs. WWTUs, not PROs, will be responsible for upgrading and operating treatment plants in accordance with national implementation programmes developed under Article 23 of the Directive. PROs will have no or very limited operational role in building, contracting, or running quaternary treatment systems. Consequently, there is nothing operational for PROs to compete over: there are no waste flows to collect or sell on secondary markets, no competitive procurement of recycling services, and no opportunity to secure better treatment prices, as wastewater treatment is a natural monopoly governed by public service obligations and strict environmental and economic regulation.

Actually, a limited operational role for the PRO may exist, but it is marginal and does not alter the overall logic. One function relates to consumer information obligations under Article 9(3)(e) of the UWWTD, which requires Member States to ensure that consumers are informed about waste prevention measures, the operation of take-back and collection systems, and the impacts of inappropriate disposal or overuse of products on the collection, treatment, and final discharge of urban wastewater. PROs may be assigned responsibilities in designing, financing, or disseminating such information campaigns, but these activities are administrative in nature, do not involve operational control over infrastructure, and do not create meaningful scope for competition.

Competition to drive administrative efficiency within PROs is equally unconvincing. Administrative and organisational costs represent only a small fraction of the total costs to be financed under the EPR mechanism, and these costs can be regulated or capped without requiring multiple competing entities.

Furthermore, competition among PROs in this context would likely increase, rather than reduce, overall system costs. Multiple PROs would necessitate a clearing house or coordination body to ensure fair allocation of financial obligations, prevent cherry-picking of advantageous areas, harmonise monitoring requirements, manage data, avoid anti-competitive behaviour, and mitigate risks of free-riding or inconsistent cost-sharing, none of which enhances environmental performance or system efficiency.

Given these characteristics, when applied under the UWWTD the EPR mechanism is expected to concern financial responsibility only, not operational control. Producers are required to collectively finance the costs of quaternary treatment, while WWTUs and public authorities remain fully responsible for infrastructure investment, day-to-day operation, and compliance with regulatory standards. The scale, capital intensity, and public-service nature of wastewater infrastructure strongly favour a centralised, monopolistic PRO model, which is more compatible with uniform treatment requirements, coordinated long-term planning, and efficient cost pooling. For these reasons, a single PRO structure is not only more practical but also more aligned with the governance, technical, and economic realities of the UWWTD's implementation.

That said, looking at the three governance archetypes outlined in Section 1.2, the following considerations can be drawn regarding their transferability to the water sector:

Centralised EPR model without industry-led PROs

The existence of a centralised fund collecting payments from obliged producers is particularly relevant for discussions on the implementation of EPR obligations under the UWWTD. In this context, Member States may consider centralising several key functions, including:

- the collection of producer contributions;
- the financing of quaternary treatment infrastructure and its operation; and
- the oversight of national-level monitoring, reporting, and audit obligations.

However, not all existing centralised EPR models are equally transferable to the wastewater sector. The concession-based model adopted in Hungary, for instance, appears difficult to replicate. In that system, the Fund Manager (a state concessionaire) plays a strong operational role in the organisation and delivery of waste management services. By contrast, under the UWWTD, responsibility for upgrading and operating Urban Wastewater Treatment Plants (UWWTPs) remains firmly with WWTUs. This fundamental difference limits the applicability of a concession-based approach in the water domain.

A more relevant reference can instead be found in the so-called "Croatian model". In Croatia, responsibility for municipal waste management, including waste streams covered by EPR, remains with local authorities, while a central public fund manages the financial flows derived from environmental contributions. The role of the fund manager (a state agency) is not operational but financial and administrative: it collects resources and redistributes them to municipalities to compensate for the costs of service provision.

The key transferable element to the wastewater sector is therefore the separation between:

- operational responsibility for service provision, which remains with utilities; and
- financial responsibility for cost coverage, which is organised through a centralised, publicly managed fund.

In this perspective, a central fund, managed by a public authority, would be responsible for collecting and allocating resources derived from environmental contributions, ensuring the coverage of both capital (CAPEX) and operational (OPEX) costs associated with quaternary treatment, in line with the rules defined by the legislator. Importantly, the entity managing the fund would not perform operational functions in the organisation of wastewater services but would instead have a purely administrative and financial role.

In parallel, and consistent with the UWWTD requirement that producers exercise their EPR obligations collectively, a Producer Responsibility Organisation would need to be established. The PRO would be responsible for:

- collecting data on the types and quantities of products placed on the market by obligated producers;
- defining eco-modulation criteria to allocate costs among producers;
- collecting financial contributions from producers; and
- transferring (a significant share of) these contributions to the central fund.

In synthesis, translating a "centralised EPR model" to the wastewater sector would imply the design of a system in which:

- an industry-led PRO is established;
- the PRO collects environmental contributions from obligated producers;
- the PRO transfers a substantial share of these contributions to a central fund dedicated to financing quaternary treatment and related activities;
- a public authority, entrusted with managing the fund, allocates and transfers resources to wastewater utilities, covering at least 80% of CAPEX and OPEX, as required under Article 9 of the UWWTD.

Within this model, the PRO would primarily play a financial and administrative role, while strategic decisions on resource allocation, as well as overall oversight of the EPR scheme, would remain under public control.

The central fund could also serve a broader purpose beyond financing utilities, by supporting the range of regulatory and coordination tasks explicitly assigned to Member States under the UWWTD. These include:

- annual independent audits of PROs' financial management, their capacity to cover required costs, and the adequacy and quality of collected data (Art. 9(3)(d));
- the national recognition procedure certifying PRO compliance prior to authorisation (Art. 9(3));
- the establishment of monitoring and enforcement frameworks (Art. 10(2));
- the designation of an independent supervisory body or competent authority in cases with multiple PROs (Art. 10(3));
- ensuring compliance of producers established in other Member States or third countries, including verification of authorised representatives (Art. 10(4));
- the organisation of regular multi-stakeholder dialogues on the functioning of the EPR scheme (Art. 10(5)).

These functions represent essential elements of governance, oversight, and coordination, and may require stable and predictable funding streams, which the central fund could provide.

At the same time, PROs would need to retain sufficient financial resources to fulfil their own statutory obligations. These include:

a) Consumer information: implementing measures to inform consumers about waste prevention, take-back and collection systems, and the impacts of improper disposal or overuse of relevant products on wastewater systems (Art. 9(3)(e));

b) Reporting and data management: establishing and operating data collection and reporting systems in line with Article 9(3)(c);

c) Transparency obligations: ensuring compliance with transparency requirements, including the publication of annual reports, financial information, and governance structures (Art. 10(1)(c)).

In conclusion, under such a model, PROs would remain key actors but would operate within a highly centralised and publicly steered framework, where financial flows are pooled and redistributed through a central fund, and where public authorities retain a

strong role in ensuring coherence, accountability, and compliance with regulatory objectives

Single-PRO (monopolistic)

Transposing this governance structure to the UWWTD would involve establishing a single, nationally recognised PRO responsible for collecting the financial contributions from obliged producers. As in the case of packaging EPR in Italy, the PRO may take the form of an "umbrella organisation" coordinating the activities of two or more product-specific consortia (e.g. for pharmaceutical and cosmetic products). The PRO would then channel most of these resources to wastewater utilities covering at least 80% of capital and operational expenditures linked to quaternary treatment.

As with packaging schemes, the PRO would function on a not-for-profit basis, with strict rules on financial transparency, internal governance, and cost allocation.

A single-PRO model could offer several advantages in the water sector. First, it would reduce administrative burdens by providing a single point of contact for all producers, including distance sellers, and ensure a unified system for data collection, auditing, and reporting. Second, it would strengthen cost-predictability and equal treatment, as all producers would contribute according to harmonised rules defined in national legislation. Third, centralised financing may facilitate long-term investment planning, particularly for capital-intensive quaternary treatment technologies, ensuring that resources are allocated strategically and equitably across utilities according to the National Implementation Programme.

However, this model requires strong regulatory oversight to prevent monopolistic inefficiencies and to ensure that the PRO remains fully accountable to public authorities and compliant with the transparency and governance requirements set out in Articles 9 and 10 of the UWWTD. Careful design would also be necessary to ensure that wastewater operators' operational autonomy is respected and that cost-coverage mechanisms correctly reflect the "full cost" concept, avoiding at the same time over- or under-compensation.

Overall, the single-PRO non-profit model represents a viable and potentially effective governance option for implementing water-related EPR under the UWWTD, provided that it is supported by a robust regulatory framework and clear allocation of responsibilities between producers, the PRO, and public authorities.

Multi-PRO (competitive)

A multiple-PRO model, similar to those operating in packaging EPR systems in Germany, Austria, Sweden, and several Central/Eastern European countries, could appear to be a valid system for implementing EPR under the UWWTD. However, this is not the case. As already pointed out before, the rationale for competition in traditional waste EPR frameworks is that multiple PROs, operating under a common regulatory framework, compete to attract producers by offering lower fees. Fee reductions are assumed to arise from greater operational efficiency leading to better performance at lower cost. However, when shifting to the water sector, there are no comparable operational activities over which PROs can effectively compete. There are no waste flows to collect or market, no competitive procurement of recycling services, and no opportunity to secure more

favourable treatment prices, as wastewater treatment constitutes a natural monopoly subject to public service obligations and stringent environmental and economic regulation.

In this context, a multi-PRO configuration would not generate tangible efficiency gains. On the contrary, it would introduce significant transaction and coordination costs, as well as an increased administrative burden for public authorities responsible for revenue collection and the management of arrears. Moreover, in the absence of strong oversight, competition may increase the risk of **inconsistent data reporting**, free-riding, and cost-shifting among PROs.

For these reasons, and in the absence of clear benefits, the adoption of a multiple-PRO model is strongly discouraged.

From the interviews it emerged that traditional EPR models cannot be directly transferred to the wastewater sector and require substantial adaptation.

Water utilities stressed that wastewater services are geographically bound and infrastructure-dependent, limiting the applicability of competitive market-based approaches.

Pharmaceutical and chemical companies emphasized the complexity of attributing pollution to specific products and the structural differences between wastewater systems and traditional product-based EPR schemes.

Waste sector representatives noted that without operational responsibilities, wastewater EPR diverges from traditional models and risks becoming a purely financial mechanism.

Local economic ecosystem economic and investment stakeholders stressed that wastewater EPR differs from traditional schemes because pollution is diffuse and difficult to attribute directly to specific products, even though the mechanism may help internalize environmental costs and support infrastructure investments.

Economic regulators explicitly highlighted the need for a dedicated EPR framework tailored to the specific technical, economic and institutional characteristics of the water sector

3 DISTRIBUTIONAL IMPACTS, COST ALLOCATION, GOVERNANCE, AND MONITORING TOOLS FOR TRANSPARENT AND EFFICIENT EPR OPERATION IN WASTEWATER SERVICES

The UWWTD was first adopted in 1991 with the primary aim of protecting the environment and public health from the harmful effects of discharges of untreated wastewater. This legislation requires EU Member States to ensure that all urban wastewater is collected and treated before being discharged into the environment, establishing minimum treatment standards depending on the size of the urban agglomerations and the sensitivity of the receiving areas. In particular, larger settlements are required to carry out secondary wastewater treatment, aimed at removing organic matter, whilst in particularly sensitive areas, more advanced tertiary treatment is required, which also allows for the removal of nutrients such as nitrogen and phosphorus.

Over the years, the Directive has been updated and strengthened, and with the recent revision, which will come into full effect by 2028, it addresses the latest environmental challenges, such as the presence of micropollutants and hazardous chemicals. In this context, the Directive introduces the concept of quaternary treatment, which represents an advanced level of purification beyond primary, secondary and tertiary treatment. Quaternary treatment within the UWWTD is specifically aimed at removing a specific set of MPs, which conventional systems fail to eliminate effectively. This type of treatment therefore becomes essential for protecting both the aquatic environment and human health, especially in sensitive or highly urbanised areas.

To finance and ensure the sustainability of the implementation of these advanced treatments, the Directive encourages the application of the EPR principle. EPR requires that manufacturers of chemicals, pharmaceuticals or cosmetics that contribute to the presence of micropollutants in wastewater be involved in financing their quaternary treatment.

The Directive requires Member States to draw up **national implementation programm**es by 2028, identifying the investments required for each urban agglomeration, taking into account both the size of the settlements and the environmental impact of the discharges. Part of this planning involves estimating the financial contributions that may be provided by EPR schemes, thereby bringing together producers, local authorities and WWTUs in a coordinated and transparent approach.

From the interviews it emerged that the introduction of EPR in the wastewater sector is widely perceived as a major regulatory innovation, although its interpretation differs across stakeholder groups.

Water utilities consider EPR a necessary step to ensure a more effective implementation of the Polluter Pays Principle, which they believe has historically been applied in a fragmented and insufficient manner.

Pharmaceutical and chemical companies underlined the importance of regulatory clarity and highlight that the system will likely evolve progressively, pointing to uncertainties in its practical implementation.

Representatives of the waste sector emphasized that EPR should not be reduced to a purely financial obligation but should instead imply an active and ongoing responsibility for producers within the system.

Economic regulators recognized the Directive as an important step toward strengthening environmental protection, while also highlighting the significant technical and financial challenges associated with its implementation

3.1 Environmental objectives and quaternary treatment

In recent decades, urban wastewater treatment plants have been designed primarily to remove organic carbon, nitrogen and phosphorus, in accordance with the European Union's Directive 91/271/EEC on urban wastewater treatment. However, conventional treatment techniques, based on basic biological and physico-chemical processes, do not allow for the effective removal of MPs, such as pharmaceuticals, pesticides, biocides, microplastics and nanoparticles.

As is well known, the Directive does not prescribe a specific technology, but rather requires, in general terms, the adoption of a treatment capable of ensuring, at present, the removal of a certain percentage of specific micropollutants.

Article 2 of the UWWTD defines, in point 14, 'quaternary treatment' as the treatment of urban wastewater by a process that reduces a broad spectrum of micropollutants present therein.

Article 17 defines micropollutants as "*a substance as defined in Article 3(1) of Regulation (EC) No 1907/2006 of the European Parliament and of the Council, including its degradation products, which are usually present in the aquatic environment, in urban wastewater or in sludge, which may be considered hazardous to the environment or human health according to the relevant criteria set out in Annex I, Parts 3 and 4, of Regulation (EC) No 1272/2008, even at low concentrations*."

The removal rate is calculated on the basis of the dry-weather flow for at least six of the twelve substances listed in Table 3, Annex I, Part C, of Directive 2024/3019 – and here represented as Table 7 of the current report.

Table 8: Substances that can pollute water (Table 3, Annex I, Part C, Directive 2024/3019)

Category	Substances that can pollute water even at low concentrations	Minimum reduction (%)
Category 1 (substances that can be treated very easily)	1. amisulpride (CAS No. 71675-85-9); 2. carbamazepine (CAS No. 298-46-4); 3. citalopram (CAS No. 59729-33-8); 4. clarithromycin (CAS No. 81103-11-9); 5. diclofenac (CAS No. 15307-86-5); 6. hydrochlorothiazide (CAS No. 58-93-5); 7. metoprolol (CAS No. 37350-58-6); 8. venlafaxine (CAS No. 93413-69-5).	80%
Category 2 (substances that can be easily removed)	9. benzotriazole (CAS No. 95-14-7); 10. candesartan (CAS No. 139481-59-7);	80%

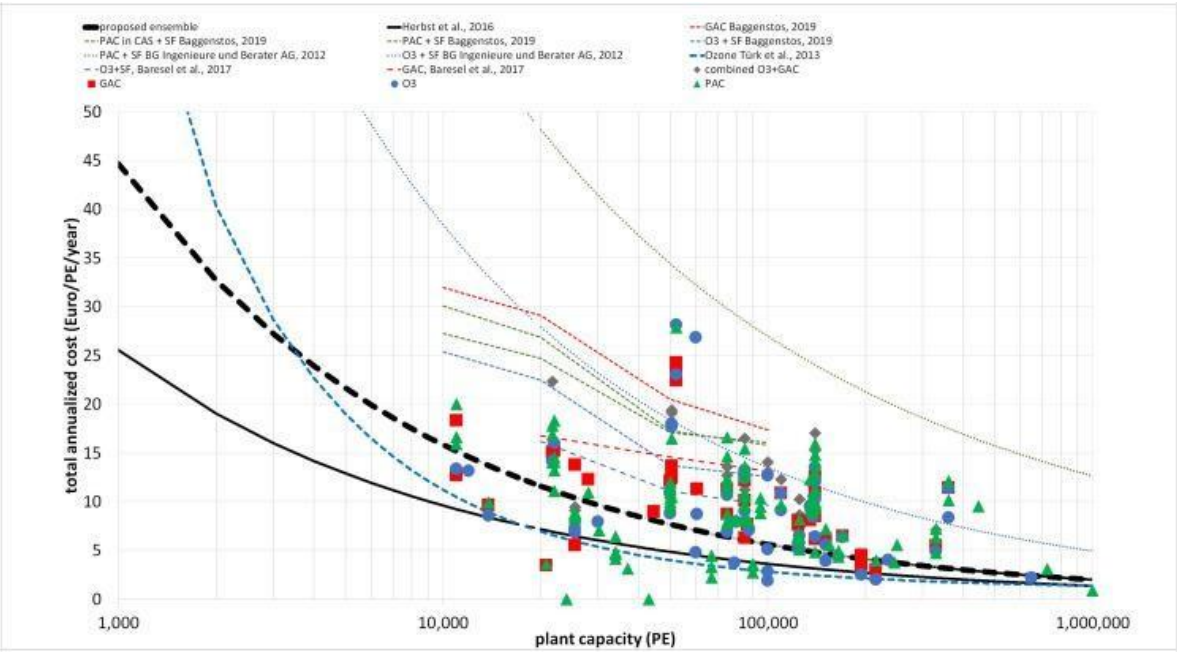
Category	Substances that can pollute water even at low concentrations	Minimum reduction (%)
	11. irbesartan (CAS No. 138402-11-6); 12. mixtures of 4-methylbenzotriazole (CAS No. 29878-31-7) and 5-methylbenzotriazole (CAS No. 136-85-6).	

Several advanced technologies are available for the removal of MPs, but not all of them are equally feasible. In particular, activated carbon, either powdered activated carbon (PAC) or granular activated carbon (GAC, and chemical oxidation with ozone - O_3) appear to be more practicable, whereas other solutions, such as membrane processes or constructed wetlands, present technical limitations or high costs and are therefore less suitable at large scale. Consequently, the main documents on the topic focus on the costs of the most consolidated and effective technologies. This paragraph provides a concise synthesis of the findings reported in these studies (Pistocchi et al., 2022; Pistocchi, 2025; Ianes et al., 2025), referring the reader to the original sources for more detailed analyses.

The main objective is to provide here a comparative ranking of technologies, without going into a comparison of the costs reported in the different studies through monetary conversions.

A 2022 study, (Pistocchi 2022) compares different quaternary treatment technologies, offering an initial overview of the available options.

Figure 5: Plot of the cost function used in the IA, and comparison with other cost estimates



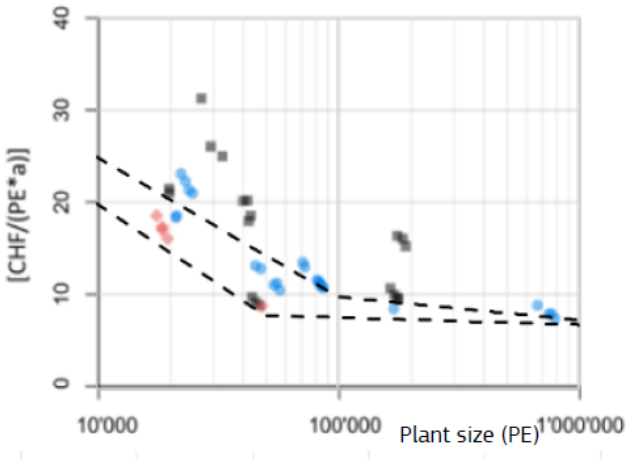
Source: Pistocchi (JRC), 2025 based on Pistocchi et al., 2022

The updated impact assessment by the Joint Research Centre (JRC) (Pistocchi, 2025) summarizes the evidence on the costs of the main quaternary treatment technologies. The cost estimates are based on a cost function proposed by a group of European experts

(Pistocchi et al., 2022), in which the cost (C) [11] combines annual payments for investment amortization (capital expenditure, CAPEX) and operational expenditure (OPEX). This model provides a single indicative cost, regardless of the treatment technology adopted, under the assumption that each plant is equipped with the most cost-effective solution based on its design and operating conditions. In the JRC study, the validity of the cost curve is assessed by comparison with other technology-specific cost estimates, including data from the Verband Schweizer Abwasser- und Gewässerschutzfachleute (VSA) (Switzerland), the Politecnico di Milano (Italy), and studies conducted in Denmark.

The VSA has documented the implementation of quaternary treatment over the past decade, reporting actual costs from a representative set of UWWTPs using PAC, GAC, or ozonation, including annual levelized costs per population equivalent (VSA, 2021).

Figure 6: Cost functions based on the costs from VSA, 2021



Source: Pistocchi (JRC), 2025 based on modified VSA, 2021

The Politecnico di Milano research team (Ianes et al., 2025) quantified unit costs of quaternary treatments (EUR/PE/year) as a function of plant size for ozonation, GAC, and PAC, showing that PAC is significantly more expensive. The cost functions depend on assumed operating parameters, such as ozone dose, GAC regeneration time, PAC dosage, and management of the resulting sludge.

[11] It should be noted that OPEX includes maintenance costs (equal to 4% of CAPEX) and energy consumption costs (€0.36/kWh). Monitoring, administrative, and compliance costs, as well as the costs of gathering and verifying data on products placed on the market and other costs required to fulfil extended producer responsibility obligations, are not included in the analysis.

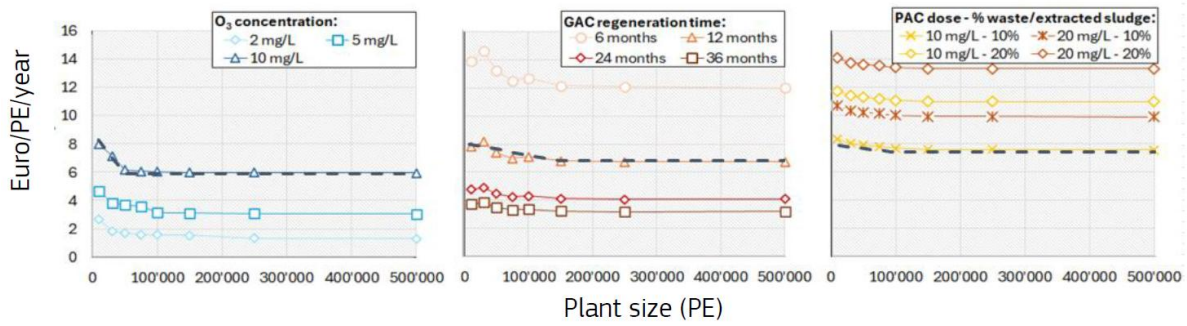
Figure 7: Parameters adopted for the cost function equation for quaternary treatment closely approximating the results

Parameters adopted for **Equation 4**

Parameter	Units	Ozonation	GAC	PAC
C_0	Euro/p.e/year	9.00	8.00	8.00
C_1	Euro/p.e/year	6.00	6.75	7.50
P_1	p.e	50,000	150,000	100,000

Source: Pistocchi (JRC), 2025

Figure 8: Cost functions proposed in Ianes et al., 2025.



Source: Pistocchi (JRC), 2025 based on Ianes et al., 2025

Recent estimates for Denmark (Envidan A/S, Teknologisk Institut, and DANVA[12]) quantify the levelized cost of treatment (net present value per m^3, combining CAPEX and OPEX) for different technologies and representative plant sizes, identifying ozonation followed by sand filtration as the most cost-efficient solution.

Figure 9: Cost of quaternary treatment for Denmark (DKK/m3)

Scenario	50,000 p.e.	100,000 p.e.	300,000 p.e.
Ozone and sand filtration	1.27	0.91	0.72
Ozone and GAC	1.42	1.17	0.95
GAC	1.17	1.01	0.9
PAC and sand filtration	1.32	1.14	1

Source: Envidan, TI and DANVA, 2025

Some studies (Ianes, 2025) observe that per capita costs do not show significant variations with the capacity of wastewater treatment plants, with marked differences only between 10,000 and 100,000 population equivalents (p.e.).

In March 2025, Utilitatis (Utilitatis, 2025) developed an update of previously conducted assessments aimed at defining the investment and operating requirements and costs needed to ensure the structural compliance of the Italian national wastewater treatment sector with the obligations set out in EU Directive 3019/2024 on quaternary treatments.

[12] https://www.envidan.com/da/nyheder/teknologivalg-4rensetrin/.

For the purposes of assessing the upgrading of quaternary treatment lines, the study compares the costs of the following technologies and treatment chains:

1. Ozone (O_3);
2. Granular activated carbon biofilter (GAC);
3. Ultrafiltration (UF);
4. Ozone + granular activated carbon biofilter (O_3 + GAC);
5. Ultrafiltration + granular activated carbon biofilter (UF + GAC).

For these technological alternatives, unit cost values were considered (representative of the sum of CAPEX and OPEX, expressed in euros per cubic metre).

The assessments refer to Italian WWTPs with a treatment capacity greater than or equal to 150,000 p.e., as extracted from the EEA 2021 database (Waterbase UWWTD – data call 2021).

The previous study was based on the assumption of implementing entirely new quaternary systems (in particular activated carbon systems and ozonation systems), applying specific cost functions to quantify and distinguish upgrading costs in terms of OPEX and CAPEX. By contrast, the 2025 analysis focused on existing plant configurations and their readiness for the implementation of treatment chains dedicated to the removal of MPs, with the aim of deriving estimates of the resulting upgrading costs.

The following table shows that, also in this case, treatment based on ozone (O_3) and granular activated carbon biofiltration (GAC) proves to be the most cost-effective option.

Table 9: Costs to upgrade Italian UWWTPs to comply with the quaternary treatment requirements of the UWWTD

	Average CAPEX+OPEX [€/a]	Average CAPEX+OPEX [€/P.E./a]	CAPEX [€/a]	Total average CAPEX [€]	Average OPEX [€/a]
O_3	76,662,384	2.0	47,778,079	734,466,173	28,884,306
GAC	153,324,768	4.0	84,216,274	1,294,610,555	69,108,494
UF	326,581,756	8.5	170,680,312	2,623,774,737	155,901,445
O_3+GAC	183,989,722	4.8	110,882,603	1,704,537,386	73,107,119
UF+GAC	383,311,921	10.0	153,324,768	2,356,977,492	229,987,152

Source: Utilitatis (2025), *Mini-Book – How much does it cost to upgrade Italian wastewater treatment plants to comply with the new wastewater Directive based on* ENEA elaboration based on Waterbase UWWTD (EEA, 2021) and literature data (Baresel et al., 2019).

In summary, the various analyses indicate **that ozonation is generally more cost-effective than GAC, while PAC emerges as the costliest option**. These considerations are, however, of a general nature and **should be interpreted with caution**, as the relative **cost-effectiveness of the different solutions ultimately depends on the specific context of application, plant characteristics, and local operating conditions**.

From an operational perspective, the above-mentioned studies emphasize that each solution presents specific advantages and disadvantages that influence its adoption (Ianes et al., 2025), and that environmental impacts and sustainability should be integrated into cost–benefit analyses. Ozone effectively degrades a wide range of MPs

and enhances their biodegradability, but it may generate by-products, requiring additional treatment steps such as sand filtration or adsorption on biologically active carbon (BAC), with associated increases in energy and operational costs.

Granular activated carbon (GAC) provides good removal performance across a wide range of compounds, is flexible in handling variable pollutant loads, and does not generate by-products. It can be regenerated, reducing the need for new carbon material and long-term costs, although regeneration is energy-intensive and may produce waste streams requiring incineration.

Powdered activated carbon (PAC) offers similar adsorption performance but must be continuously dosed into the water stream and cannot be regenerated, leading to increased sludge production and higher operational costs. The resulting sludge cannot be reused in agriculture due to the risk of micropollutant remobilization, potentially requiring dedicated sludge treatment lines.

Key sustainability aspects to be considered include (Mainardis et al., 2024): (i) ozonation requires substantial energy and may generate harmful by-products; (ii) PAC requires regular carbon dosing, additional sludge treatment, and disposal through incineration; and (iii) GAC, when regenerated, reduces the demand for new material and waste generation, although regeneration processes can be energy-intensive and produce waste streams requiring treatment.

With regard to energy consumption, UWWTPs can partially offset energy demand by producing energy through anaerobic digestion and using biogas, thereby improving overall sustainability.

It is important to highlight that energy costs make up a significant portion of the operational expenses associated with quaternary treatment (Pistocchi et al., 2022). The new energy neutrality requirements under the UWWTD (Art. 11) are expected to gradually reduce energy costs and, consequently, treatment expenses.

Moreover, the progressive deployment of quaternary treatment across Europe could foster economies of scale and other economic benefits, due to the expansion of the market for the relevant technologies. This could also facilitate the scaling up and broader application of innovative technologies already in existence or under development within European and international research.

These and other factors should be integrated into a detailed techno-economic assessment to select the most sustainable and cost-effective treatment configuration adapted to local conditions.

3.2 The economic impact of the Directive

As of today, based on the updated impact assessment by the JRC (Pistocchi, 2025), **the overall cost of quaternary treatment associated with the implementation of the UWWTD is estimated at EUR 1.48–1.8 billion per year at 2025 prices**, at full scale and with full implementation foreseen by 2045. Applying the cost-sharing criterion established by the Directive, the 80% share of these costs, to be borne by producers under extended producer responsibility, would amount to EUR 1.184–1.44 billion per year, while the remaining 20% share would range between EUR 296 and 360 million per

year. As the Directive requires producers to cover at least 80% of the costs, these figures represent a minimum threshold: any national decision to set a higher contribution rate would result in a corresponding increase in the financial burden borne by producers.

The cost estimates developed by the Joint Research Centre (JRC) reflect an overall European-level picture; however, **their impact will inevitably be differentiated across Member States, depending on the initial conditions of existing wastewater treatment systems, the level of compliance already achieved, and the technologies selected for treatment**.

The Directive itself acknowledges this technological variability and, under Article 10(5), provides for the exchange of information, experience and best practices ("regular dialogues") among Member States, inter alia with a view to identifying the most appropriate quaternary treatment technologies.

The costs associated with the introduction of quaternary treatment in urban wastewater systems may therefore vary depending on the technological solutions adopted by operators. Technologies entail different cost profiles in terms of both capital expenditure (CAPEX), related to the design, construction and installation of facilities, and operational expenditure (OPEX), linked to energy consumption, labour and treatment-related inputs (oxygen, GAC, PAC, sand, ...), and maintenance of machinery and electricity (Deloitte, 2025).

From the interviews it emerged that cost allocation is one of the most contested aspects of the future EPR system, with differing views on fairness, methodology and impacts on consumers.

Water utilities support cost-efficiency principles based on lifecycle assessments and emphasized the importance of transparency and regulatory validation of costs.

Pharmaceutical and chemical companies questioned the proportionality of cost allocation, highlighting the risk of misalignment between actual pollution contributions and financial responsibilities, as well as potential impacts on product availability.

Local economic ecosystem stakeholders advocate for evidence-based allocation mechanisms linked to monitoring data and environmental risk assessments.

Economic regulators stressed the importance of tariff affordability, noting that residual costs may still be passed on to consumers and require appropriate distributional and protection mechanisms.

3.2.1 Hypothetical Member State-level impact

In the updated impact assessment by the JRC (Pistocchi, 2025), the overall cost, estimated using different cost functions from various studies, is summarized as follows:

Table 10: EU Cost Comparison: Proposal vs Adopted Directive - €/year

Cost model	*EU Total cost (legislative proposal)*	Ratio of cost to nominal cost in the IA[19]	Ratio of cost to nominal cost in the IA (adjusted for inflation)	*EU Total cost (adopted Directive)*	Ratio of cost to nominal cost in the IA 19	Ratio of cost to nominal cost in the IA (adjusted for inflation)
Cost (IA) - Equation 1	1.198.308.285	1	0,77	818.779.478	0,68	0,53
Cost (IA) after inflation - Equation 2	1,557,800,771	1.3	1	1,064,413,322	0.89	0.68
VSA (average) - Equation 3	2,858,918,913	2.39	1.84	2,154,781,606	1.8	1.38
VSA (optimized) - Equation 3	2,353,552,642	1.96	1.51	1,835,774,786	1.53	1.18
PoliMi (O3) - Equation 4	1,854,051,195	1.55	1.19	1,484,315,667	1.24	0.95
PoliMi (GAC) - Equation 4	2,096,025,528	1.75	1.35	1,671,056,327	1.39	1.07
PoliMi (PAC) - Equation 4	2,284,043,039	1.91	1.47	1,836,343,916	1.53	1.18
UBA variant 1 - Equation 5	2,180,363,174	1.82	1.4	1,519,002,799	1.27	0.98
UBA variant 2 - Equation 6	2,110,162,482	1.76	1.35	1,553,351,611	1.3	1
DK study - Equation 7	2,467,022,359	2.06	1.58	1,880,351,942	1.57	1.21

Source: JRC, 2025

In particular, the overall cost estimated using the IA cost function adopted in the Directive is also reported at the Member State level. By applying the same distribution to the total cost across the different cost models, the following table is obtained. Considering that the level of information on the actual characteristics of existing plant installations is still limited, the analysis should be regarded as a purely mathematical exercise.

Table 11: Member State-Level costs based on the proportionally constructed IA Cost Function (€ million)

Member State	MS	Cost (adopted Directive) Cost (IA) - Equation 1	Cost (IA) after inflation - Equation 2	PoliMi (O3) - Equation 4	UBA variant 1 - Equation 5	UBA variant 2 - Equation 6	PoliMi (GAC) - Equation 4	VSA (optimized) - Equa-tion 3	PoliMi (PAC) - Equation 4	DK study - Equation 7	VSA (average) - Equa-tion 3
Austria	***AT***	24.9	32.4	45.2	46.2	47.3	50.9	55.9	55.9	57.2	65.6
Belgium	***BE***	14.1	18.3	25.5	26.1	26.7	28.7	31.5	31.6	32.3	37.0
Bulgaria	***BG***	9.9	12.8	17.9	18.3	18.7	20.1	22.1	22.1	22.6	25.9
Cyprus	***CY***	1.9	2.5	3.5	3.6	3.7	3.9	4.3	4.3	4.4	5.1
Czech Republic	***CZ***	8.6	11.2	15.6	16.0	16.4	17.6	19.3	19.3	19.8	22.7
Germany	***DE***	166.7	216.6	302.1	309.2	316.2	340.1	373.6	373.8	382.7	438.6
Denmark	***DK***	19.2	24.9	34.7	35.5	36.3	39.1	42.9	43.0	44.0	50.4
Estonia	***EE***	2.8	3.6	5.0	5.1	5.2	5.6	6.2	6.2	6.3	7.2
Greece	***EL***	11.9	15.5	21.5	22.1	22.5	24.3	26.6	26.7	27.3	31.3
Spain	***ES***	116.4	151.3	211.0	216.0	220.9	237.6	261.0	261.1	267.4	306.4
Finland	***FI***	9.8	12.7	17.8	18.2	18.6	20.0	22.0	22.0	22.5	25.8
France	***FR***	94.6	122.9	171.4	175.4	179.4	193.0	212.0	212.1	217.1	248.8
Croatia	***HR***	2.6	3.4	4.8	4.9	5.0	5.3	5.9	5.9	6.0	6.9

Member State	MS	Cost (adopted Directive) Cost (IA) - Equation 1	Cost (IA) after inflation - Equation 2	PoliMi (O3) - Equation 4	UBA variant 1 - Equation 5	UBA variant 2 - Equation 6	PoliMi (GAC) - Equation 4	VSA (optimized) - Equa-tion 3	PoliMi (PAC) - Equation 4	DK study - Equation 7	VSA (average) - Equa-tion 3
Hungary	***HU***	23.5	30.5	42.5	43.5	44.5	47.9	52.6	52.6	53.9	61.8
Ireland	***IE***	4.9	6.3	8.8	9.0	9.2	9.9	10.9	10.9	11.2	12.8
Italy	***IT***	115.9	150.7	210.2	215.1	220.0	236.6	259.9	260.0	266.3	305.1
Lithuania	***LT***	5.4	7.1	9.9	10.1	10.3	11.1	12.2	12.2	12.5	14.3
Luxembourg	***LU***	1.2	1.6	2.3	2.3	2.4	2.5	2.8	2.8	2.9	3.3
Latvia	***LV***	2.0	2.5	3.5	3.6	3.7	4.0	4.4	4.4	4.5	5.1
Malta	***MT***	1.5	1.9	2.7	2.7	2.8	3.0	3.3	3.3	3.4	3.9
Netherlands	***NL***	44.8	58.2	81.2	83.1	84.9	91.4	100.4	100.4	102.8	117.8
Poland	***PL***	68.1	88.6	123.5	126.4	129.3	139.0	152.8	152.8	156.5	179.3
Portugal	***PT***	19.5	25.3	35.3	36.2	37.0	39.8	43.7	43.7	44.8	51.3
Romania	***RO***	24.7	32.1	44.7	45.8	46.8	50.3	55.3	55.3	56.7	64.9
Sweden	***SE***	19.2	24.9	34.8	35.6	36.4	39.2	43.0	43.0	44.1	50.5
Slovenia	***SI***	1.1	1.5	2.0	2.1	2.1	2.3	2.5	2.5	2.6	2.9
Slovakia	***SK***	3.8	4.9	6.9	7.0	7.2	7.7	8.5	8.5	8.7	10.0
EU total		**818.8**	**1,064.4**	**1,484.3**	**1,519.0**	**1,553.4**	**1,671.1**	**1,835.8**	**1,836.3**	**1,880.4**	**2,154.8**

Source: JRC, 2025

Countries where virtually all UWWTPs already perform tertiary or advanced tertiary treatments (such as Germany and Austria) are bound to face lower overall costs. On the contrary, in countries like Spain, Italy, Ireland, Portugal and, to a lesser extent, France and Hungary, the upgrade costs may be larger (Pistocchi et al., 2022).

In any case, the costs incurred by WWTUs for the installation of advanced treatment systems constitute sunk costs, to be recovered over the long term, regardless of any future reduction in micropollutant loads achieved through upstream measures. As a result, these costs are largely insensitive to subsequent variations in the quantities of MPs treated.

Each Member State will have to define its national implementation programme by 1 January 2028, including the identification and planning of the investments required for each agglomeration. At this stage, the currently available aggregate estimates can be progressively refined and adapted to national and local specificities, and the economic and distributional impacts will become clearer.

Significant heterogeneities exist across the EU in terms of price levels for investments and capital goods (Pistocchi, 2025). Countries such as Switzerland, Denmark, and Sweden face markedly higher investment and construction costs compared to Member States such as Bulgaria and Poland. These differences will lead to substantial variability in the costs of complying with UWWTD requirements.

The data published on the EEA website[13] regarding the types of existing wastewater treatment plants, available at the level of detail of individual Member States, show a differentiated situation. It concerns all wastewater treatment plants, of which only some will be above 150,000 p.e.

[13] https://sdi.eea.europa.eu/data/52b2e779-a146-414f-bf00-d63dfbf9c4f1

Table 12: Wastewater treatment plants

Country	Total plants	Biological treatment with nitrogen and phosphorus removal (tertiary treatment)	Biological treatment (secondary treatment)	Primary treatment	Other Treatment or without information	Biological treatment with nitrogen and phosphorus removal (%)	Biological treatment (%)	Primary treatment (%)	Other Treatment or without information
Belgium	574	338	66	0	170	59%	11%	0%	30%
France	4062	3285	777	0	0	81%	19%	0%	0%
Germany	3798	3577	218	3	0	94%	6%	0%	0%
Greece	357	232	41	0	84	65%	11%	0%	24%
Hungary	828*	650*	173*	5*	0	76%	21%	0%	3%
Ireland[14]	1062**	131	56	4	7				
Italy	5008	1785	1784	281	1158	36%	36%	6%	23%
Latvia	545***	15***	453***	77***	0	30%	70%	0%	0%
Netherlands	315	315	0	0	0	100%	0%	0%	0%
Poland	1656	786	870	0	0	47%	53%	0%	0%
Portugal	528****	63****	420****	8****	1****	17%	81%	2%	0%
Romania	1622	206	797	35	584	13%	49%	2%	36%
Slovenia	202	105	13	0	84	52%	6%	0%	42%
Spain	2.357	1.139	994	32	192	48%	42%	1%	8%
Sweden	434	434	0	0	0	100%	0%	0%	0%
Total	**23348**	**13061**	**6662**	**445**	**2280**	**58%**	**29%**	**1%**	**12%**

*Sources: *MEKH - Hungarian Energy and Utilities Regulatory Authority; ** Irish national water utility Uisce Éireann Water-Forum-Factsheet-4-Water-Services-final.pdf; *** The Public Utilities Commission (PUC);**** European Environmental Agency Files - EEA. Where not otherwise indicated, all figures not marked by a asterisks refer to reworked data from the EEA, available at the following link: Files - EEA.*

The following tables show the same breakdown for wastewater treatment plants whose treatment capacity, expressed in population equivalent (p.e.), has been reported. The first table presents data for plants declared with a capacity above 150,000 p.e.; the second reports data for plants declared with a capacity above 10,000 p.e. and below 150,000 p.e.

[14] Total plant figures are based on national water utility source Uisce Éireann (*Water-Forum-Factsheet-4-Water-Services-final.pdf*), while the breakdown by treatment level is derived from the European Union database European Union | Country profiles on urban waste water treatment | WISE Freshwater. As these data come from different sources, the total number of plants does not correspond to the sum of the individual treatment categories.

It should, however, be noted that, in the database under examination, the treatment capacity is not indicated for 12,184 plants; some of these could nevertheless have a capacity above 10,000 p.e. or even above 150,000 p.e. The third table therefore also shows the breakdown of these plants.

Table 13: Wastewater treatment plants (>=150.000 p.e.)

Country	Total plants	Biological treatment with nitrogen and phosphorus removal (tertiary treatment)	Biological treatment (secondary treatment)	Primary treatment	Other Treatment or without information	Biological treatment with nitrogen and phosphorus removal (%)	Biological treatment (%)	Primary treatment (%)	Other Treatment or without information
Belgium	12	12	0	0	0	100%	0%	0%	0%
France	88	76	12	0	0	86%	14%	0%	0%
Germany	162	162	0	0	0	100%	0%	0%	0%
Greece	10	9	1	0	0	90%	10%	0%	0%
Hungary	15	13	2	0	0	87%	13%	0%	0%
Ireland	7	2	5	0	0	29%	71%	0%	0%
Italy	114	87	26	1	0	76%	23%	1%	0%
Latvia	1	1	0	0	0	100%	0%	0%	0%
Netherlands	36	36	0	0	0	100%	0%	0%	0%
Poland	68	68	0	0	0	100%	0%	0%	0%
Portugal	29	5	23	1	0	17%	79%	3%	0%
Romania	24	19	1	2	2	79%	4%	8%	8%
Slovenia	3	3	0	0	0	100%	0%	0%	0%
Spain	140	84	55	1	0	60%	39%	1%	0%
Sweden	17	17	0	0	0	100%	0%	0%	0%
Total	**726**	**594**	**125**	**5**	**2**	**82%**	**17%**	**1%**	**0%**

Table 14: Wastewater treatment plants (>=10.000 and <150.000 p.e.)

Country	Total plants	Biological treatment with nitrogen and phosphorus removal (tertiary treatment)	Biological treatment (secondary treatment)	Primary treatment	Other Treatment or without information	Biological treatment with nitrogen and phosphorus removal (%)	Biological treatment (%)	Primary treatment (%)	Other Treatment or without information
Belgium	180	178	0	0	2	99%	0%	0%	1%
France	1229	1047	182	0	0	85%	15%	0%	0%
Germany	2071	2060	11	0	0	99%	1%	0%	0%

Country	Total plants	Biological treatment with nitrogen and phosphorus removal (tertiary treatment)	Biological treatment (secondary treatment)	Primary treatment	Other Treatment or without information	Biological treatment with nitrogen and phosphorus removal (%)	Biological treatment (%)	Primary treatment (%)	Other Treatment or without information
Greece	172	158	14	0	0	92%	8%	0%	0%
Hungary	193	154	39	0	0	80%	20%	0%	0%
Ireland	67	50	16	1	0	75%	24%	1%	0%
Italy	1249	853	360	32	4	68%	29%	3%	0%
Latvia	28	22	6	0	0	79%	21%	0%	0%
Netherlands	231	231	0	0	0	100%	0%	0%	0%
Poland	597	548	49	0	0	92%	8%	0%	0%
Portugal	188	45	137	6	0	24%	73%	3%	0%
Romania	201	146	27	5	23	73%	13%	2%	11%
Slovenia	38	38	0	0	0	100%	0%	0%	0%
Spain	864	571	266	26	1	66%	31%	3%	0%
Sweden	185	185	0	0	0	100%	0%	0%	0%
Total	**7493**	**6286**	**1107**	**70**	**30**	**84%**	**15%**	**1%**	**0%**

Table 15: Wastewater treatment plants (>=10.000 and <150.000 p.e.)

Country	Total plants	Biological treatment with nitrogen and phosphorus removal (tertiary treatment)	Biological treatment (secondary treatment)	Primary treatment	Other Treatment or without information	Biological treatment with nitrogen and phosphorus removal (%)	Biological treatment (%)	Primary treatment (%)	Other Treatment or without information
Belgium	205	143	60	0	2	70%	29%	0%	1%
France	2745	2162	583	0	0	79%	21%	0%	0%
Germany	1565	1355	207	3	0	87%	13%	0%	0%
Greece	91	65	26	0	0	71%	29%	0%	0%
Hungary	649	486	134	1	28	75%	21%	0%	4%
Ireland	123	79	35	3	6	64%	28%	2%	5%
Italy	2364	843	1393	93	35	36%	59%	4%	1%
Latvia	50	1	49	0	0	2%	98%	0%	0%
Netherlands	48	48	0	0	0	100%	0%	0%	0%
Poland	991	170	821	0	0	17%	83%	0%	0%
Portugal	311	39	270	1	1	13%	87%	0%	0%

Romania	1397	42	768	28	559	3%	55%	2%	40%
Slovenia	77	64	13	0	0	83%	17%	0%	0%
Spain	1336	487	670	5	174	36%	50%	0%	13%
Sweden	232	232	0	0	0	100%	0%	0%	0%
Total	**12184**	**6216**	**5029**	**134**	**805**	**51%**	**41%**	**1%**	**7%**

Against this background, the implementation of the UWWTD is expected to generate differentiated distributional impacts across the various stakeholders involved, including producers, wastewater service operators, end users and taxpayers. Overall, the distributional effects of the Directive depend not only on the formal allocation of financial responsibilities set out in the regulatory framework, but also on sector- and country-specific market structures, existing subsidy regimes, and the design of complementary measures aimed at preserving affordability and access to essential goods.

Box 1: Cases of implementation of quaternary treatments - web search

The information related to quaternary treatments already in place or in the process of being implemented was obtained from the websites of operators or public entities. This is a partial analysis and has not been verified.

Belgium

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment. Therefore, a brief and incomplete analysis was conducted on the websites.

At the wastewater treatment plant managed by Aquafin in Aartselaar, an advanced treatment unit has been installed, combining ozonation and granular activated carbon filtration to remove MPs from the final effluent. This plant is considered one of the first examples in Belgium of the application of a process that, in practice, corresponds to a quaternary level of treatment — following tertiary and biological treatments — and this installation operates as a large-scale pilot or demonstration project. (https://prewapharm.nweurope.eu/blog/prewapharm-news-208/new-milestone-in-tackling-pharmaceutical-pollution-in-flanders-1036?utm)

Universities such as Ghent University and the University of Antwerp are involved in research projects — for example, testing ozonation and the combined use of activated carbon as an advanced process for the removal of MPs in Belgian wastewater treatment plants and in joint projects with the Netherlands. (https://www.ugent.be/ea/en/news-events/news/clean-watercourses-through-ozonation-and-granular-activated-carbon-2013-o3g?utm)

France

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment. Therefore, a brief and incomplete analysis was conducted on the websites.

The Seine Centre WWTP is the most cited case of advanced treatment towards quaternary treatment in France.

Under the supervision of the Greater Paris Hygiene Service (SIAAP), the Seine Centre wastewater treatment plant hosted a large-scale pilot project to test the use of micro-granular activated carbon in a fluidized bed as an advanced method for removing MPs from effluents. (https://pubmed.ncbi.nlm.nih.gov/26571333)

Germany

The German federal government recently stated that it is not yet possible to precisely determine how many plants in Germany already have a fourth treatment stage (quaternary treatment) for the removal of MPs, as data collection is still ongoing at the regional and federal levels.

(https://www.bundestag.de/presse/hib/kurzmeldungen-1039774?utm)

Although there is no official national census, there are some known plants that are already operating or have been upgraded with a fourth treatment stage:

1. Westerheim (Baden-Württemberg)

One of the first plants in Germany equipped with a fourth treatment stage (quaternary treatment), operational since 2015, with advanced filtration systems.

2. Lonsee/Halzhausen (Baden-Württemberg)

This plant has also integrated a fourth-stage system, operational at least since 2020.

3. Bickenbach (Hesse)

A plant equipped with integrated quaternary treatment (ozonation + activated carbon) and officially put into service with this technology in 2025.

4. Mörfelden-Walldorf (Hesse)

A recognized example of a plant already using quaternary treatment (https://www.welt.de/regionales/hessen/article68a3db42bdc63e69381ba555/Zu-Besuch-in-der-Super-Klaeranlage.html?utm)

Greece

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment. Therefore, a brief and incomplete analysis was conducted on the websites.

According to studies, Greece has hundreds of wastewater treatment plants serving the population primarily with biological treatment and nutrient removal (tertiary), but there is no clear public data or census currently documenting how many plants include a fourth stage of advanced treatment.

(https://www.researchgate.net/publication/396523536_Current_Operational_State_of_Wastewater_Treatment_Plants_in_Greece_A_Nationwide_Survey)

Hungary

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment.

Ireland

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment. Therefore, a brief and incomplete analysis was conducted on the websites.

As of now (2024), no plant in Ireland has been documented as applying complete quaternary treatment.

(https://www.catchments.ie/wp-content/uploads/2024/05/Impacts-of-Urban-Wastewater-on-Water-Quality.pdf?utm) (p.6)

Italy

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment. Therefore, a brief and incomplete analysis was conducted on the websites.

(https://atomonzabrianza.it/wp-content/uploads/2025/02/Relazione-Generale-PianoAmbito_2024_rev0g.pdf)

Introduction to the quaternary treatment section: experimentation is underway for the use of an integrated GAC/Zeolite process and plant system, with an expected duration of 12 months. The introduction of powdered carbon is currently being sized based on the pollutants identified during the first phase of the effluent analysis (the pilot-scale test will be conducted in the second half of the year)

Latvia

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment.

Lithuania

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment.

Netherlands

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment. Therefore, a brief and incomplete analysis was conducted on the websites.

The Netherlands is actively involved in the experimentation and development of advanced technologies to remove MPs from effluents through technical and pilot programs such as the Innovation Programme for Micropollutants from Wastewater Treatment Plant Effluent (IPMV), which has mapped various available advanced treatment technologies for plants.

(https://www.waternewseurope.com/dutch-technical-study-maps-advanced-treatment-technologies/?utm)

An article reporting preliminary results from Dutch projects indicates at least 12 Dutch municipal plants that, by the end of 2024, are expected to have an additional full-stage large-scale wastewater treatment — configurable as advanced quaternary treatment.

(https://www.dutchwatersector.com/news/promising-fourth-stage-technologies-for-wastewater-treatment-revealed-at-aquatech-amsterdam?utm)

Poland

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment. Therefore, a brief and incomplete analysis was conducted on the websites.

In various technical projects and workshops in Poland — for example, within the EMPEREST project — advanced technologies for micropollutant treatment in urban wastewater treatment plants (ozonation, adsorption, etc.) are being discussed and experimented with.

(https://interreg-baltic.eu/project-posts/emperest/emperest-workshop-in-szczecin-tackles-micropollutants-in-wastewater/?utm)

Portugal

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment.

Romania

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment.

Slovenia

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment. Therefore, a brief and incomplete analysis was conducted on the websites

Official environmental data from Slovenia, collected by the Agency of the Republic of Slovenia for the Environment (ARSO), provide detailed information on wastewater treatment plants, including treatment levels (primary, secondary, and tertiary), but do not include a specific classification or count for plants with quaternary treatment. Therefore, ARSO's datasets on treatment systems do not provide a distinct number of quaternary treatment plants.

(https://www.arso.gov.si/varstvo%20okolja/onesna%C5%BEevanje%20voda/?utm)

Spain

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment. Therefore, a brief and incomplete analysis was conducted on the websites.

Technical publications on Spanish plants highlight that there are plants with treatments beyond simple biological/tertiary treatment, for example, some already equipped with processes like reverse osmosis or ultrafiltration, especially in the regions of Catalonia and Valencia. For now, these technologies are mainly case studies of plants with advanced treatment/regeneration, and there are no official published numbers of plants already classified as quaternary.

(https://www.researchgate.net/publication/352659592_Wastewater_Treatment_Plants_in_Mediterranean_Spain_An_Exploration_of_Relations_between_Water_Treatments_Water_Reuse_and_Governance)

Sweden

No official and verifiable public data were found regarding the number of wastewater treatment plants equipped with quaternary treatment. Therefore, a brief and incomplete analysis was conducted on the websites.

According to a comparative analysis of wastewater treatment systems in the Nordic countries, the coverage of quaternary treatment in Sweden is estimated at around ~2% of the total UWWTPs. These plants employ additional technologies such as ozonation or granular activated carbon filtration as an advanced stage beyond tertiary treatment.

(https://link.springer.com/article/10.1007/s43832-025-00297-9?utm)

From the interviews it emerged that stakeholders recognize the environmental ambition of EPR in wastewater but also highlighted important limitations and trade-offs.

Water utilities emphasized that EPR should not only finance treatment infrastructure but also act as a driver for upstream changes, encouraging the substitution of hazardous substances.

Pharmaceutical and chemical companies highlighted the limited potential for prevention, especially in the pharmaceutical sector, due to long development timelines and regulatory constraints, although greater flexibility exists in other sectors such as cosmetics.

Local economic ecosystem stakeholders stressed that environmental outcomes depend on the availability of reliable monitoring systems and robust data, given the variability of micropollutants across territories.

Economic regulators acknowledged the potential benefits for environmental protection and public health but underlined the significant economic pressures associated with large-scale infrastructure investments: according to them it would be necessary to clarify whether large-scale investments in quaternary treatment would remain proportionate if the pharmaceutical and cosmetic industries significantly reduce their emissions of microplastics and micropollutants through upstream measures.

3.2.2 Financing at least 80% of quaternary treatment cost

The obligation for pharmaceutical and cosmetic producers to cover up to 80% of quaternary treatment costs has raised concerns within the industries regarding the potential negative impacts on producers and consumers, as well as on the availability of medicines, particularly generic medicines subject to strict price regulation. However, updated estimates for 2045 indicate that a hypothetical full pass-through to consumers would add only very few euros per EU citizen, constituting a very small financial impact.

To discuss the impact on these two sectors, it is useful to examine the main areas of use for the substances listed in the Directive and for which there is a requirement to reduce their levels. The table below specifies whether these are pharmaceutical or cosmetic products.

Table 16: Attribution of the substances to be removed to pharmaceutical and cosmetic products

Substance	CAS No	Use in Pharmaceutical Products	Use in Cosmetics
Category 1 (substances that can be very easily treated)			
Amisulpride	71675-85-9	Active pharmaceutical ingredient (antipsychotic)	—
Carbamazepine	298-46-4	Antiepileptic and mood stabilizer	—
Citalopram	59729-33-8	SSRI antidepressant	—
Clarithromycin	81103-11-9	Macrolide antibiotic	—
Diclofenac	15307-86-5	Non-steroidal anti-inflammatory drug (systemic and topical medicinal use)	—
Hydrochlorothiazide	58-93-5	Thiazide diuretic	—
Metoprolol	37350-58-6	Beta-blocker	—
Venlafaxine	93413-69-5	SNRI antidepressant	—
Category 2 (substances that can be easily disposed of)			
Benzotriazole	95-14-7	Not used as an active pharmaceutical ingredient	Possible use as UV stabilizer
Candesartan	139481-59-7	Angiotensin II receptor antagonist	—
Irbesartan	138402-11-6	Angiotensin II receptor antagonist	—
4-Methylbenzotriazole	29878-31-7		Possible UV stabilizer
5-Methylbenzotriazole	136-85-6		Possible UV stabilizer

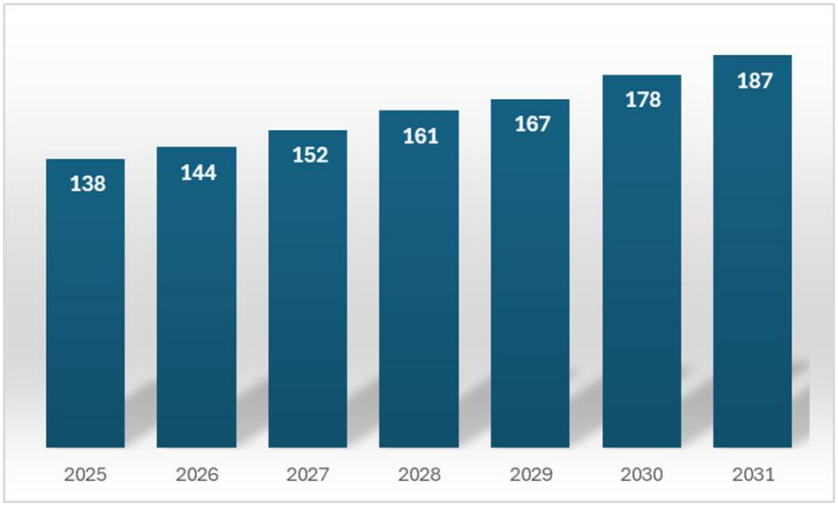
The substances included in the first category are primarily pharmaceutical active ingredients intended for human therapeutic use.

The substances listed in the second category are mainly used in industrial applications, such as corrosion inhibitors or UV stabilisers, with potential use in certain cosmetic formulations as stabilising agents, where permitted by the applicable regulatory frameworks.

In light of the above, the impact on the pharmaceutical sector is expected to be greater than that on the cosmetics industry.

The cosmetic sector market in Europe generates revenues of around 138 billion dollars in 2025 and is expected to grow up to 187 billion dollars in 2031 (source: MRA Market Reports Analytics).

Figure 10: European Cosmetics Industry Market Size (billion dollars)



The pharmaceutical sector is substantially larger, with revenues of approximately €425 billion in 2025 (495 billion US dollars), volume that is expected to increase up to €850 billion in 2034 (820 billion US dollars).

Figure 11: European Pharmaceutical Market Size (billion dollars)

When assessing the impact on these sectors, it should be noted that there are significant structural differences between the cosmetic and pharmaceutical industries in Europe, and that their ability to absorb or pass on these costs varies considerably.

In the pharmaceutical sector, medicines are largely financed through public healthcare systems[15] and are subject to stringent regulatory approval processes, which significantly

[15] 70% of EU medicine costs are covered by governments. See OECD (2024c). *Health at a Glance: Europe 2024*.

limit the scope for reformulation or substitution of active substances in response to environmental cost signals, and therefore constrain the ability to reduce EPR contributions, with the sector remaining highly exposed both in terms of compliance obligations and limited flexibility to adapt.

A further layer of complexity arises from differences between generic and branded medicines. Generics account for a substantial share of the European market, around 70% of volumes and 90% of critical medicines but only about 19% of pharmaceutical value,[16] reflecting their low-price, low-margin structure. They are typically subject to strict and rigid price regulation (e.g. reference pricing and tendering), which leaves very limited scope for price increases. As a result, additional UWWTD-related costs are likely to be absorbed by manufacturers, increasing the risk of market exit, reduced supply, or decreased competition, especially for the generic segment.[17]

In contrast, cosmetics are generally sold directly to consumers in competitive, non-subsidised markets. While companies may attempt to pass on additional compliance costs, price sensitivity and brand competition significantly constrain their ability to do so.

In addition, patients constitute a specific group within the broader category of consumers, as any pass-through of UWWTD-related costs in the pharmaceutical sector may influence access to essential medicines, which are less price-elastic goods compared to the cosmetic ones, and public health expenditure.

On this point, the Directive explicitly provides in Article 10, paragraph 6:

> "*6. By 1 January 2025, the Commission shall provide for the organisation of exchange of information, experience and best practices between Member States on the implementation of Article 9 and this Article and in particular on: [..]*
>
> *(f) the possible impacts of the application of the requirements referred to in Article 9 on the accessibility, availability and affordability of medicines placed on the Union market*."

As of the date of publication of this document, there is no evidence of what was supposed to be completed by 1 January 2025.

In light of the above considerations, the pharmaceutical sector is expected to be more significantly affected from a regulatory perspective than the cosmetics industry, although the overall financial burden may be partially shared with public healthcare systems. At the same time, the relative impact across sectors will also depend on their capacity to adapt, including their level of R&D investment and ability to reformulate products.

A reduction in the impact on producers in the cosmetic and pharmaceutical sectors could certainly be achieved if, at a later stage, the approach referred to in Recital (20) of the Directive were pursued. That recital acknowledges that pharmaceutical and cosmetic residues currently represent the main sources of MPs found in urban wastewater requiring quaternary treatment and, for this reason, provides for the application of extended producer responsibility to these two product groups. At the same

[16] https://www.medicinesforeurope.com/wp-content/uploads/2025/03/Medicines-for-Europe-PR-UWWTD-Legal-Case-Press-release.pdf.
[17] Op. cit.

time, the Directive foresees that, on the basis of the results of urban wastewater monitoring and the most recent scientific data, the Commission should periodically assess whether the extended producer responsibility system should be extended to other product categories. Any extension of the scope of the EPR scheme to additional products could allow for a broader distribution of costs, thereby reducing the financial burden currently concentrated on cosmetic and pharmaceutical producers.

3.2.3 Financing the remaining 20% of quaternary treatment costs

Since operators of wastewater treatment services must be ensured compliance with the full cost recovery principle, the residual share of costs not covered by producers is expected to be recovered through service tariffs, unless other forms of financing are identified.

In this regard, the Directive already provides, in Article 23, that national implementation programmes should identify, or at least indicate, **potential sources of public financing, where needed, to complement user charges**.

Furthermore, Member States may continue to make use of the available European Union funding for the implementation of the Directive, as provided for in Article 23 of the Directive.

Given the essential nature and universal consumption of water services, if the entire residual 20% share of total costs were to be charged to users through tariffs, regressive effects could arise, making it necessary to strengthen accessibility safeguards and complementary mitigation measures for low-income households.

Even if Member States were to intervene with their own funds, citizens, as taxpayers, would still be affected to the extent that other public budget items not related to water tariffs were mobilised to co-finance investments in wastewater treatment.

Although to a limited extent, an additional source of cost coverage could derive from administrative penalties and sanctions imposed on producers or producer responsibility organisations (PROs) for non-compliance with EPR obligations and collected by public authorities, such as failure to register with a PRO, failure to submit declarations on products placed on the market, or failure to comply with reporting and payment deadlines.

In most EPR schemes, sanctions are typically collected directly by the PRO and may be used to offset system costs, potentially contributing to a reduction in environmental fees for compliant producers. In less frequent cases, certain infringements, such as placing EPR-covered products on the market without registration, may lead to penalties levied and collected by public authorities, in which case the revenues could contribute indirectly to financing the remaining, non-mandatory 20% of advanced wastewater treatment costs.

Although these mechanisms are not intended to be the primary source of funding, they may nevertheless marginally increase the system's overall financial capacity or reduce the burden on compliant producers.

The interviews conducted revealed that the entire remaining 20% of the total costs of advanced treatment is expected to be covered by water charges.

3.2.4 Distributional policies recommendations

3.2.4.1 Distributional safeguard for the 80% public cost coverage

The following table summarises how distributional policies can be targeted at different stakeholders in order to mitigate the distributional impacts associated with UWWTD implementation.

Table 17: Policy options to cushion distributional impacts of UWWTD implementation across stakeholders

Stakeholder	Distributional policy		
	Income-based rebates / exemptions	Public co-financing of UWWT investments	Targeted protection for essential medicines
Pharmaceutical companies			Partial compensation where EPR costs materially affect affordability or availability of essential medicines.
Cosmetic companies			
Citizens (general taxpayers)	• Eligibility-based reductions on water tariffs for low-income households; • Regulatory monitoring of affordability indicators • Lifeline tariffs for essential consumption; • Cross-subsidisation across user categories; • Household-size adjusted tariff schemes.		Direct protection of affordability and access to essential medicines.
Urban wastewater treatment operators		Support for early-stage investments.	

Public co-financing of urban wastewater treatment investments plays a central role in easing the transition for utilities. By covering part of the capital expenditure required for advanced treatment upgrades, public funding reduces the upfront financial burden on operators, facilitates timely compliance with regulatory requirements, and limits the

need for sharp or immediate increases in wastewater tariffs. This mechanism also helps smooth investment cycles and alleviate financing constraints, particularly for smaller or highly indebted utilities.

In parallel, targeted protection mechanisms are needed in the pharmaceutical sector. Given the essential nature of many medicinal products and their low price elasticity of demand, passing EPR-related costs directly onto prices could undermine affordability or, in extreme cases, affect product availability. Targeted compensation or protection measures help preserve public health objectives while maintaining the integrity and credibility of the EPR framework.

Finally, tariff-based cushioning measures for citizens ensure that the residual costs passed through to water tariffs do not disproportionately affect vulnerable households. They can build on and strengthen existing affordability measures related to drinking water services (e.g. social tariffs or bonuses) already in place in several Member States, where integrated water services (SII) are provided. In contexts where integrated water services are not in place, such measures can instead be applied specifically to wastewater treatment and sewerage services.

Income-based water tariff rebates are primarily aimed at protecting low-income users, while lifeline tariffs for essential consumption can guarantee access to a basic volume of water at a very low or zero price. Higher levels of consumption are then charged at increasing rates, limiting regressive effects while preserving price signals.

More generally, progressive tariff structures based on increasing consumption blocks introduce an implicit redistributive effect, as higher-income households tend to consume more water and therefore contribute more to cost recovery. Redistribution can also be achieved through cross-subsidisation mechanisms, whereby higher tariffs applied to non-household users or high-consumption residential users are used to finance lower tariffs for vulnerable households.

In addition, tariff thresholds or social allowances can be adjusted to reflect household size, preventing large but low-income households from being penalised due to structurally higher essential water needs. Finally, a regulatory monitoring by public authorities regarding tariff affordability indicators could be performed, as well.

3.2.4.2 Distributional safeguard for the remaining 20% of quaternary treatment costs

The coverage combinations presented below illustrate how different financing mixes can be accompanied by targeted distributional policies to mitigate impacts. In the balanced tariff–public funding mix (**Option A**), the residual 20% UWWT upgrade cost is shared across tariffs, other non-tariff-related public budgets and, to a very limited extent, additional producer financing, though penalties levied and collected by public authorities. In this configuration, moderate income-based tariff rebates help protect vulnerable consumers from excessive water bill increases, while the use of general taxation spreads part of the burden across the wider population. At the same time, targeted and time-limited relief mechanisms for producers may facilitate compliance

during the early phases of implementation without undermining the polluter pays principle.

In the predominantly tariff-based recovery option (**Option B**), most of the residual costs are recovered through wastewater tariffs, with only limited support from public budgets. This approach necessitates stronger distributional measures to ensure tariff affordability. Targeted exemptions or discounts for low-income households, combined with phased and capped tariff increases, regulatory monitoring of affordability indicators, lifeline tariffs for essential consumption, and cross-subsidisation across user categories all contribute to smoothing the impact over time.

Table 18: Policy combinations for covering the remaining 20% cost share, with distributional measures

Coverage combination options	Coverage percentage points (examples)			Distributional policies
	Tariff-based	**Other non-tariff-related public funding sources**	**Additional producer financing**	
A) Balanced tariff–public funding mix	10% p.	8% p.	2% p.	(i) Moderate income-based water tariff rebates to limit impacts on vulnerable consumers; (ii) use of general taxation to spread part of the cost across higher income taxpayers; (iii) targeted, time-limited relief mechanisms for producers to smooth compliance costs during the initial implementation phase.
B) Predominantly tariff-based recovery	15% p.	5% p.	/	(i) Targeted tariff exemptions for low-income households; (ii) phased and capped tariff increases; (iii) regulatory monitoring of affordability indicators; (iv) lifeline tariffs for essential consumption; (v) cross-subsidisation across user categories; …

Box 2: Water tariff distributional policy: Country examples

The case of Italy – The ARERA water bonus

The ARERA (Italian Regulatory Authority for Energy, Networks and Environment) water bonus[18] is a financial benefit established by law and implemented by ARERA. It guarantees a reduction in the cost of water services for households experiencing economic hardship and for large families, in order to ensure access to a basic amount of water at an affordable cost.

The water bonus is granted to domestic resident users who belong to a household with an ISEE indicator not exceeding 9,530 euros, or to a large family with at least four

[18] https://www.arera.it/atlante-per-il-consumatore/acqua/diritti-e-tutele/bonus-acqua

dependent children and an ISEE indicator not exceeding 20,000 euros. The water bonus for economic hardship is granted for a period of twelve months. To continue receiving the benefit, households must submit a declaration to the National Institute of Social Security (INPS).

In addition to the national water bonus, a local integrated water bonus may be introduced at local level. This is an additional form of support that can provide an extra economic benefit or a different type of assistance compared to the national ARERA water bonus.

The case of France – Social water pricing

Social water pricing (*tarification sociale*)[19] is a tariff-based affordability measure aimed at reducing water bills for vulnerable households while preserving cost recovery. Inspired by former social tariffs for gas and electricity, this approach adjusts water prices for specific categories of users in order to enhance affordability.

It works by modulating the fixed and/or volumetric components of the water bill, for example through reduced or zero fixed charges, lower prices for essential consumption, or preferential pricing of initial consumption blocks under progressive tariff structures. Eligibility is typically defined using social assistance criteria or locally defined socio-economic thresholds. Once implemented, social water pricing is relatively low-cost to administer and can both improve access to water and incentivise water savings, although it requires upfront data coordination and mainly benefits users with individual water meters.

Local authorities may define eligibility based on:

- beneficiaries of existing social assistance schemes; or
- households or individuals meeting predefined socio-economic criteria.

The case of Belgium (Wallonia region) – the Social Water Fund

The Social Water Fund (Fonds Social de l'Eau – FSE)20 is a financial support mechanism established under the Walloon Water Code to assist households facing difficulties in paying their water bills. It applies exclusively in Wallonia and does not cover the German-speaking Community of Belgium.

The FSE is financed through a solidarity levy included in all water bills, amounting to approximately €0.033 per cubic metre in 2025, paid by all domestic water consumers. The fund is designed to guarantee continued access to water as an essential service, even in situations of temporary or structural financial hardship.

The FSE is available to private individuals (not companies), whether tenants or homeowners, who:

- reside in Wallonia (excluding the German-speaking Community);
- experience payment difficulties related to their primary residence;
- use water for domestic purposes only.

[19] Fiche Tarification sociale.pdf

[20] Besoin d'aide pour payer votre facture d'eau ? Le Fonds social de l'eau peut vous aider | SWDE

Eligibility is not limited to recipients of social assistance. Households apply through the local Public Centre for Social Action (CPAS), where a social worker assesses the situation and determines whether support from the fund can be granted.

In 2025, the maximum support amounts to:

- €635 per intervention,
- plus €127 for each dependent household member from the fourth person onwards.

Higher support may be granted in specific cases, such as water leaks causing abnormal consumption or the accumulation of unpaid bills over several years. Support is typically provided as a direct financial contribution toward outstanding water bills, helping households overcome temporary financial stress while preventing service disconnection.

The case of Portugal – Social water tariff

The social water tariff (tarifa social da água)[21] in Portugal is a public support measure designed to ensure that all households, especially those facing economic hardship, can afford access to essential water services.

The social water tariff is established by the Portuguese government but implemented at municipal or intermunicipal level by local water and sanitation service providers. Its main purpose is to reduce the cost of water bills for low-income or socially vulnerable households. The discount is applied directly to the monthly bill and may also cover sanitation and urban waste services, depending on local regulations.

Eligibility for the social water tariff can be automatic or upon request. Automatic eligibility applies to households that already receive certain social benefits, such as the Social Integration Income, the Solidarity Supplement for the Elderly, social unemployment benefits, family allowances (for specific income brackets), or social pensions for disability or old age. Households that do not receive social benefits may still apply if their annual income is below a defined threshold, which increases according to household size.

In addition to automatic allocation, the system allows for voluntary social tariff measures, which can be introduced at the discretion of the municipal assembly upon proposal by the municipal council. This local flexibility enables municipalities to extend support to additional households that may not qualify under the standard automatic criteria, adapting the scheme to local needs.

The regulation also establishes the mechanisms for funding the social tariff. Financial support or tariff reductions granted through the social water tariff are funded either by the municipalities themselves or, in the case of services provided by state-owned companies, by the companies.

The case of Ireland – The new Drinking Water Regulations

[21] https://www.ersar.pt/pt/consumidor/tarifas-dos-servicos/tarifarios-sociais.

Ireland's new Drinking Water Regulations[22], which transpose EU Directive 2020/2184, include specific measures aimed at ensuring access to safe and high-quality drinking water while recognizing the practical limitations of very small supplies.

A key feature of the regulations is their distributional approach: individual water supplies that provide less than 10 cubic meters (10,000 litres) per day or serve fewer than 50 people are exempt from the full regulatory requirements.

The case of Spain – Social Water Tax (Catalonia)

The water tax (canon del agua)[23] is an environmental levy included in water bills, which can account for up to 40% of the total water bill. In 2011, Catalonia introduced the social water tax tariff, a subsidy aimed at economically vulnerable households.

Under this scheme:

- Vulnerable families consuming up to 27 m^3 per quarter receive a 100% exemption of the water tax. This applies to about 72% of water bills in Catalonia, corresponding to those within the first consumption bracket.
- For vulnerable households exceeding this consumption threshold, the exemption is 50%.

Currently, around 76,000 families benefit from the social water tax tariff, and the number could rise to 100,000 families.

3.3 EPR governance in the wastewater sector

As already outlined in the previous chapters, the possible schemes that can be identified are as follows:

Monopolistic scheme:

- One PRO for both sectors;
- One PRO per sector.

Market-based scheme:

- Multiple PROs operating in competition;
- The Member State designates a coordinator body as required by Art. 10(3) of the UWWTD.

At the risk of repetition from a functional perspective, having a single PRO would reduce the complexity of the system: regulated utilities or centralised fund – depending on the implemented model - would have a single counterpart thereby lowering the coordination costs associated with a multi-PRO scheme.

Within a "monopolistic" scheme, it is possible to envisage a role, within the governance of the PRO, for stakeholders other than producers, such as public authorities, utilities and their associations, consumers, and research bodies. A purely auditing role for these

[22] https://www.gov.ie/en/department-of-housing-local-government-and-heritage/press-releases/new-drinking-water-regulations-to-enhance-standards-from-source-to-tap/.
[23] https://aca.gencat.cat/es/laca/campanyes-i-divulgacio/campanyes/tarifa-social-canon-aigua/.

stakeholders, without decision-making powers, appears plausible. The issue of the possible involvement of the regulatory authority is more complex, as it would likely be assigned an external and independent role, given the nature of its mandate.

A competitive scheme could allow for greater efficiency in the generation of PRO structural costs; however, it may also create organisational complexity that is itself costly and difficult to manage.

The analysis of the possible governance options suggests that **the most coherent model for implementing EPR in the water sector is the one based on a single national PRO,** possibly structured into **two distinct sub-sections** – one for pharmaceuticals and one for cosmetics – organised on a not-for-profit basis and **supported by a public fund or a centralised allocation system managed by a competent public authority**.

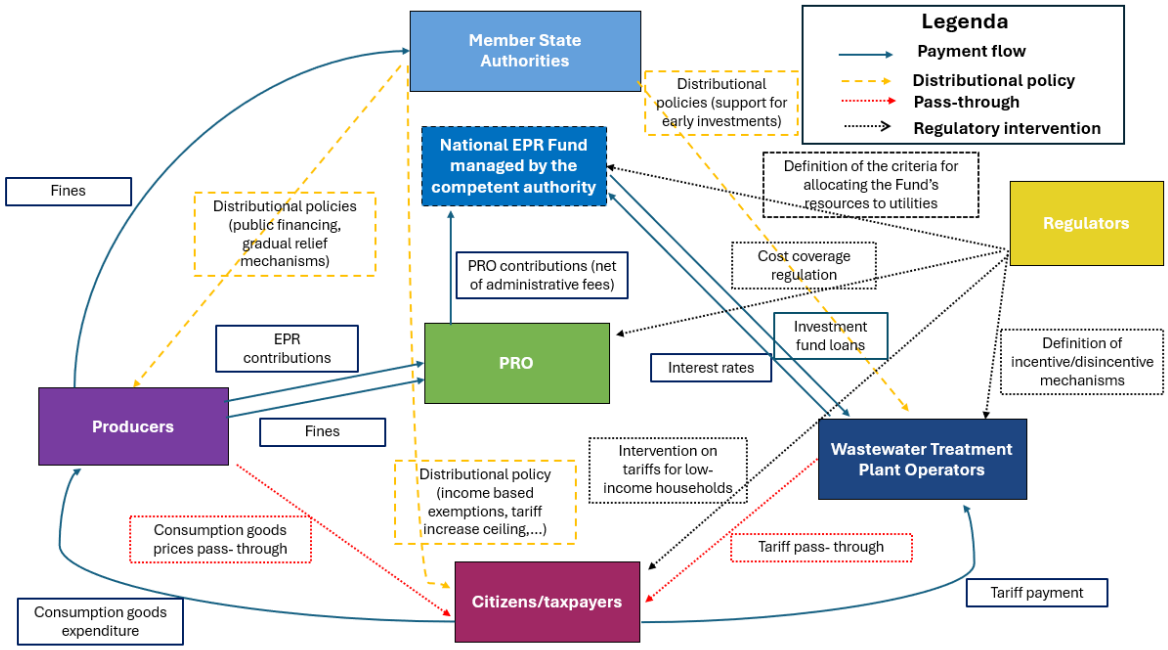
Under this scheme, the PRO is responsible for collecting contributions, managing data, eco-modulation and consumer information obligations, whilst the distribution of resources to water operators takes place according to criteria that are transparent, stable and harmonised at national level.

This model drastically reduces administrative complexity, facilitates financial risk management and allows the State or the regulator to integrate EPR in an orderly manner into tariff systems and investment planning. The division into two sub-sections, within the same PRO, can meet the need to ensure more effective eco-modulation of contributions, given the specific characteristics of the two industrial sectors (i.e. greater scope for modifying product formulations in the case of cosmetics, and less so in the case of pharmaceuticals).

Economic and financial flows under the UWWTD Extended Producer Responsibility framework

Figure 10 illustrates the main economic and financial flows that could be generated by the implementation of the UWWTD EPR framework, highlighting how costs may be allocated and potentially passed through across stakeholders. Figure 10 is based on the assumption that Member States have opted for a national EPR Fund managed by the competent authority and the presence of a single PRO. In this context, “regulators” refers specifically to economic regulators.

Figure 12: Economic flows, cost pass-through and distributional mechanisms under the UWWTD Extended Producer Responsibility: a suggested framework



Producers would contribute financially through EPR payments to PROs, which channel resources towards a national fund managed by the Government that ultimately provides support to WWTUs for investments in advanced treatment technologies, with wastewater treatment operators providing interest repayments to the fund. Such a fund would not be directly accessible to the Member State for general expenditure.

Wastewater operators are expected to recover the residual investment costs primarily through tariffs, creating potential pass-through effects to consumers. In parallel, producers may pass part of their compliance costs through product prices, indirectly affecting consumers and, in the pharmaceutical sector, public healthcare budgets.

Finally, Member States, where impacts of the application of the EPR requirements on the accessibility, availability and affordability of medicines are deemed too burdensome, can implement distributional policies to mitigate economic impacts. For producers, this may include public financing support, gradual relief mechanisms, or other measures that ease the burden of EPR compliance. For citizens, distributional policies may include income-based tariff exemptions, ceilings on tariff increases, while, for wastewater utilities, it could imply financial support to invest early in advanced treatment technologies, ensuring affordability and equitable access.

From the interviews it emerged that wastewater EPR is structurally different from traditional waste EPR systems, particularly in the separation between financial and operational responsibilities, and that there is no single preferred governance model.

Water utilities emphasized that producers would assume financial responsibility while utilities would retain operational roles, and they stressed the need for strong public oversight regardless of the institutional configuration adopted. Waste sector

representatives also questioned the effectiveness of competition between PROs in this context, noting that when PROs primarily manage financial transfers, efficiency gains from competition are limited and may require additional coordination mechanisms.

Pharmaceutical and chemical companies advocate for harmonized PRO structures across Member States and express concerns that multiple competing organizations could increase administrative complexity. They also pointed to the institutional asymmetry between private producers and publicly operated wastewater services. In this context, the actors selecting and operating treatment technologies are typically municipalities or publicly owned wastewater treatment plants, while the costs would be borne by private producers through PROs. This raises concerns about cost control and accountability, since public operators could adopt overly expensive or sophisticated solutions and pass the costs on to industry. For this reason, they argued that PROs should have strong oversight over both the technologies selected and the costs charged to producers.

Local economic ecosystem economic stakeholders tend to favour a single national PRO under strong public supervision, reflecting the natural monopoly characteristics of wastewater services. Investment stakeholders emphasized the importance of stable and predictable financial flows and expressed a preference for publicly managed funding mechanisms capable of supporting long-term infrastructure investments.

Investment stakeholders rather a publicly managed funding mechanisms capable of supporting long-term infrastructure investments.

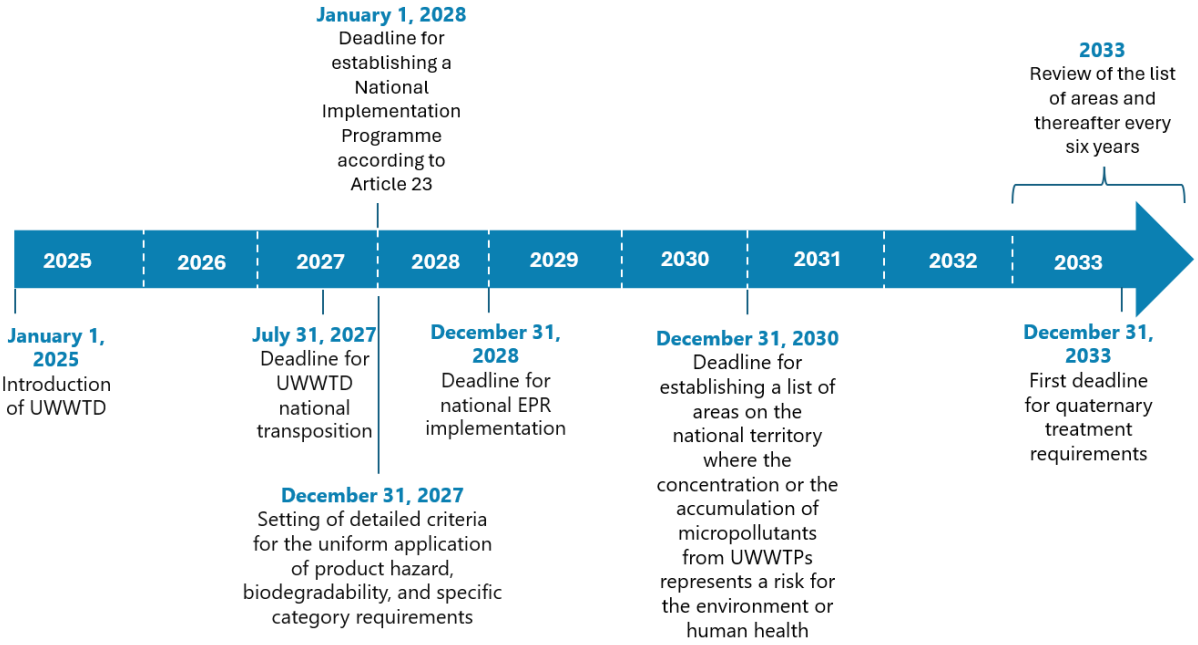
Economic regulators highlighted the advantages of centralized models in terms of control and consistency, while also warning about potential inefficiencies and the need for strong governance mechanisms.

3.4 Implementation timeline, governance and monitoring tools to ensure transparent and efficient EPR operation

3.4.1 Milestones for the UWWTD implementation

The implementation of the UWWTD can be planned by analysing the activities to be carried out within the main scheduled deadlines.

Figure 13: UWWTD – Timeline (deadlines indicated in the Directive)



Given that, as of today (May 2026), regulatory responsibilities are not yet clearly defined, meeting this timeline appears particularly challenging and potentially no longer realistic.

1) July 31, 2027: Deadline for UWWTD national transposition

On 1 January 2025, the new UWWTD came into force. During the first 31 months, Member States should focus on transposing the Directive into national law. The government and the competent environmental ministry are responsible for translating the provisions of the UWWTD into national legislation and regulations, while the competent authorities must map the urban wastewater treatment plants

2) December 31, 2027: Setting of detailed criteria for the uniform application of product hazard biodegradability and specific category requirements

No later than 31 December 2027, the European Commission may adopt implementing acts to establish detailed criteria regarding specific product categories and their biodegradability or hazard, in reference to paragraph 2, point b) of the UWWTD (art.9.5). These acts are adopted according to the examination procedure referred to in Article 28(2), in order to ensure harmonized application across Member States.

3) January 1, 2028: Deadline for establishing a national implementation programme (NIP) according to Article 23

Pursuant to Article 23(b) of the UWWTD, by 1 January 2028 Member States shall develop a national implementation program for this Directive, which includes "*the identification and planning of investments required to implement this Directive for each agglomeration, including an indicative financial estimation and when available an estimation of the financial contribution from the producer responsibility organisations established in accordance with Article 10, and a prioritisation of those investments related to the size of*

the agglomeration and the level of environmental impact of discharges of untreated urban wastewater and related risks for the environment or human health".

Figure 14: Wastewater treatment plants treating urban wastewater with a load of 150,000 p.e. and above Timeline (deadlines indicated in the Directive)

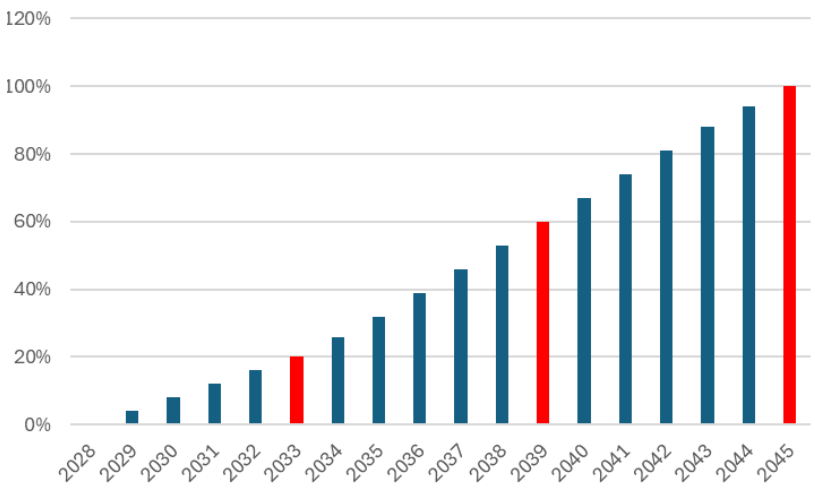
The investment planning for quaternary treatments scheduled by the Directive is very long, from 2028 to 2045, following the milestones indicated in the Directive.

For WWTPs treating urban wastewater with a load of 150,000 p.e. and above the estimated yearly investment rate is indicated in the following figure.

Considering an average rate of depreciation of this plant in 15 years, it means that the development of financial relationships between PROs and WWTUs, will be alive (considering the last investments in 2045) up to 2060.

The economic impact assessment of the investment plan during the period indicated by the Directive is considered progressive in the years to reach the different targets in the years 2033, 2039, and 2045 (red columns). The Figure represents the increase of yearly amount of new investment stock in the single years, in a constant progressive scenario. In 2028 no new investments are considered, as only at the end of 2027 the Member States will adopt the National Implementation Program, so 2028 in considered a bridge period to prepare the investment plan and only in 2029 the first plant will be operating.

Figure 15: Estimated yearly new investments - % of total discharges from waste water treatment plants with a load of 150 000 p.e. and above

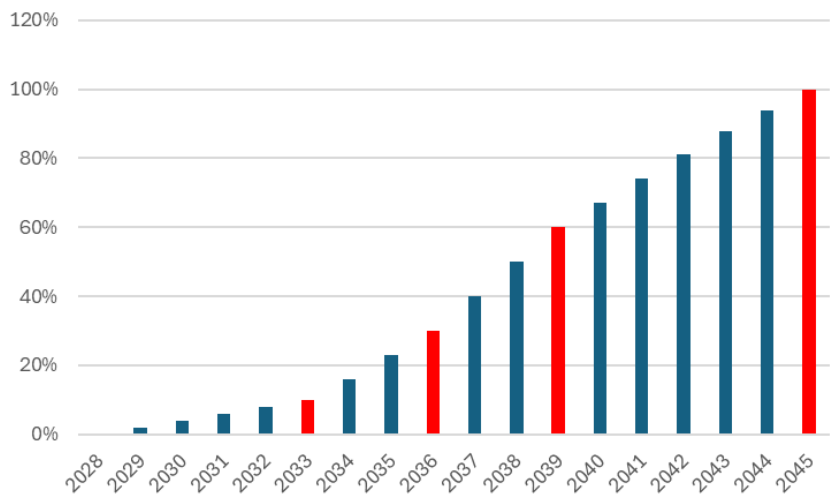


For agglomerations of 10,000 p.e. and above the estimated yearly investment rate is indicated in the following figure[24].

Considering an average rate of depreciation of this plant in 15 years, it means that the development of financial relationships between PROs and WWTUs, will be alive (considering the last investments in 2045) up to 2060.

The economical impact assessment of the investment plan during the period indicated by the Directive is considered progressive in the years to reach the different targets in the years 2033, 2039, and 2045 (red columns). The Figure represents the increase of yearly amount of new investment stock in the single years, in a constant progressive scenario. In 2028 no new investments are considered, as only at the end of 2027 the Member States will adopt the National Implementation Program, so 2028 in considered a bridge period to prepare the investment plan and only in the 2029 the first plant will be operating.

Figure 16: new investment - % of agglomerations from 10 000 p.e. and above



Additional considerations should be useful considering the timeline of investments to understand the connection between the timeline of all costs in charge of providers and the timeline of cost coverage from EPR scheme.

First of all, contributions "*should also cover operational costs of already established quaternary treatment at the date of entry into force of this Directive when it is necessary to meet the obligations of the extended producer responsibility system. It should also cover part of the investment costs of the established quaternary treatments, taking into account the depreciation of the investments and the deadlines of the financing obligations established in this Directive*". It means that starting from 1/1/2029 (beginning

[24] The theoretic investment trajectories have been computed as the linear interpolation between the mandatory requirements stated in the UWWD

of EPR operations) regulators and utilities can be covered for the operational yearly costs in 2029 and capital costs (considering the depreciation) of quaternary treatments existing at the date of 1/1/2025 (Directive entered into force). Investment and operational costs of quaternary treatments built between 1/1/2025 and 1/1/2029 are not considered in the directive as "costs of previous years" .

Starting from 1/1/2029 EPR schemes cover the current year operational and capital costs of new plants also built in the period 1/1/2025 to 1/1/2029 if used to meet the Directive obligations, and of course the cost of plants built from 1/1/2029 onwards.

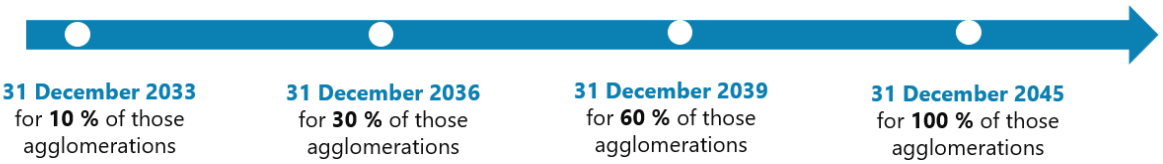
4) December 31, 2028: deadline for national EPR implementation

- Member States must ensure that all producers placing products listed in Annex III of the UWWTD on the market assume extended producer responsibility, covering at least 80% of the total compliance costs under Article 8, including:
    - Investment and operational costs for quaternary treatment of urban wastewater
    - Costs of monitoring micropollutants (Article 21(1)(a));
    - Costs of collecting, compiling, and verifying product data;
    - Other costs necessary to fully exercise extended producer responsibility.
- By the same date, Member States must take the necessary measures to ensure that each PRO is established in accordance with Article 9(3), with clearly defined geographic coverage, adequate financial and organizational means, and operational transparency.
- Member States must set quantitative and qualitative objectives to ensure compliance with the obligations of Article 8(1), (4), and (5), as well as any other objectives deemed relevant for fulfilling extended producer responsibility.
- Member States must establish a data communication system to collect:
    - Information on products placed on the market by producers;
    - Data on quaternary treatment of urban wastewater;
    - Other relevant data for the management of micropollutants.
- Competent authorities must also ensure the periodic exchange of data with other relevant authorities, ensuring compliance and transparency (Article 10).

5) December 31, 2030: deadline for establishing a list of areas on the territory where the concentration or the accumulation of micropollutants from UWWTPs represent a risk for the environment or human health

Member states must establish a list of areas on the national territory where the concentration or the accumulation of micropollutants from UWWTPs represents a risk for the environment or human health (Art.5, par. 2)

Figure 17: Agglomerations of 10,000 p.e. and above —only those selected on the basis of the outcome of the risk assessment referred to in Article 8 shall be concerned) Timeline — (deadlines indicated in the Directive)



6) December 31, 2033: first deadline for quaternary treatment requirements

From the interviews it emerged that the implementation timeline is widely perceived as ambitious and potentially challenging.

Water utilities emphasized the tight sequencing between the establishment of EPR and the deployment of treatment infrastructure, noting that current deadlines may be difficult to meet.

Pharmaceutical and chemical companies questioned the realism of the timeline given the complexity of governance, cost allocation and regulatory design.

Waste sector representatives stressed the urgency of immediate action by governments and proposed accelerated timelines for establishing PROs and operational structures.

Economic regulators called for realistic timelines, clear prioritization of investments and adaptive implementation strategies.

The above timeline requires the implementation and establishment of several elements from an economic, financial, and governance perspective which will be explored and detailed in the following sections.

3.4.2 Implementation of EPR economic and financial aspects

In accordance with the provisions of the UWWTD, the application of EPR can be described through the following steps, presented in chronological order. For each step, the aspects that must be assessed and defined to ensure its effectiveness and efficiency are also outlined:

1. Member States shall identify and classify the eligible costs forming the basis for the calculation of EPR contributions.
2. As from the first year of application (2029), the OPEX and CAPEX related to treatment processes already in operation shall be quantified.
3. In order to determine the actual costs, a data collection system shall be established at operator level. Operators shall transmit such data to Member States or, where existing and duly mandated, to the regulatory authorities.
4. Member State (or, on their behalf, the regulatory authority) shall determine the overall amount of the contribution, by applying a percentage of at least 80% to the total costs. Financial contribution = share borne by producers (≥ 80%) × $[\sum_{p=1}^{n}(Capex_p + Opex_p)]$ The Member State shall communicate the overall amount of the contribution to the PRO.
5. In the meantime, the PRO shall collect the following information from producers:

- annual quantities of substances contained in the products listed in Annex III that are placed on the market in the context of their professional activity.
- information on the hazardousness of the substances contained in such products for urban wastewater and on their biodegradability at end of life.
- where applicable, the list of products exempted.

On the basis of this information, the PRO shall allocate the overall contribution among producers.

6. Producers shall pay the due contribution to the PRO.
7. The PRO shall transfer the amounts collected to the state-managed public fund or directly to the utilities, depending on the type of EPR architecture chosen by the MS.
8. Where a public fund is established, the public authority entrusted with its management shall transfer the financial resources to the WWTUs.
9. Entities (regulatory authorities) responsible for defining and applying tariff-setting methodologies shall take EPR contributions into account, ensuring that tariffs cover only the portion of costs not already borne by producers. To this end, such entities shall adapt the data collection systems underlying tariff determination, ensuring a clear distinction between CAPEX and OPEX.

1. **Eligible costs**

Differently from the WFD (but also from the wording generally used within EU and national waste legislation governing specific EPR schemes), the UWWTD refers to the concept of "**full cost**". Article 9 (*Extended producer responsibility*) stipulates that producers falling within the scope of the EPR schemes established by Member States must cover, among other elements, "*at least 80% of the **full costs** for complying with the requirements set out in Article 8*" (*Quaternary treatment*).

A clear and operational definition of the term "**full cost**" is therefore essential for the proper implementation of the EPR mechanism. All key stakeholders, including industry, PROs, regulators, and WWTUs, need a common understanding of what WWTUs can legitimately include in their "**full cost**" calculation related to the introduction and operation of quaternary treatment for micropollutant removal.

These costs explicitly include the investment and operational expenses associated with the quaternary treatment of urban wastewater to remove MPs originating from the products placed on the market and from their residues, as well as the costs related to the monitoring of MPs. However, the precise interpretation of this term must be read in conjunction with Recital 23, which provides important clarification and boundaries on what producer contributions may cover. Recital 23 specifies that producer contributions **should cover, but not exceed**, a defined set of cost categories (without, however, a specific reference to the concept of efficient costs), ensuring alignment with the polluter-pays principle while preventing overcompensation or misuse of EPR funds.

In light of these provisions, the "**full cost**" of quaternary treatment under the UWWTD should be understood as the total, justifiable, and proportionate cost of achieving and maintaining compliance with the Directive's MPs removal obligations, without exceeding what is necessary.

In the Deloitte Denmark's assessment (Deloitte, 2025) the components under "full cost" are defined as the following:

- **Development expenditures (DEVEX)**: These include costs incurred during the initial stages of a project, from the idea and development phase to design and planning. DEVEX covers a wide range of activities that lay the groundwork for the project's execution.[25] According to this study "DEVEX is defined as costs spent in the period from idea and development to design and planning. In many cases, DEVEX costs will be part of the total asset costs and included in depreciation over time. In that case, depreciation from the point of commissioning should be used as the cost base for calculating full cost. In some cases, DEVEX will be seen as costs not part of the asset. These costs should be included in the calculation of total costs" (Deloitte, 2025).
- **Capital expenditures (CAPEX)**: These include costs related to the construction of the quaternary treatment facilities, procurement of e.g. machinery and equipment, and installation of components related to e.g. automation systems etc. CAPEX also covers engineering and design fees, permits, project management, and temporary installations during construction. The costs are inclusive of financing costs and are often measured based on the yearly depreciation of the assets.
- **Operational expenditures (OPEX)**: These encompass the ongoing costs of running the treatment facilities, such as energy consumption, chemical usage, maintenance, and salaries. OPEX also includes costs for monitoring and compliance, consumables, sludge treatment and disposal.
- **Indirect costs**: These are overhead expenses incurred to support the operation of the treatment facilities, including administrative expenses, regulatory compliance, insurance, and other necessary costs.

The Deloitte's study also provides a table summarising the different cost elements (including direct and indirect costs and excluding profit elements) with the aim to create "*a common starting point for further discussions between the utilities, the pharmaceutical and cosmetics industries, and legislators*"[26].

Table 19: Overview of cost elements divided into cost types (Source: Deloitte 2025)

Cost type	Cost element	Cost allocation	Description
	Planning and design		
DEVEX	Design and planning	Direct	Including stages like pre-FEED and FEED studies before beginning the construction with the aim of designing and outlining the best solution for the quaternary treatment.
	Procurement	Direct	Relevant procurement in relation to the construction process.

[25] DEVEX represent the "costs to make the project ready for construction," while CAPEX are the "costs to build the asset." Tracking DEVEX separately from CAPEX is useful for several reasons: 1) Not all DEVEX necessarily become CAPEX: if the project does not proceed, they remain "sunk" costs; 2) The separation facilitates compliance with accounting standards (IFRS), 3) It allows for assessing the efficiency of the development phase, 4) It helps limit potential overspending before the Final Investment Decision (FID).
[26] A more detailed table is provided in the Appendix 1 to the Deloitte's report

Cost type	Cost element	Cost allocation	Description
	Administrative expenses	Direct	Permits and licences, regulatory compliance (specific to a project or product).
	Administrative expenses	Indirect	Often mentioned 'overhead' – costs related to administration, management, bookkeeping, contingency costs, IT, etc.
	Operating expenses		
OPEX	Energy and utilities, chemicals, materials	Direct	Direct costs for the operation and maintenance of the facility necessary to deliver the service.
	Monitoring and measuring	Direct	Costs of monitoring MPs in the wastewater and measuring efficiency in the treatment facilities. This is done at utility level by the utilities.
	Maintenance	Direct	Costs for the maintenance of the facility necessary to deliver the service. Where possible, resources used (time and material) related to the quaternary treatment should be recorded on separate work orders related thereto.
	Maintenance	Indirect	Indirect maintenance costs can be in the case where maintenance is not directly recorded to the quaternary treatment steps but to maintenance of the treatment plant in general and allocated through cost allocation.
	Personnel costs	Direct	Salaries and benefits for staff required to operate and maintain the plant.
	Administrative expenses	Direct	Permits and licences, regulatory compliance (specific to a project or product).
	Administrative expenses	Indirect	Often mentioned 'overhead' – costs related to administration, insurance, management, bookkeeping, accounting, contingency costs, IT, etc.
	Testing, optimisation, measurements, surveillance, data management	Direct	Necessary cost for environmental surveillance and testing and optimisation (initial and ongoing), measurement of selected substances in inflow and outflow when relevant, data management of e.g. energy consumption etc.
	Depreciation and capital costs		
CAPEX	Construction of quarternary treatment facility	Direct	The cost is considered direct, as it is an expense directly involved in the delivery of the service. Costs are often external and regarding e.g. contractors and construction management.
	Internal time in the construction process	Direct and Indirect	If internal hours are utilized in the construction process, the hourly rate should encompass costs related to wages, overhead, and any applicable profit margin. The profit margin is contingent upon the specific regulatory framework of each country.
	Equipment and machinery, parts to the plant	Direct	The cost is considered direct, as it is an expense directly involved in the delivery of the service.
	Financial cost	Direct	If funding the construction (incl. DEVEX) requires external financing, costs of interest can be included in the cost
	Land acquisition	Direct	The cost is considered direct, as it is an expense directly involved in the delivery of the service.

Cost type	Cost element	Cost allocation	Description
	Abandonment	Direct	The pertinent abandonment costs should be incorporated into the overall cost calculation, as they constitute a component of the expenses associated with the establishment of quaternary treatment. Only the probable costs should be considered; for instance, if there is no requirement for re-establishment, such costs should not be included.

It should also be noted that, unlike in the WFD, the UWWTD does **not include any explicit requirement** stating that "*such costs shall be established in a transparent way between the actors concerned*." Given the potential for differing interpretations across Member States, there is broad agreement among stakeholders that the European Commission should issue guidance, potentially through implementing acts or common cost calculation methodologies, to define the components and boundaries of "full cost".

This guidance should:

- **Ensure** consistency and comparability across national EPR systems;
- **Prevent** disputes between producers, PROs, and utilities over eligible expenditures;
- **Safeguard** transparency and accountability in the use of EPR funds; and
- **Support** the establishment of trust and cooperation among all parties involved.

In summary, the interpretation of "full cost" under the UWWTD will play a decisive role in shaping how the EPR system functions in practice. It must balance financial fairness, technical realism, and environmental integrity, ensuring that producer contributions fully cover legitimate treatment and monitoring costs, but do not exceed the necessary level. Achieving this balance through clear, harmonised definitions will be essential to maintain credibility and effectiveness in this pioneering application of EPR to the wastewater sector.

Further considerations on the definition of a clear taxonomy of eligible costs are provided below:

Investment costs include the costs of construction and upgrading of treatment plants, including capitalised costs such as design, extraordinary maintenance and other expenses directly related to bringing the assets into operation. These costs are allocated over time according to the technical lifespan of the investments. In some studies (Pistocchi et al., 2022b), the lifespan is assumed to be 20 years. In addition to depreciation, CAPEX also includes financial costs incurred to secure the financial resources required to implement the investments, where such resources are obtained through financing.

Operating costs include expenditures incurred for both existing and newly implemented plants and cover, inter alia, costs for raw materials, electricity, personnel and monitoring activities.

It is reasonable to assume that both direct costs, i.e. those directly attributable to quaternary treatment, and indirect costs should be considered; however, it remains to be

clarified whether, and to what extent, general overhead costs should also be included. Operating costs also include activities related to monitoring, reporting, communication and the production of statistical data, for which a clear allocation of responsibilities between PROs and service operators will need to be defined.

Costs may be estimated on a forward-looking basis or recorded on an ex post basis. From a reading of the Directive, it appears that the objective is to recognise costs actually incurred. However, since actual operating and investment costs are generally available only in the financial year following that in which they are incurred, the issue of the temporal recognition of costs arises.

In particular, it is necessary to assess whether costs should be recognised ex ante on the basis of forecast estimates, with a subsequent reconciliation mechanism once the deviation between estimated and actual values has been quantified, or whether it would be preferable to provide from the outset for the coverage of actual costs with a time lag, which could reasonably be assumed to be one or two years. In the latter case, it would be necessary to consider the possible application of an interest rate in order to compensate for the delayed recognition of costs.

The reconciliation mechanism could be limited to the recovery of the mere difference between estimated and actual costs, or it could be governed by rules designed to prevent the recognition of costs deemed unreasonable. In this context, the issue of defining standard average costs or appropriate benchmark values arises. Where it is not feasible to define a benchmark for total costs, such an approach could be applied to individual cost components. In some national contexts, such as in Italy with respect to electricity costs, regulatory benchmarking mechanisms are already in place. In the absence of such instruments, there would be a risk of transferring to the system costs arising from unfavourable procurement conditions or managerial inefficiencies, which should instead fall within the operator's operational risk.

Finally, it may be assumed that, in an initial implementation phase, reported costs are fully recognised in order to build a robust information base on actual cost levels. Subsequently, once this knowledge has been consolidated, cost containment mechanisms (caps) or other regulatory instruments aimed at promoting efficiency could be introduced.

2. Costs for quaternary treatments already in operation before 31 December 2028

Both operating costs and investment costs shall also include those related to quaternary treatment plants that were already in operation prior to 31 December 2028. This provision is set out in Recital 23 of the Directive, which states that "*those contributions should also cover operational costs of already established quaternary treatment at the date of entry into force of this Directive when it is necessary to meet the obligations of the extended producer responsibility system. It should also cover part of the investment costs of the established quaternary treatments, taking into account the depreciation of the investments and the deadlines of the financing obligations established in this Directive*".

Consequently, both in defining national implementation programmes and in transposing the Directive, Member States will need to establish an appropriate accountability framework for this specific cost category - namely, the costs linked to existing quaternary

treatment plants - alongside those implemented in accordance with the timeline set out in the Directive.

Unlike the latter (with a first deadline set at 31 December 2033), costs related to quaternary treatment facilities already in operation at the time of the Directive's entry into force will have to be covered from the very beginning of the EPR implementation phase (1 January 2029). This will require the definition of clear criteria for cost identification, unbundling models, calculation methodologies (for example, depreciation rules and the remuneration of invested capital, or the allocation of common costs), mechanisms for the recalculation of costs from the date of entry into force of the Directive between 1 January 2025 and 31 December 2028, as well as the corresponding regulatory mechanisms.

3. Data collection system and data validation

For the purpose of cost validation, it is necessary to ensure that:

- the types of eligible costs are clearly defined;
- uniform reporting frameworks are adopted, so as to ensure that all operators present data in a consistent format; and
- requirements are established for supporting documentation to be submitted or, alternatively, retained for verification purposes is established. To support the validation process, sample checks may be conducted.

Member States or regulatory authorities receiving data and information may, over time, carry out benchmarking analyses to assess the reasonableness of the costs incurred.

Regarding the validation of investments, it must be clarified whether Member States or regulatory authorities may extend the assessment to include the technological choices made for quaternary treatment. In this case, operators may be required to submit an intervention plan proposal to the Member States or the regulatory authority, subject to prior approval, in order for the investments to be considered eligible. Alternatively, eligibility could be determined after the costs have been incurred, which, however, carries the risk of transferring the burden of uncertainty to the operator, an eventuality that should preferably be avoided.

4. Determination of the financial contribution due by the PRO

Member States may set a share of costs to be borne by PROs at a level higher than 80%. Where a higher percentage is adopted, such a decision should be based on objective evidence relating to costs, rather than on policies aimed solely at reducing the impact on end users, with the sole effect of lowering the corresponding tariff component.

5-6. PRO data collection from producers and eco-modulation

The contribution due from each producer shall be determined on the basis of the quantities, hazardousness, and biodegradability of the substances contained in the products placed on the market. For this purpose, the development of substance and product identification templates for producers, subject to formal validation, may be envisaged.

PROs shall be subject to annual independent audits of their financial management, with particular regard to their capacity to cover costs, the quality and adequacy of the information collected, and the appropriateness of the contributions collected.

PROs shall make the following information publicly available in an appropriate and easily accessible form, in particular through their websites and without the need for any request by interested parties:

i. ownership structure and membership;
ii. financial contributions paid by producers;
iii. activities carried out each year, including clear information on how financial resources are used.

PROs shall also be subject to a national recognition procedure, as defined by the Member States, certifying their compliance with producer responsibility obligations prior to their establishment and effective operation.

Member States shall define an appropriate framework of control and assurance to ensure that all entities subject to EPR transmit reliable data to PROs and to the competent authorities.

Where more than one PRO operates within the territory of a Member State, the Member State shall designate at least one body independent of private interests, or entrust a public authority, to oversee the implementation of the extended producer responsibility system.

7. PRO contribution payment

The payment of the contribution by PROs does not necessarily have to occur only after the PRO has in turn received the amounts from the producers. The PRO is directly and independently liable for the obligation and may not invoke non-payment by its member producers as justification. The contribution could therefore be paid in an advance or lump-sum form, with a subsequent ex post adjustment based on the amounts actually due.

The payment of the contribution by PROs should ideally take place on an annual basis. While a multi-year frequency could ensure greater financial stability, annual payments would allow the contribution amount to be updated more effectively and in a timelier manner, based on the actual data that producers are required to submit every year under the Directive. This includes: (i) the annual quantities of substances contained in the products listed in Annex III placed on the market; (ii) information on the hazardousness of those substances in urban wastewater and on their biodegradability at the end of their life cycle; and (iii) where relevant, a list of exempted products.

It is also worth noting that Article 9 of the Directive requires PROs to possess not only the financial and organisational means necessary to fulfil the obligations arising from the EPR of their members, but also adequate financial guarantees to ensure, under all circumstances, the continuity of quaternary treatment of urban wastewater.

It is also worth noting that Article 9 of the Directive requires PROs to possess not only the financial and organisational means necessary to fulfil the obligations arising from the EPR of their members, but also adequate financial guarantees to ensure, under all circumstances, the continuity of quaternary treatment of urban wastewater. In line with

this requirement, Member States are responsible for ensuring that the EPR system is financially robust and aligned with the investment needs identified in the National Implementation Programme, including the planning of required investments and indicative financial estimates. Where Member States provide for the involvement of economic regulators, regulation could define specific safeguards to manage late payment or non-payment by producers and avoid temporary funding gaps. For instance, this could be achieved by requiring PROs to establish dedicated funds or reserves amounting to a given percentage of the annual contribution, for example 30% or 50%, adjusted annually in line with the overall level of contributions. Such reserves could be financed through an additional charge levied by PROs on producers, on top of ordinary EPR contributions, late-payment interest or surcharges paid by producers in arrears, and/or the use of fines collected from non-compliant producers.

8. Transfer of financial resources to WWTUs

The verification and validation of costs could be carried out by Member States prior to the transfer of financial resources to WWTUs, rather than at the stage of determining the costs to be recovered from PROs.

9. Integration of the PRO financial flow into tariff regulation

The Water Framework Directive establishes the basic requirements for the economic regulation of water supply and wastewater services, introducing the principles of cost recovery for water services, including environmental and resource costs, as well as the polluter-pays principle.

The European Commission Communication COM (2000) 477, *Pricing policies for enhancing the sustainability of water resources*, provides that water tariffs shall reflect different types of costs:

- financial costs of water services, including operational and maintenance costs as well as capital costs (repayment of capital, interest payments and, where applicable, a return on equity);
- environmental costs, representing the damage caused to ecosystems and to environmental users (for example, the deterioration of the ecological quality of water bodies or the degradation of soils);
- resource costs, related to foregone opportunities for other uses resulting from the exploitation of the resource beyond its natural rates of recharge or recovery (for example, the over-abstraction of groundwater).

However, the Directive does not provide detailed or operational rules for the definition of tariff-setting methodologies. The approval of tariffs for water supply and wastewater services is entrusted to different types of competent authorities, including municipalities, regional governments, regional regulatory authorities, national ministries and national regulators.

As a result, the cost recovery principle may be applied differently depending on the approach adopted by each Member State, and each Member State regulates this matter autonomously.

It is essential to evaluate how to coordinate and align the tariff systems and methods of Member States in order to avoid double recognition for operators. The regulation of tariff

systems may, at discretion, include or exclude the OPEX and CAPEX of quaternary treatments in dedicated cost items. It is, however, advisable that costs are not reported net of the shares borne by PROs, but that the portion corresponding to "reimbursements" is indicated separately among both cost and revenue items.

For the reporting requirements set out in the Directive, operators must adopt detailed analytical accounting systems and procedures that allow costs to be identified directly rather than indirectly, and they should be accustomed to reporting them while providing supporting evidence. The costs incurred must be reported to the Member States or to the delegated authorities.

To avoid double counting, for example, within the Italian tariff method, PRO contributions could be treated, for the investment component, as non-repayable grants, thereby reducing the CAPEX portion, and, for the operational cost component, as operating subsidies.

3.4.3 Governance and monitoring tools for transparent and efficient EPR operation in wastewater services

Effective implementation of EPR in wastewater services requires a governance and monitoring framework capable of ensuring transparency, operational efficiency and accountability, while safeguarding public trust. Experience from waste-related EPR schemes and from regulatory frameworks governing water services provides a solid basis for identifying the tools that regulatory authorities may deploy. These tools typically combine ex ante governance instruments, such as licensing and authorisation conditions, with ongoing monitoring mechanisms, including performance indicators, reporting obligations and audits, as well as enforcement and incentive-based measures designed to ensure compliance, efficiency and transparency over time.

Licensing and authorisation conditions

A first layer of governance consists of clear licensing and authorisation conditions for PROs. Drawing on practices in waste EPR schemes, authorisation may be conditional upon compliance with minimum requirements related to governance, financial capacity and operational readiness.

Licensing conditions:

- **Legal form and governance rules**, as clear governance rules, including transparent decision-making procedures, separation of management and control functions, and conflict-of-interest safeguards, reduce the risk of regulatory capture and misallocation of funds.
- **Demonstrated financial capacity**, implying that PROs should demonstrate sufficient financial capacity to manage large and potentially volatile financial flows and to provide predictable funding to wastewater operators. This may include minimum capital requirements, guarantees or reserve funds to ensure continuity of payments, even in the event of market fluctuations or delays in producer contributions

- **Transparent fee-setting methodologies**, which should be based on clear and objective criteria, linking producer contributions to the quantity of hazardous substances placed on the market. Transparency in fee calculation allows producers to understand the basis of their obligations and supports the application of the "polluter pays" principle.
- **Data management and confidentiality protocols**, required to ensure the accuracy, reliability and traceability of information submitted by producers and aggregated by PROs. At the same time, confidentiality protocols must protect commercially sensitive data, limiting disclosure to aggregated or anonymised information where appropriate.

Key performance indicators (KPIs)

Regulatory authorities may rely on a set of financial, operational and environmental KPIs to monitor the performance of the wastewater EPR system.

Environmental Key performance indicators (KPIs)

- **Quantity of micropollutants in products:** A KPI could be introduced to monitor the quantity of micropollutants contained in products placed on the market. This would make it possible to assess whether producers are progressively changing product composition upstream, for example by reducing the presence or concentration of substances of concern. The indicator could be calculated as: *quantity of micropollutants present in products in year t / quantity of micropollutants present in products in year t-1*
- **Number of micropollutants monitored:** A further KPI could track the number of micropollutants actually monitored by the PRO. While the UWWTD requires monitoring of 6 out of the 12 listed substances, it would be useful to know whether the PRO monitors a broader set, for example 7, 8, or more substances, and how this number evolves over time.
- **Removal rates at outflow for selected micropollutants**: removal rates at the outflow provide a direct measure of the environmental effectiveness of advanced treatment processes supported by the EPR system. Tracking these rates over time allows authorities to assess whether investments are delivering tangible improvements in water quality.
- **Compliance with discharge standards**: this indicator captures the extent to which treated wastewater complies with applicable discharge limits and environmental quality standards. Sustained compliance demonstrates that the EPR system contributes effectively to achieving regulatory objectives under water and environmental legislation.
- Economic/financial Key performance indicators (KPIs)
- **Contribution collection rate:** it would be relevant to monitor the collection rate of contributions by the Producer Responsibility Organisation from its members. The indicator would be useful to detect potential financial issues at an early stage and assess whether the PRO has sufficient and reliable financial inflows to meet its

obligations. The indicator could be calculated as: *contributions actually collected by the PRO / contributions due from PRO members*.

- **Investment recovery rate from PROs:** it would be relevant to monitor the extent to which the investment borne by the utilities is recovered through payments from PROs. The indicator could be calculated as*: amounts actually recovered from PROs / total investment to be recovered*.
- Operational Key performance indicators (KPIs)
- **Share of wastewater treatment plants equipped for micropollutant removal**: this KPI measures the proportion of relevant wastewater treatment plants that have been equipped with technologies for micropollutant removal. It provides a clear indication of the operational deployment of the required treatment capacity and helps monitor whether implementation is progressing at the pace needed to meet regulatory objectives.

Monitoring and reporting systems

Within the UWWTD framework, Member States are required to establish robust monitoring and reporting systems to support the effective implementation of EPR. These systems encompass, inter alia, the tracking of producer declarations, including the quantities and hazardousness of products placed on the market; the monitoring of financial flows from producers to Producer Responsibility Organisations (PROs) and wastewater utilities; and the assessment of the effectiveness of quaternary treatment in reducing micropollutant emissions. In addition, Member States must regularly report on progress towards the environmental objectives set out in Article 8.
The information collected is to be reported to the European Commission in a harmonised manner, ensuring comparability across Member States. This enables the identification and dissemination of best practices, supports knowledge transfer, and provides a sound basis for the Commission to assess the need for further harmonisation or corrective measures at EU level.

Transparency in the governance of EPR systems is essential to ensure accountability, enable effective performance assessment and foster public trust. In line with practices already applied in waste-related EPR schemes, PROs may be required to publish aggregated information on their governance arrangements, financial flows and funded activities, while ensuring the protection of commercially sensitive data.

To support effective monitoring, all entities involved in the EPR system, including PROs, producers and wastewater operators receiving EPR funding, should be registered with the competent authorities and subject to clear record-keeping obligations. Records should document financial inputs and outputs, as well as the allocation of funds to eligible micropollutant removal activities, enabling verification that EPR resources are used in accordance with regulatory objectives.

PROs may also be required to prepare and publish annual reports, including externally audited financial statements, providing a transparent overview of revenues, expenditures and administrative costs. Such reporting practices are already applied in several waste EPR systems and have proven effective in strengthening accountability and reducing the risk of misuse of funds.

From the interviews it emerged that strong governance and monitoring frameworks are considered essential for the credibility and effectiveness of the system.

Water utilities highlighted the importance of transparent cost recognition and validation processes.

Waste sector representatives emphasized the role of regulatory authorities in ensuring transparency, accountability, and proper implementation.

Local economic ecosystem stakeholders stressed the need for harmonized monitoring methodologies and reliable environmental data.

Economic regulators identified a central role in approving investments, defining eligible costs, coordinating monitoring systems and ensuring compliance through audits and reporting mechanisms. In their view, auditing should focus on verification and quality control, including data validation checks and targeted inspections where risks, gaps or inconsistencies are identified. Reporting should be based on harmonised data standards, methodologies and indicators, supported by detailed guidance, technical definitions and common templates. Data requests should remain aligned with the legal powers and responsibilities of the supervisory authority, focusing only on information that can be meaningfully used for regulatory assessment, oversight or enforcement. The resulting information should then be used for benchmarking and comparative analysis, and aggregated for communication to national policy-makers and EU institutions, while avoiding multiple or duplicative obligations for utilities.

Audits and verification

Independent financial, operational and data audits should verify correct use of funds, eligibility of financed measures and reliability of reported data. The UWWTD establishes supplementary and more rigorous oversight requirements, in recognition of the technical complexity and significant financial scale of quaternary wastewater treatment. Pursuant to Article 9(3)(d), Producer Responsibility Organisations (PROs) are subject to annual independent audits assessing:

- the robustness of their financial governance;
- their ability to cover the costs linked to quaternary treatment and related monitoring duties;
- the reliability and quality of data gathered on product volumes and hazard profiles;
- the adequacy and appropriateness of the financial contributions levied on producers.

These audits are designed to ensure that PROs retain sufficient financial reserves, raise adequate funds to support the necessary treatment infrastructure, and function with a high level of transparency and accountability. In addition, they furnish regulators with reliable, verifiable evidence enabling timely intervention in cases of inadequate performance or financial imbalance.

Penalties and corrective measures

Urban wastewater treatment operators may be subject to fines and penalties imposed by competent authorities in cases of non-compliance with obligations laid down under the

UWWTD. The enforcement framework should be designed to ensure effective compliance while remaining proportionate and predictable, and should focus on obligations that fall within the operators' direct control, notably the timely upgrading of treatment plants in accordance with the Directive's implementation timeline and the achievement of the required 80% removal rate for polluting substances between influent and effluent, as set out in Article 8 and the relevant annexes.

Where operators fail to complete mandated infrastructure upgrades within the prescribed deadlines, and where such delays cannot be duly justified by factors beyond their control, competent authorities may impose administrative penalties. These may include fixed fines linked to missed intermediate milestones, as well as daily penalty payments for continued non-compliance beyond the final deadline, subject to caps to avoid disproportionate financial impacts. In parallel, operators may be required to submit corrective investment plans and be placed under enhanced regulatory supervision until compliance is restored.

In cases where treatment plants are upgraded but fail to achieve the minimum percentage removal requirements for polluting substances, authorities may apply performance-based fines calibrated to the degree and duration of non-compliance. Such penalties may increase progressively where deviations persist across consecutive monitoring periods or where underperformance affects environmentally sensitive receiving waters.

Accurate and timely reporting constitutes a further condition for compliance. Failure to submit monitoring data, submission of incomplete or inaccurate information, or lack of cooperation with audits and inspections may give rise to additional administrative sanctions.

Finally, the penalty regime should incorporate safeguards to ensure proportionality and fairness. In particular, sanctions should not apply where non-compliance is demonstrably attributable to delayed availability of earmarked funding, pending authorisations or other factors beyond the operator's control. By combining clear obligations, proportionate penalties and corrective mechanisms, the enforcement framework supports timely compliance with the UWWTD while preserving incentives for investment, operational efficiency and sustained environmental performance.

Table 20: Hypothetical penalty measures

Area of non-compliance	Measure description	Illustrative penalty measures
Delays in plant upgrading	Measures addressing delays in completing required infrastructure upgrades within the timelines set by the Directive and authorities, taking into account whether delays fall within the operator's control.	Obligation to submit and implement corrective investment plans; daily non-compliance penalties; enhanced regulatory supervision until compliance is restored.
Treatment performance	Measures linked to the failure to achieve required pollutant removal efficiencies between influent and	Performance-based penalties; requirements to optimise operational processes; intensified monitoring; escalation measures

	effluent, as established under Article 8 and the relevant annexes.	in cases of repeated underperformance.
Reporting and transparency	Measures ensuring accurate, complete and timely submission of monitoring data and cooperation with audits and inspections.	Warnings for minor breaches; corrective reporting obligations; administrative penalties for repeated or deliberate misreporting.

Box 3: Waste Penalty: the case of Germany

The legislative amendments to the German Packaging Act (**VerpackG**) came into effect on **1 July 2022** and establish that all packaging placed on the German market must comply with registration, system participation, and data reporting obligations. Failure to comply with these obligations may result in the following consequences:

- **E-commerce platforms** will prevent you from selling or distributing in Germany;
- **Order fulfillment service providers** (e.g., Amazon FBA) have the right to refuse services to any non-compliant customer;
- **Competitors** may report you for non-compliance;
- **Exposure to fines** of up to €200,000.

Incentives and rewards

The incentive framework for urban wastewater treatment operators complements the enforcement mechanisms of the UWWTD by promoting preventive compliance and operational excellence. By rewarding sustained compliance with effluent quality and removal performance requirements, incentives encourage operators to maintain treatment outcomes that consistently meet the standards set out in the Directive and its annexes. Incentives linked to the timely completion of upgrading milestones support the phased implementation approach of the UWWTD, reducing the risk of delays in achieving environmental objectives.

Additional incentives focusing on robust monitoring and high-quality reporting strengthen the reliability of data used for regulatory oversight and policy evaluation. By encouraging early detection of deviations and prompt corrective action, the framework shifts regulatory focus from ex post sanctions to ex ante risk prevention. Overall, such incentive mechanisms enhance the effectiveness of the UWWTD by fostering stable plant operation, reducing compliance risks and reinforcing trust between operators and competent authorities, while preserving the integrity of binding regulatory obligations.

Table 21: Hypothetical incentive measures

Urban wastewater treatment operator action	Measure description	Illustrative incentive measures
Sustained compliance with	Incentives rewarding operators that consistently comply with, or	Performance-based tariff rewards linked to technical quality

Urban wastewater treatment operator action	Measure description	Illustrative incentive measures
UWWTD effluent requirements	exceed, the effluent quality standards and removal rates set out in the UWWTD and its annexes, including nutrients and other regulated parameters.	indicators; avoidance of economic penalties associated with non-compliance.
Timely investments and delivery of upgrading milestones	Incentives encouraging operators to plan and implement required investments, including advanced and quaternary treatment upgrades, in line with or ahead of the timelines established by the Directive.	Enhanced capital remuneration for priority or early investments; early or accelerated tariff recognition of completed investments.
Improvement of receiving water quality and environmental performance	Incentives linked to demonstrable improvements in the quality of outflow waters and overall environmental performance attributable to wastewater treatment, beyond minimum compliance requirements.	Environmental performance bonuses linked to pollutant load reductions; recognition of efficient additional costs incurred to achieve improved environmental outcomes.
High-quality reporting and data transparency under the UWWTD	Incentives rewarding accurate, complete and timely reporting of monitoring, performance and compliance data required by the Directive, supporting effective regulatory oversight and transparency.	Eligibility for performance-based incentives conditional on data quality; recognition of efficient costs for monitoring, reporting and digitalisation systems.

Data disclosure requirements and confidentiality risks under the UWWTD

The UWWTD requires that attention be paid to the management of information provided by producers, with the aim of reconciling the protection of commercially sensitive data with the need for transparency and public accountability.

Article 9 establishes that producers are obliged to submit annually to Producer Responsibility Organisations (PROs) the information necessary to fulfill their obligations under extended producer responsibility. In particular, the following must be reported:

- the annual quantities of substances contained in the products listed in Annex III that are placed on the market in the context of their professional activity;
- information on the hazardousness of these substances in urban wastewater and their biodegradability at end-of-life;
- a list of exempted products, where applicable, according to the conditions set out in paragraph 2 of Article 9.

These data allow for the calculation of financial contributions from producers, proportionate to the quantity and hazardousness of the substances, in order to cover costs associated with micropollutant management and wastewater treatment. Pursuant to Article 9(4)(c), a communication system must be established to collect data on

products placed on the market, on quaternary treatment of urban wastewater, and on other relevant elements, while according to subparagraph (d), competent authorities must periodically exchange the necessary information with other competent authorities, thereby ensuring effective regulatory oversight.

Article 10 governs public communication, requiring PROs to make available aggregated information on their structure, members, total financial contributions received from producers, and annual activities, including details on the use of financial resources. The Directive emphasizes that this transparency must not compromise the confidentiality of commercial information, in accordance with EU and national law.

Member States are also required to establish a framework for monitoring and enforcement, aimed at ensuring that PROs fulfil their obligations transparently, use financial resources correctly, and receive reliable data from producers, transmitted to competent authorities and, upon request, to the PROs themselves. Commercially sensitive information is thus protected through aggregated reporting and targeted controls, while ensuring that regulatory oversight and public accountability are maintained.

In summary, the UWWTD requires that attention is paid to the confidentiality of commercial data while ensuring an effective data collection system, independent verification, and transparent communication of information relevant to the public.

Table 22: Points of confidentiality under the UWWTD

Subject	Activity / Data Processed	Level of Confidentiality
Producer	Transmission of product data: quantities per substance, hazardousness, biodegradability, exempted products	Commercially sensitive data
PRO	Management of financial contributions Aggregation of producer data	Detailed data of individual producers not disclosed
Independent Audit	Annual verification of data quality and financial contributions	Verification without disclosure of sensitive data
Competent Authority / Member State	Supervision of aggregated data Verification of compliance with regulations and continuity of wastewater treatment	Verification without disclosure of sensitive data
Public / Stakeholders	Public information on PRO structure: - ownership and members - financial contributions received - annual activities performed	Aggregated contribution information No specific commercial data of individual producers disclosed

Table 23: Data Category and Level of Confidentiality

Data Category	Collected by	Accessed by	Level of Confidentiality
Technical data on treatment plants	Plant operators, competent authorities	Public, authorities	Public / not commercially sensitive
Treatment levels, pollutant removal efficiency, flow rates, volumes treated			
Quantitative and financial data	PRO, competent authorities	PRO, authorities	Aggregated: public; Details per producer: commercially sensitive
Operational costs, financial contributions, volumes of products placed on the market			
Substances and product data	Producers → PRO → competent authorities	PRO, authorities	Commercially sensitive
Type of substances, quantity per substance, hazardousness, biodegradability, exempted products			
Audit and control data	Independent audits, competent authorities	Auditors, authorities	Verification without disclosure of sensitive data
Data quality, adequacy of financial contributions			
Public / aggregated data	PRO, competent authorities	Public	Aggregated public data; no individual producer commercial data
PRO structure and ownership, members, aggregated financial contributions, annual activities			

From an IPR perspective, the cosmetic industry may be more exposed to potential impacts than the pharmaceutical sector, primarily due to the greater relevance of trade secrets. In cosmetics, product formulations and ingredient combinations are often not protected by patents and represent a key source of competitive advantage; therefore, reporting obligations under the UWWTD (e.g. on substance composition, biodegradability or hazard characteristics) could, in some cases, increase the risk of reverse engineering.

However, the UWWTD establishes that such information is to be transmitted to competent authorities and Producer Responsibility Organisations, providing a clear legal basis for data collection while limiting unnecessary disclosure. At the same time, EU legislation—particularly Directive (EU) 2016/943 on the protection of trade secrets—ensures that commercially sensitive information is not made publicly available, thereby mitigating potential risks to competition.

By contrast, the pharmaceutical industry relies more heavily on patents and regulatory exclusivity frameworks, which already entail extensive disclosure requirements and

provide strong legal protection, reducing the relative importance and vulnerability of trade secret information.

Table 24: Intellectual Property Rights (IPRs) risks under the UWWTD: cosmetic vs pharmaceutical industries

IPRs	Cosmetic industry risk level	Pharmaceutical industry risk level
Patents	Low risk; cosmetic products are generally not patented. In any case, patent-related information is publicly disclosed and not economically exploitable during the patent protection period	Low risk; while patents are more relevant in the pharmaceutical sector, patent-related information is already publicly disclosed and not economically exploitable during the patent protection period.
Trade secrets	Moderate relevance. Reporting under the UWWTD on substance composition, biodegradability or hazard characteristics could, in some cases, facilitate reverse engineering of proprietary formulations.	Limited relevance. Extensive regulatory oversight, mandatory disclosures to authorities and strong patent and regulatory exclusivity regimes significantly reduce the economic value and exploitability of potential trade secret information.
Trademarks and branding	Generally limited relevance; potential reputational impacts may occur only if substance hazard information is publicly linked to specific products or manufacturers.	

Data protection policies

To balance the need for effective regulatory oversight - which requires complete and reliable data for the authorities - with the protection of producers' commercial confidentiality, several operational solutions can be implemented. Data provided by producers, such as quantities of substances in products, chemical composition, hazard information, and biodegradability, can be aggregated before publication. This approach allows publicly available information to reflect the overall functioning of the system and the status of Directive implementation without exposing sensitive data of individual companies, thereby avoiding potential harm to competition.

Moreover, access to detailed data can be restricted to the competent authorities and PROs, which are bound by administrative confidentiality obligations. This ensures that the information necessary for inspections, audits, and calculation of financial contributions is fully available without compromising commercial confidentiality.

Then, the separation of functions can ensure that those who collect the data — typically PROs or third-party organisations — are not the same entities that use the data for compliance checks or enforcement, reducing the risk of misuse of sensitive information and preventing conflicts of interest.

Further operational policies may strengthen confidentiality and trust without duplicating existing safeguards. In particular, controlled role-based access mechanisms may be applied within digital reporting systems, ensuring that users can only view or process data strictly necessary for their institutional role. This minimises the risk of unintended disclosure and supports the principle of data minimisation.

Standardised data submission templates may also be introduced to limit the level of granularity required from producers to what is strictly necessary for regulatory purposes. By constraining the structure and scope of reported data ex ante, such templates reduce the likelihood that commercially sensitive details are collected unnecessarily.

Finally, formal safeguards may be established to prevent the secondary use of collected data for purposes unrelated to UWWTD implementation, such as commercial analysis or market surveillance beyond the scope of the Directive. Limiting data use to clearly defined statutory purposes reduces legal uncertainty for producers and reinforces compliance with trade secret protection rules.

Table 25: Suggested policies to protect data confidentiality under the UWWTD

Policy option	How it could work	Intended effect
Aggregation of publicly disclosed information	Information made public could be limited to aggregated indicators on system performance and implementation progress.	Ensure transparency without revealing company-specific or product-level data.
Restricted access to detailed datasets	Access to non-aggregated data could be limited to competent authorities and PROs subject to confidentiality obligations.	Allow inspections and oversight while preventing unauthorised dissemination.
Functional separation of roles	Data collection, data processing and enforcement functions could be allocated to separate entities.	Reduce risks of conflicts of interest and misuse of sensitive information.
Role-based access in digital systems	Digital reporting platforms could apply differentiated access rights depending on institutional roles.	Minimise the risk of unintended or excessive access to sensitive data.
Standardised reporting templates	Reporting formats could be designed to request only data strictly necessary for UWWTD purposes.	Avoid unnecessary collection of commercially sensitive details.
Purpose limitation rules	Formal rules could restrict the use of collected data exclusively to UWWTD implementation tasks.	Prevent secondary use of data for unrelated regulatory or commercial purposes.

From the interviews it emerged that transparency, data reliability and regulatory oversight are key cross-cutting concerns, although confidentiality is not always explicitly addressed as a standalone issue.

Water utilities emphasized the importance of transparency in cost justification and validation processes.

Local economic ecosystem stakeholders highlighted practical challenges related to traceability and verification, particularly in tracking the micropollutant content of products across complex supply chains, including those involving imported products.

Moreover, they stressed the need for robust and harmonized monitoring systems, which implies balancing data availability with administrative burden.

According to economic regulators, their role should be to ensure central coordination of data by setting common standards and methodologies, verifying and benchmarking information, and producing harmonised reporting to guarantee consistency, quality, and credibility across the system

4 CONCLUSIONS: THE IMPACT OF THE INTRODUCTION OF THE EPR IN THE WASTEWATER DIRECTIVE ON POLICY AND REGULATION

Since the entry into force of the UWWTD (1 January 2025), an important phase in the implementation of the Directive's provisions on the introduction of EPR in water treatment services has commenced, involving the cosmetics and pharmaceutical industries.

Where they have been established and are operational, Water Authorities will play a key role in implementing EPR schemes in accordance with the UWWTD.

WAREG, as the European Association of Water Regulators, is called upon to liaise with the services of the European Commission, both with regard to the requirements to be met by Member States in the run-up to the transposition phase, and in relation to the development of delegated and implementing acts, as well as the management of legal disputes initiated by certain parties. It may also play a role in supporting the verification of implementation and any subsequent updates to the regulatory framework, as provided for by the Directive.

In the run-up to the transposition of the Directive in individual Member States, WAREG could play a leading role in promoting guidelines agreed with its members to ensure consistent implementation of the Directive, thereby avoiding market distortions and unequal treatment of consumers and water service users.

At national level, individual WAREG members, with the support of the Association, could play a key role both during the transposition phase and throughout the implementation, monitoring and updating phases. National regulators therefore have both a supporting role vis-à-vis Member States in the definition of national policies (on issues related to regulation and the proper functioning of markets) and an independent role in economic regulation.

The role of regulators at different stages

The UWWTD came into force on 1 January 2025, and Member States must transpose it into national law by **31 July 2027.**

By **1 January 2028**, Member States must adopt the National Implementation Programme, a requirement under the Directive, which must contain initial guidance on the necessary investments and the contributions expected from EPR schemes.

EPR schemes must be operational by **31 December 2028**.

The various operational deadlines set out in the Directive extend until **2045**.

The following phases, involving national regulators, have therefore been identified:

1. From the adoption of the Directive to its transposition by Member States (1 January 2025 – 31 July 2027): 2 years and 7 months;
2. From the transposition phase to the approval of the National Implementation Programme (31 July 2027 – 1 January 2028): 5 months;

3. From the approval of the National Implementation Programme to the operational launch of the EPR scheme (1 January 2028 – 31 December 2028): one year;
4. From the activation of the EPR scheme onwards (1 January 2029 onwards) with compliance deadlines extending until 2045: several years.

Phase 1: from 1 January 2025 to 31 July 2027

At this stage, regulators are called upon to:

a) examine in depth the various issues relating to the introduction of EPR in the water sector (WAREG and national regulators);
b) participate (WAREG) in any Commission working groups or consultations related to the adoption of relevant delegated and implementing acts, as well as other Commission initiatives;
c) define specific regulatory issues in the implementation of the EPR scheme (WAREG and national regulators) and identify common proposals;
d) consider drawing up (WAREG) the identification of common guidelines at European level to facilitate a uniform transposition process;
e) support (WAREG) national regulators in their discussions with individual Member States regarding the definition of transposition rules and the design of the EPR;
f) monitor (WAREG) the transposition rules.

Second phase: from 31 July 2027 to 1 January 2028

In this phase, national regulators are required to:

a) support Member States in drafting National Implementation Programmes, with reference to the regulatory issues contained in the Programme (i.e. cost estimates);
b) technical support from WAREG to Member States without a regulatory authority could also be considered.

Phase 3: from 1 January 2028 to 31 December 2028

In this phase, national regulators are required to:

a) support the Member State in defining the EPR scheme;
b) carry out the regulatory functions assigned to them by the transposition law;
c) technical support from WAREG could also be considered for Member States without a regulatory authority.

Fourth phase: from 1 January 2029 onwards

In this phase, national regulators are required to:

a) manage the regulatory activities assigned to them;
b) assess implementation challenges and promote any corrective measures and amendments to the national (and/or European) framework.

The following figure illustrates the main milestones for the implementation of the UWWTD, especially connected with the adoption of Extended Producer Responsibility Schemes (EPR) in the European Union.

1) The revised EU Urban Wastewater Treatment Directive (UWWTD) was formally adopted by the Council of the European Union on November 27, 2024.

2) The Directive entered into force on January 1st, 2025.

3) By 1 January 2025, the Commission must organise an exchange between Member States on how to implement art. 9 (Extended producer responsibility) and art. 10 (Minimum requirements for producer responsibility organisations) effectively (art.10.6). The exchange must cover producer responsibility organisations, producer compliance, cost coverage, contribution calculations, exemptions, and possible effects on medicines. The Commission must publish the results and may provide recommendations or guidelines to help Member States apply the rules consistently.

4) The Directive requires Member States to organise regular stakeholder dialogues to ensure the effective and cost-efficient implementation of the extended producer responsibility (EPR) system (art.10.5). These discussions should support measures to reduce micropollutants at source and identify the most appropriate quaternary treatment technologies, involving producers, wastewater operators, local authorities and civil society organisations.

5) The Directive must be transposed into national law by Member States by July 31st, 2027 (art. 33).

6) No later than 31 December 2027, the European Commission may adopt implementing acts to establish detailed criteria regarding specific product categories and their biodegradability or hazard, in reference to paragraph 2, point b) of the UWWTD (art.9.5).

7) Then, Member States "shall take measures to ensure that by 31 December 2028, producers who place any of the products listed in Annex III on the market have extended producer responsibility" (art.9).

8) The Directive requires Member States to draw up National Implementation Programmes by January 1st, 2028, identifying the investments required for each urban agglomeration, taking into account both the size of the settlements and the environmental impact of the discharges (art.23). Member States shall update their national implementation programmes at least every 6 years. They shall submit them to the Commission by 31 December of the year of the update, except where they can demonstrate that they are in compliance with Articles 3 to 8 (art.23.3).

9) Member states must establish a list of areas on the national territory where the concentration or the accumulation of micropollutants from UWWTPs represents a risk for the environment or human health (art.8.2). Member States shall review that list in 2033, and thereafter every six years, updating it if deemed necessary.

10) Between 1 January 2025 and 31 December 2028, quaternary treatment costs accrue in relation to quaternary treatment plants that are already in operation prior to the date in

which the Directive entered into force (recital 23). For those existing plants, operating costs accrue as the plants continue to run, while the relevant share of past investment costs is recognised progressively through depreciation.

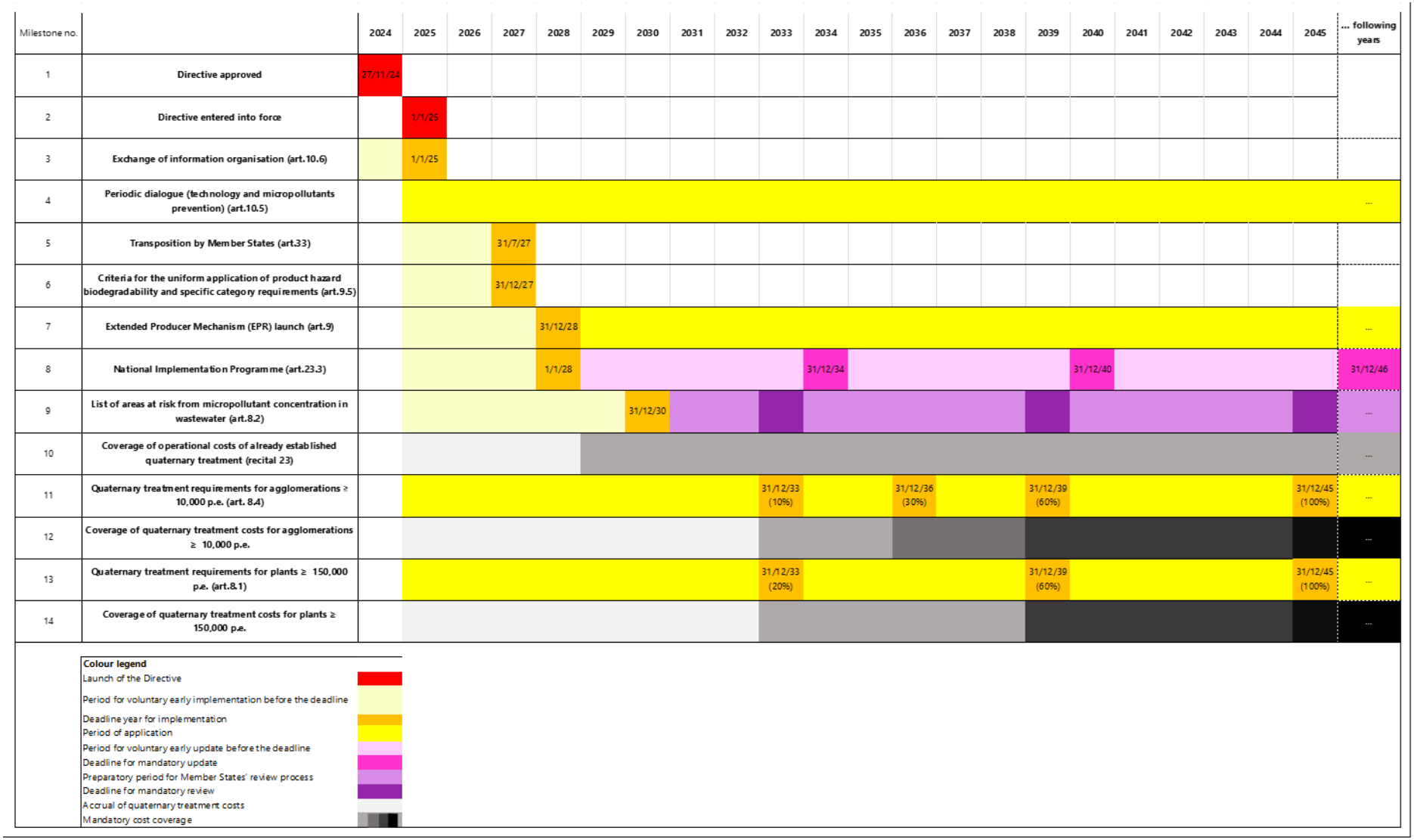
11) Member States must progressively ensure compliance for urban wastewater treatment plants and agglomerations above specific population equivalent (p.e.) thresholds before wastewater is discharged into receiving waters. For agglomerations of 10,000 p.e. and above discharging into designated sensitive areas, compliance must cover 10% of agglomerations by 31 December 2033, 30% by 31 December 2036, 60% by 31 December 2039, and 100% by 31 December 2045 (art.8.4).

12) Each of these 10,000 p.e. deadlines marks the start of a corresponding cost coverage period under the EPR system.

13) For treatment plants serving 150,000 p.e. and above, compliance must cover 20% of discharges by 31 December 2033, 60% by 31 December 2039, and all discharges by 31 December 2045 (art.8.1).

14) Each of these 150,000 p.e.-related deadlines mark the start of a corresponding cost coverage period under the EPR system.

Figure 18: activity timeline



The role of WAREG in defining policy directions

WAREG can play a strategic role in shaping the political and regulatory debate on the most important and sensitive issues relating to the application of EPR in the wastewater sector.

In particular, it can contribute to strengthening coordination across different national approaches, whilst promoting greater consistency in the implementation of European legislation, whilst respecting the specific characteristics and autonomy of individual Member States.

Table 26: Key Issues and Policy Recommendations

1	**Management and pricing structure, EPR impact assessment**
	Recommendation *Contribute to the development of national implementation programmes and provide an initial assessment of the expected operational, economic, and financial impacts, including impacts on tariffs.*
	Motivation and discussion National regulators will be required, from the very outset of the development of the national implementation programme, to assess the impact of the new regulations on water management and water tariffs, with particular regard to the obligations concerning the advanced treatment of wastewater and the introduction of extended producer responsibility (EPR). To do so, they will need to share with operators and the Member State an overview of existing and under-construction treatment plants and the quality characteristics of water bodies, to help identify the plants (of various sizes) to be included in the national implementation programme and, consequently, in investment plans and tariff schemes. To achieve this, it will be necessary to refine the information on the operators of the treatment phase (integration with other water services, form of management, industrial management, in-house management, unserved areas, size), and information on the tariff (or fiscal) structure of treatment, including for the purposes of an initial analysis of the impact of the new costs not covered by EPR.

2	**Scope of regulated entities**
	Recommendation *Ensure maximum stability in the operational framework of EPR, preventing changes or dynamic processes from undermining the certainty and predictability of financial transfers between PROs and WWTUs (Wastewater Treatment Utilities), which underpin the system.*
	Motivation and discussion

	It is necessary to monitor current uncertainties and anticipated developments in order to ensure a stable and clearly defined scope of application, with specific reference to: a) the outcome of the legal proceedings initiated by certain parties (possible postponement or suspension of EPR obligations and the implications for compliance with requirements on quaternary treatment); b) the potential inclusion of additional sectors (beyond the pharmaceutical and cosmetics sectors) within the scope of EPR.

3	**Transposition of the Directive: national regulators and WAREG**
	Recommendation *Ensure that economic regulators are involved from the preparatory phase through national transposition, so that the EPR framework for wastewater is designed coherently, transparently and consistently with the regulated nature of water services.* *Ensure consistency across Europe in the way EPR is implemented at national level, by reducing potential disparities, standardising the criteria for the recognition, validation and inclusion of EPR-covered costs in tariffs, and discouraging 'opportunistic' behaviour in Member States.*
	Motivation and discussion *Between the entry into force of the UWWTD and its transposition into national law, economic regulators should focus on the following key priorities:* • supporting Member States in defining the national governance architecture for EPR, including the respective roles of producers, PROs, competent authorities, wastewater operators and regulators; • contributing to the assessment of investment needs, expected costs, tariff impacts and affordability implications, in view of the National Implementation Programmes to be adopted by 1 January 2028; • helping define the main categories of costs to be covered by EPR, including investment, operating, monitoring, data-gathering and verification costs related to quaternary treatment; • supporting the design of future financial-flow arrangements, including the possible role of a central public fund, transfer mechanisms from PROs to wastewater operators, and financial guarantees to manage default or delay risks; • contributing to the regular stakeholder dialogues required by the Directive, involving producers, PROs, wastewater operators, local authorities and civil society organisations; • following the Commission-led exchange of information and any related recommendations or guidelines on producer compliance, cost coverage, contribution calculation, exemptions and potential impacts on medicines; • preparing common regulatory principles on accounting unbundling, cost validation, tariff integration, monitoring, audits and transparency, to be

reflected in national transposition rules.

WAREG finally could support this process from a trans-national perspective.

It would be beneficial, in fact, for WAREG to play a role in promoting consistency in national transposition rules and economic regulatory aspects, whilst respecting the scope for autonomy afforded to Member States by the Directive. This objective can be pursued through the issuance of guidelines, standards or model documents. The main aspects concern the determination of the cost recovery rate (between 80 and 100%), their classification, accounting unbundling (for costs attributable to quaternary treatment), financial guarantees from PROs, criteria for the validation of eligible costs, mechanisms for transferring EPR contributions to utilities, and the relationship between the operation of EPR schemes and the timelines for the implementation of quaternary treatment by operators.

4	**EPR frameworks and relational models between PROs and utilities**

Recommendation

Establish clear operational mechanisms, subject to regulatory oversight, that allow for periodic adjustments and updates in response to evolving conditions, while avoiding uncertainty or open-ended transitional arrangements.

Motivation and discussion

The roll-out of quaternary treatment and the associated implementation of EPR will take place over many years (plants commissioned in 2045 will have depreciation periods extending until 2060).

During this long period, the issue is set to evolve:

- likely new regulations on MPs with possible consequences for treatment processes;
- likely developments in the market and in the chemical composition of medicines and cosmetics;
- possible extensions to the range of parties required to share the obligations arising from EPR;
- likely developments in wastewater treatment, management and analysis technologies, with a consequent impact on costs;
- links with wastewater reuse mechanisms;
- possible changes to exemption criteria (e.g. biodegradability, hazardousness, volumes placed on the market).

It is therefore essential that EPR schemes and the relational models between PROs and utilities are clear and robust, yet also flexible and adaptable, thereby reducing the risk of litigation during the long implementation period.

5	**Correlation between the timing of the EPR and the implementation of the quaternary treatment process**

Recommendation

Establish reliable and stable mechanisms for the transfer of contributions, ensuring that operators, tariffs and, consequently, consumers do not bear costs that are not attributable to them, including transitional periods, and that the implementation deadlines are met

Motivation and discussion

The Directive stipulates that capital and operating costs attributable to quaternary treatment must be borne (at least 80%) by producers subject to Extended Producer Responsibility. For this reason, the Directive sets a specific deadline by which EPR schemes must be established and operational (31 December 2028). At the same time, wastewater treatment operators are required (obliged) to implement quaternary treatment (as defined by the national implementation programme) within the timeframes and to the extent specified by the Directive (the first deadline is 31 December 2033). Once quaternary treatment has been implemented, operators will be responsible for meeting the micropollutant removal targets (80% between input and output). The two obligations are functionally interlinked; it must therefore be clear that operators will implement and manage quaternary treatment only in return for agreements on the transfer of defined, certain and guaranteed contributions. The implementing regulations must, however, define the safeguards for operators in the event of a mismatch in timelines, should the EPR schemes be delayed or halted.

It must be made clear in the transposition legislation that the obligation to remove 80% of pollutants applies, for each plant, from the date on which it becomes subject to the EPR scheme, in accordance with the phased implementation scheduled between 2033 and 2045.

It must also be made clear in the transposition measures that the operators' commitment to remove 80% of pollutants applies only to plants that will be brought into operation in accordance with the timeline set out for the period from 2033 to 2045.

6	**Cost coverage rate (range 80–100%)**

Recommendation

Minimise the impact of the costs of implementing and operating quaternary treatment on tariffs, and consequently on end users, to avoid further increasing the financial burden associated with an essential service, for which an adequate level of affordability must be ensured.

Motivation and discussion

Whilst this remains a matter for Member States, WAREG could play a useful role in promoting the adoption of schemes with cost coverage levels as close as possible to 100%, in order to minimise any impact on tariffs during a period – the coming decades – characterised by high investment needs linked to the implementation of the Drinking Water and Wastewater Directives as well as the Water Resilience Strategy. WAREG could also help define the methods for covering the residual share (1–20%), for example through general taxation, tariffs or European funds. In this context, it could also promote the allocation of dedicated resources within the EU's Multiannual Financial Framework (MFF) 2028–2034, as well as support the establishment of transparency criteria for the presentation of these costs on bills, in order to ensure clarity for consumers.

7	**The 'polluter pays' principle, eco-modulation, incentive mechanisms**

Recommendation

Contribute to the achievement and monitoring of the upstream objectives of EPR regulation.

Motivation and discussion

The Directive introduces an EPR scheme based on the 'polluter pays' principle.

In this context, the eco-modulation mechanism should incentivise manufacturers to reduce the presence of MPs in product formulations. EPR is therefore designed not only to cover treatment costs, but also to encourage manufacturers of medicines and cosmetics to promote ongoing eco-innovation, aimed at reducing the generation of MPs at source and making the subsequent 'end-of-pipe' treatment phase more effective and efficient.

However, the Directive does not introduce binding pollutant reduction targets for producers. In this context, it is in the interest of the environmental regulator, and to some extent also of the economic regulator, to ensure that the incentive mechanism functions effectively, reducing pollutants in wastewater and enabling water utilities to remove them more efficiently and effectively. To this end, it is appropriate for WAREG at European level, and associated regulators at national level, to ensure that implementing rules do not undermine this mechanism (for example, by permitting the use of proxies in eco-modulation), whilst monitoring the actual impact.

8	**Monitoring**

Recommendation

Ensure that the monitoring and control systems are operational, so as to have the information needed to assess the impact of the EPR scheme as an incentive to reduce pollutants, and thus adjust the operator's activities (paradoxically, a

reduction in pollutants could increase treatment costs rather than reduce them, due to the effect of dilution).

Motivation and discussion

It is important that the various activities are carried out in accordance with clear and transparent criteria. In particular, on the one hand, there is the monitoring carried out by utilities, which are responsible for checking the quality of the water entering and leaving wastewater treatment plants, ensuring environmental and operational compliance; on the other hand, there is the work of PROs, which are responsible for collecting data on the types, hazardous properties and quantities of products placed on the market. Both sets of costs, relating to monitoring and verification activities, are borne by the EPR schemes, and it must therefore be ensured that they are carried out consistently, transparently and effectively.

In this context, it is useful to distinguish between environmental and compliance monitoring and economic-regulatory oversight. The role of economic regulators under the Directive with regard to monitoring is limited and does not overlap with operational environmental control functions; however, they have a legitimate interest in the results of such monitoring, as these are relevant for assessing the effectiveness of quaternary treatment and the overall implementation of the EPR scheme.

9	**Financial flows, financial guarantees, and default risk**

Recommendation

Ensure that the flow of EPR contributions is consistent and guaranteed, so as not to burden the operator and users with any economic and/or financial consequences arising from discrepancies in the flow of funds.

Motivation and discussion

We suggest that the mechanism for transferring contributions from PROs to WWTUs should be managed by a fund administered by a national public body.

It is essential to ensure that the flow of funds remains stable and is not affected by any difficulties the PRO may face in collecting the required contributions from its members, nor by delays in transferring contributions to the National Fund, nor by delays in transferring funds from the National Fund to the operator. The flow from the PRO to the WWTUs must therefore be guaranteed and decoupled from the PRO's collection of contributions. For this reason, the Directive provides for a form of general financial guarantee from the PRO, but rigorous mechanisms governing this aspect will need to be defined during implementation.

10	**Identification of treatment technologies and their efficiency/effectiveness**

Recommendation

Ensure that technological choices are made within a framework that assigns responsibility to WWTUs and, given that they operate under a natural monopoly, that expenditure is efficient, within reasonable limits, in order to protect both consumers (for the share of costs not covered by EPR) and producers, who are required to bear the majority of the costs.

Motivation and discussion

For the removal of MPs in quaternary treatment, there are various types of technology, each associated with different cost structures (both capital and operational). This technological landscape is set to evolve over time. The responsibility (operational and legal) for removing 80% of incoming MPs is placed by legislation on the WWTUs; it therefore seems reasonable that the choice of technology should be their responsibility, as they are ultimately accountable for the environmental and legal outcomes of the removal process. It should, however, be noted that the obligation to carry out quaternary treatment is based on the result and not on the technology. Therefore, the decision to invest in quaternary treatment may, in principle, be avoided if the same results can be achieved through tertiary treatment.

As these are operators in a natural monopoly, this 'freedom of choice' could be 'regulated' by mechanisms of verification and approval by public authorities; in this scenario, a role arises for national and regional regulators, regarding the 'efficiency' aspect of the operator's decisions (scale, appropriate choice of technology, management decisions relating to operating costs, possible use of quaternary treatment). This role is designed to protect both consumers (for the portion of costs not covered by EPR) and producers (to avoid inefficient costs to the system). Since operators are responsible, together with Member States, for meeting the deadlines for the construction of plants set out in the Directive's timeline, regulators should ensure that the project approval phase is carried out within a reasonable timeframe. A first deadline, set out in the Directive, is the approval of the National Implementation Programmes, which should already contain an indication (estimate) of the costs. Finally, the Directive provides (Article 10(5)(b)) that in the periodic dialogues promoted by Member States for the implementation of the Directive, 'the most appropriate technologies for advanced treatment' shall be determined, and it is in these phases that we identify a role for national regulators.

11	EPR design and governance model

Recommendation

The most coherent model for implementing EPR in the water sector is one based on a single national PRO, possibly structured into two distinct sub-sections – one for pharmaceuticals and one for cosmetics – organised on a not-for-profit basis and supported by a public fund or a centralised allocation system managed by a competent public authority.

Motivation and discussion

Under this scheme, the PRO is responsible for collecting contributions, managing data, eco-modulation and consumer information obligations, whilst the distribution of resources to WWTUs takes place according to criteria that are transparent, stable and harmonised at national level. This model drastically reduces administrative complexity, facilitates financial risk management and allows the State or the regulator to integrate EPR in an orderly manner into tariff systems and investment planning.

12	Cost classification and calculation criteria

Recommendation

Clearly identify both the cost items to be covered and the methodologies for their calculation and validation, including: the scope of eligible costs; reference to reliable accounting data (e.g. year n–2); accounting unbundling; criteria for calculating operating costs; criteria for calculating capital costs (including depreciation, provisions, and return on capital); adjustments; tax charges; and the allocation of general and mixed costs.

Only under these conditions will it be possible to effectively apply the full cost recovery principle through PRO contributions, within the range set out in the UWWTD (80–100%), which should be clearly defined in national transposition legislation.

Motivation and discussion

The precise definition of the taxonomy of costs to be covered by EPR contributions is typically a regulatory function. It should ideally be guided by harmonised European-level guidelines capable of ensuring methodological consistency and comparability across Member States, and subsequently implemented at national level through transposition legislation, national implementation programmes, and operational instruments (e.g. PRO statutes, agreements).

The Directive refers to the concept of "full cost", i.e. the total costs incurred by utilities in complying with the requirements set out in Article 8. Accordingly, the first issue to be addressed, prior to assessing the effectiveness and efficiency of expenditure, is the clear identification of all cost items falling within the scope of producers' financial responsibility. This is essential to avoid disputes and to ensure that PRO contributions cover, at the applicable percentage, all relevant costs.

Drawing on regulatory frameworks already adopted in Member States, it will be possible to assess different approaches to the recovery of investment costs, whether ex ante (i.e. on a budgetary basis) or ex post (i.e. once investments have been made and accounted for).

13	Operational efficiency

	Recommendation *Ensure that operating costs are "efficient", including when determining the costs to be covered by the EPR scheme, in order to protect both consumers (for the share not covered by EPR) and producers participating in the scheme. It is reasonable to expect that national regulators will apply the same criteria used in general tariff regulation.*
	Motivation and discussion The Directive refers to "full costs" (Article 9(1)(a)). It does not explicitly address cost efficiency, nor does it appear to require oversight of operators' efficiency levels. Given that wastewater management constitutes a natural monopoly, it may be appropriate for regulators to play a role in discouraging potential abuses by the monopolist. This is a typical regulatory matter, which is not explicitly addressed in the Directive, although Member States may choose to do so. As regards investment cost efficiency, reference is made to the section on technology selection. With regard to operational costs, where regulators already apply efficiency criteria to the monopoly operator, these could also be extended to costs associated with quaternary treatment.

14	**Internal governance of the PRO**
	Recommendation *Ensure the representation of public stakeholders within the internal governance of PROs*
	Motivation and discussion In a 'monopolistic' model, it is conceivable that stakeholders other than manufacturers (e.g. public bodies, utilities and their associations, consumer associations, NGOs, research bodies) could be involved in the internal governance of the PRO. A role as auditors is likely, with the possibility of contributing to discussions regarding decisions on eco-design, eco-modulation of the environmental contribution, prevention strategies, communication and awareness-raising initiatives, technological solutions for the reduction of specific types of MPs, innovation and R&D.

15	**Transparency**
	Recommendation *Ensure transparency for water service users regarding the costs associated with quaternary treatment, specifying the share of costs covered by producer contributions and the remaining share covered through tariffs*

	Motivation and discussion Once PROs begin to cover part of the costs, it is important that water service users are properly informed about the share covered by EPR contributions and the remaining share still included in tariffs, where applicable. This is a typical regulatory function, which could be supported by WAREG through the development of specific guidelines on how to present the costs of quaternary treatment on water bills.

REFERENCES

Ahlers, J., Hemkhaus, M., Hibler, S., & Hannak, J. (2021). Analysis of extended producer responsibility schemes. Adelphi Consult GmbH: Berlin, Germany
Available here

Colelli, P.F., Croci, E., Pontoni, F. B., & Zanini, S. F. (2022). Assessment of the effectiveness and efficiency of packaging waste EPR schemes in Europe. Waste Management, 148, 61–70.
Available here

Compagnoni, M. (2022). Is Extended Producer Responsibility living up to expectations? A systematic literature review focusing on electronic waste. Journal of Cleaner Production, 367, 133101
Available here

Deloitte (2025). Description of the term "full cost" in relation to EPR in connection with the EU Urban Wastewater Treatment Directive
Available here

EC (2022). SWD (2022) 541 final Commission Staff Working Document: Impact Assessment Accompanying the document "Proposal for a Directive of the European Parliament and of the Council concerning urban wastewater treatment (recast)" {COM(2022) 541 final} - {SEC(2022) 541 final} - {SWD(2022) 544 final}.
Available here

EUNOMIA (2020). Study to Support Preparation of the Commission's Guidance for Extended Producer Responsibility Schemes, Report for DG Environment of the European Commission
Available here

Facco P., Berner R. (2025), Efficiency and performance of packaging EPR systems in the EU - A comparative analysis of different countries and market structures – Adelphi Consult GmbH: Berlin, Germany

Available here

Ianes et al., (2025) - Jessica Ianes, Sara Piraldi, Beatrice Cantoni, Manuela Antonelli, Micropollutants removal, residual risk, and costs for quaternary treatments in the framework of the Urban wastewater Treatment Directive, Water Research X, Volume 29, 2025,
Available here

Joltreau, E. (2018). Pricing products' negative externalities at end-of-life using eco-modulation: discussion from case studies. Econ. Policy Energy Environ. pp. 149-172
Available here

Laubinger, F., Brown, A., Dubois, M., & Börkey, P. (2021), Modulated fees for Extended Producer Responsibility schemes, OECD Environment Working Papers No. 184
Available here

Lifset, R., Kalimo, H., Jukka, A., Kautto, P., & Miettinen, M. (2023). Restoring the incentives for eco-design in extended producer responsibility: The challenges for eco-modulation. Waste Management, 168, 189-201
Available here

Lindhqvist, T., Lidgren, J., (1990). Modeller för förlängt producentansvar" ("Models for Extended Producer Responsibility," in Swedish), 26 October 1990, published by the Ministry of the Environment in "Från vaggan till graven - sex studier av varors miljöpåverken" ("From the Cradle to the Grave - six studies of the environmental impact of products," in Swedish), DC 1991:0

Magalini, F., Heinz, C., Holt, A., Manclark, T., Daniel, R., Haarman, A., Leroy, P., Hajósi, E., (2022). The eco-modulation of producers' financial obligations for WEEE in the UK
Available here

Mainardis, M., Ferrara, C., Cantoni, B., Di Marcantonio, C., De Feo, G., Goi, D., (2024). How to choose the best tertiary treatment for pulp and paper wastewater? Life cycle assessment and economic analysis as guidance tools. Sci. Total Environ 906, 167598.
Available here

Mallick, P. K., Salling, K. B., Pigosso, D. C., & McAloone, T. C. (2024). Designing and operationalising extended producer responsibility under the EU Green Deal. Environmental Challenges, 16, 100977.
Available here

Massarutto, A. (2014). The long and winding road to resource efficiency–An interdisciplinary perspective on extended producer responsibility. *Resources, Conservation and Recycling*, *85*, 11-21.
Available here

Micheaux, H., Aggeri, F. (2021). Eco-modulation as a driver for eco-design: A dynamic view of the French collective EPR scheme, Journal of Cleaner Production, Volume 289, 2021

Available here

Monier, Véronique et al. (2014). Development of Guidance on Extended Producer Responsibility (EPR). BIO Intelligence Service; in collaboration with Arcadis, Ecologic Institute, Institute for European Environmental Policy (IEEP), Umweltbundesamt (UBA).
Available here

OECD (2014). The State of Play on Extended Producer Responsibility (EPR): Opportunities and Challenges. OECD. Paris.
Available here

OECD (2016). Extended Producer Responsibility: Updated Guidance for Efficient Waste Management
Available here

Pistocchi, A. (2025). Updated estimation of the costs of quaternary wastewater treatment in the EU - A comparison of cost models, Publications Office of the European Union, Luxembourg, 2025
Available here

Pistocchi, A., Dorati, C., Grizzetti, B., UDIAS, M. A., VIGIAK, O., & ZANNI, M. (2019). Water quality in Europe: Effects of the urban wastewater treatment Directive.
Available here

Pistocchi, A., Andersen, H. R., Bertanza, G., Brander, A., Choubert, J. M., Cimbritz, M., .. & Thornberg, D. (2022). Treatment of micropollutants in wastewater: Balancing effectiveness, costs and implications. Science of the Total Environment, 850, 157593.
Available here

Pistocchi, A., Dorati, C., Grizzetti, B., Udias Moinelo, A., Vigiak, O. and Zanni, M. (2025) Water quality in Europe: effects of the Urban Wastewater Treatment Directive. EUR 30003 EN, Publications Office of the European Union, Luxembourg, 2019.
Available here

Pouikli, K. (2020). Concretising the role of extended producer responsibility in European Union waste law and policy through the lens of the circular economy. ERA Forum, 491-508
Available here

Pruess, J. T., & Garrett, R. D. (2025). Potential effectiveness of extended producer responsibility: An ex-ante policy impact analysis for plastic packaging waste in Belgium, France, and Germany. Resources, Conservation and Recycling, 219, 108297.

Available here

Sachdeva, A., Araujo, A., Hirschnitz-Garbers, M. (2021). Extended Producer Responsibility and Ecomodulation of Fees. Opportunity: Ecomodulation of Fees as a Way Forward for Waste Prevention. Berlin: Ecologic Institute.
Available here

Utilitatis (2025), Mini-Book - Quanto costa adeguare gli impianti di depurazione italiani alla nuova direttiva acque reflue?
Available here

VSA (Verband Schweizer Abwasser- und Gewässerschutzfachleute), 2021. Abklärungen Verfahrenseignung Ozonung – Empfehlung. Version 2.