AWARD

Alternative Water Resources and Deliberation processes to renew water supply strategic planning

Deliverable 2.1: AWR regulatory, policy framework and funding mechanisms

Eduard Interwies (InterSus), Stefan Görlitz (InterSus)

Co-author(s): Sergio Santorio ALDARIZ (Cetaqua), Giulio CONTE (IRIDRA), Brais GARCÍA FERNÁNDEZ (Cetaqua), Francesca FRAMBA (CMM), Traian GHIBUS (UTCB), Radu GOGU (UTCB), Santiago GÓMEZ-CUERVO (AIMEN), Oana LUCA (UTCB), Ioannis MANTZIARAS (NTUA), Raluca MIHAI (BDG), Irina MORARU (UTCB), Ciprian NANU (BDG), Florentina NANU (BDG), Eleni NYKTARI (NTUA)

Funded by the European Union

Disclaimer

This document arises from the European project Alternative Water Resources and Deliberation process to renew water supply strategic planning (AWARD), which has received funding from the European Union, under the Grant Agreement N° 101136987.

This document reflects only the authors' view. The European Commission is not responsible for any use that may be made of the information it contains.

Any communication or dissemination activity related to the action must use factually accurate information. Moreover, it must indicate the following disclaimer (translated into local languages where appropriate): "Funded by the European Union. Views and opinions expressed are, however, those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them."

Intellectual Property Rights

Project Consortium

EXECUTIVE SUMMARY

The present report is one of the initial deliverables of the **AWARD** ("Alternative Water Resources and Deliberation processes to renew water supply strategy planning") project, funded by the EU through Horizon Europe. AWARD´s Work Package 2 – "Socio-political support and engagement for AWRs management" – aims at improving the understanding of the social awareness and acceptability of AWR use in Europe through examining the existing policies and regulatory frameworks in order to identify **current challenges** in managing and upscaling AWR. The **EU-added value** of this report is a set of recommendations to boost AWR use in Europe.

The deliverable 2.1 ("Alternative Water Resources´ (AWR) regulatory, policy framework and funding mechanisms") under Task 2.1 ("Review of regulatory and policy framework in Europe") analyses the **political and legal systems** in which AWR are operated in Europe, focusing on the legal and regulatory frameworks as well as the financing of AWR. AWR are influenced by regulation/legislation on the European level, but also by national or even sub-national and municipal laws, regulations and standards. Hence, the focus is two-fold: the **European framework** is presented in Part A of the report. In Part B, the **national/subnational frameworks** in the Demo Cases as well as in four Lower Danube countries (Moldova, Serbia, Hungary and Bulgaria, which are partners in the Local Water Forums Network) are presented based on local expertise.

As such, this report serves as a **basis for further research** and other AWARD products, namely AWR guidelines (subtask 2.2.2) and recommendations and a list of actions (task 2.3) to strengthen AWR use in Europe, as well as any other tasks that rely on information on the EU and national policy framework to issue concrete **recommendations and proposals for action**.

The research into the regulatory and legislative frameworks as well as financing conditions presented in this AWARD Deliverable 2.1 is based on a **three-way approach**. A desktop-based analysis formed the basis of the later work, and identified the **main regulations**, especially on the European level. Via a **questionnaire**, detailed information on the regulatory and legislative frameworks in the Demo Cases and Serbia, Hungary, Moldova and Bulgaria were being solicitated. Interviews have been conducted in September, October and November 2024, which represents the status of the presented results. Based on these results, **targeted interviews** were conducted to gain insight into legislative gaps and gaps in financing opportunities.

AWR are regulated - to a certain extent - at the **European and national/sub-national levels**. Regulation can either be applied at a) the "source", i.e., regulating the alternative resource itself and providing quality standards e.g., for reclaimed/cleaned water, or b) at the "final use/final user", i.e., regulating the quality or quantity of the receiving water body (groundwater, surface water, bathing water etc.) or influencing the conditions under which the water is (economically) used.

On the European level, the **legislative acts** of importance for AWR use are described in detail, such as the Water Reuse Regulation (Regulation 2020/741), the (recast) Urban Wastewater Treatment Directive (Directive 91/271), as well as the extensive water quality legislation, namely the Water Framework Directive (Directive 2000/60) and its "Daughter Directives". European and international **funding opportunities** are described here as well.

The **national level** legislative frameworks for AWR are described in detail for the four AWARD Demo Case countries, which are Cyprus, Italy, Romania and Spain, and with less detail for another four countries, which are all members of the Danube Water Forum (Bulgaria, Hungary, Moldova and Serbia). **Policy gaps and other barriers** to wider AWR use are identified for each country, which are summarized and categorized in the final section of the report.

The main gaps and barriers reported on the **national level** mainly concern the lack of a specific legislative framework for some aspects of AWR use, lack of financial incentives and knowledge of the risks and benefits of certain AWR applications, etc.

On the **European level**, main policy gaps and barriers have been identified on the basis of what the practitioners in the Demo Case countries face in their day-to-day business, and by interviews with EU policy officers working in the field. The **main policy gaps and barriers** identified on the European level predominantly concern a lack of legislation on rain- and stormwater use, the lack of a unified regulatory framework and regulatory and technical guidance, standards and policy and economic frameworks.

Based on the identified gaps and barriers, **recommendations to close these gaps** are also formulated. The recommendations for boosting AWR use in Europe are:

- Water tariffs should include costs of stormwater management (investment costs and O&M).
- Strengthen and promote best practice examples, guidance and practitioner´s handbooks.
- The introduction of a "rainwater fee" on the extension of sealed surface (i.e., a monetary amount charged for increasing sealed surface areas) could be a powerful tool to reduce soil sealing and promote rainwater collection and infiltration through SUDS and NBS.
- Include into EU legislation a "discharge hierarchy" similar to the one adopted in the UK regarding urban stormwater (Priority 1: Discharge into the ground; Priority 2: Discharge to a surface water body; Priority 3: Discharge to a surface water sewer; Priority 4: Discharge to a combined sewer).
- New or renovated building should envisage two different water distribution lines (potable and not potable), as black water and grey water collection networks must be separated until out of the building to ease treatment and reuse.
- The existing legislation primarily focuses on agricultural irrigation as an alternative water use. However, other critical uses, such as industrial processes, urban landscaping, and non-potable purposes (e.g., toilet flushing, cooling systems), are not adequately addressed. Expanding the scope to cover these uses would enhance water efficiency and resilience.
- The absence of Environmental Quality Standards (EQS) specifically tailored for rainwater and stormwater reuse is a gap. EQS provide essential guidelines for water quality, ensuring safety and environmental protection. Developing EQS for these sources would promote sustainable urban water management.
- Regulations related to AWR should be better integrated with urban planning and building codes. This includes incentivizing rainwater harvesting systems, greywater reuse, and green infrastructure in construction projects. Clear guidelines and incentives can drive adoption.
- Incentives and Financing Mechanisms: The legislation could enhance incentives for adopting AWR. Financial support, tax breaks, or subsidies for implementing rainwater harvesting, stormwater management, and greywater reuse systems would encourage their widespread adoption.
- Legislation should explicitly address climate change adaptation strategies related to water resources.
- Strengthen communication activities to increase stakeholder participation and knowledge in AWR use on different levels (especially of treated wastewater use and on groundwater quantity monitoring).

RELATED DELIVERABLES AND WORKPACKAGES' CONNECTION

This section details if there are any related Deliverables (e.g. interim versions, prerequisites etc.) and highlights links with the other Work Packages:

- The work carried out was based on the **inputs from** the Demo Cases, where national and local level interviews where conducted in the frame of the Demo Case workshops.
- The results presented in this deliverable **will feed** WP2 (T2.2.2, "Accountability on AWRs", which includes AWR Guidelines) and WP2 (T2.3, "Policy Support and Planning towards Water Supply Planners into Action", which includes a List of Actions), as well as any other tasks that rely on information on the EU and national policy framework to issue concrete recommendations and proposals for action.

DOCUMENT INFORMATION

Grant Agreement N°	101136987
Project Acronym	AWARD
Project full name	Alternative Water Resources and Deliberation process to renew water supply strategic planning
Start of the project	1 January 2024
Duration	36 months
Deliverable	**D2.1: AWR regulatory, policy framework and funding mechanisms**
Work Package	**WP2: Socio-political support and engagement for AWR management**
Task	Task 2.1: Review of regulatory and policy framework in Europe
Author(s)	Eduard INTERWIES (InterSus), Stefan GÖRLITZ (InterSus)
Co-author(s)	Sergio Santorio ALDARIZ (Cetaqua), Giulio CONTE (IRIDRA), Brais GARCÍA FERNÁNDEZ (Cetaqua), Francesca FRAMBA (CMM), Traian GHIBUS (UTCB), Radu GOGU (UTCB), Santiago GÓMEZ-CUERVO (AIMEN), Oana LUCA (UTCB), Ioannis MANTZIARAS (NTUA), Raluca MIHAI (BDG), Irina MORARU (UTCB), Ciprian NANU (BDG), Florentina NANU (BDG), Eleni NYKTARI (NTUA)
Quality check	Marwan Shamekh (OIEAU), Jean-Marc DOUGUET (University of Paris Saclay)
Due Date	31/12/2024
Delivery Date	29/01/2025
Explanation of the delay (if any)	Interviews in the Demo Cases have been delayed.
Citation	Interwies, E. Görlitz, S. et al. (2024): *Alternative Water Resources´ regulatory, policy framework and funding mechanisms,* Deliverable D2.1, EU Horizon AWARD Project, Grant agreement N° 101136987
Dissemination Level	Public

REVISION HISTORY

Version	Date	Who	What
V1	05/September/2024	All Demo Case partners	Quality check and revision of national-level sections.
V2	September-October	All Demo Case partners	Recurrent quality checks of additional information delivered by Demo Case partners.
V3	12th December 2024	All Demo Case partners; project lead	Version 3 which includes results of national and EU-level interviews
Draft Final for QA	19th December 2024	Internal QA team	Final draft for Quality Assurance
VF	29th January 2025	All	Final version delivered

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

Abbreviations

AWR	Alternative Water Resource(s)
BAT	Best Available Technique
BOD	Biochemical Oxygen Demand
CF	Cohesion Fund
CIS	Common Implementation Strategy
DALY	Disability Adjusted Life Year
DWD	Drinking Water Directive
EAFRD	European Agricultural Fund for Rural Development
EC	European Commission
EEA	European Environment Agency
EIB	European Investment Bank
EIPW	European Innovation Partnership on Water
EQS	Environmental Quality Standards
ERDF	European Reconstruction and Development Fund
EU	European Union
IED	Industrial Emissions Directive
IPPC	Integrated Pollution and Prevention Control
IWA	International Water Association
JRC	Joint Research Centre
LIFE	Programme for the Environment and Climate Action
MS	Member States
ND	Nitrates Directive
PoM	Programme of Measures
PPPD	Plant Protection Products Directive
TOC	total organic carbon
UWWTD	Urban Wastewater Treatment Directive
WFD	Water Framework Directive
WHO	World Health Organization
WWTP	Wastewater Treatment Plant

Introduction and background

Europe's freshwater resources are under increasing stress in several regions, with a mismatch between demand for, and availability of, water resources across both temporal and geographical (spatial) scales. Water scarcity and droughts, which are increasingly frequent and widespread across Europe, have become a major challenge. According to the EC´s Communication on Water Scarcity and Drought, at least 11% of the European population and 17% of its territory have been affected by water scarcity (Sanz/Gawlik 2014, EC 2007). One way to reduce the pressure on water resources is to use Alternative Water Resources (AWR), for example water generated from wastewater or any other marginal water treated to a standard appropriate for its intended use. Water reuse, as an alternative water source, can provide significant economic, social and environmental benefits, which are key motivators for implementing such reuse programmes (Cipolletta et al. 2021; CIS 2016). These benefits include:

- increased water availability;
- integrated and sustainable use of water resources;
- drinking water substitution – keep drinking water for drinking and reclaimed water for non-drinking use;
- reduced over-abstraction of surface and groundwater;
- reduced energy consumption compared to using deep groundwater resources, water importation or desalination;
- reduced nutrient loads to receiving waters;
- reduced manufacturing costs of using high quality reclaimed water;
- increased agricultural production;
- reduced application of fertilisers (as reclaimed water is a potential nutrient source for crops);
- enhanced environmental protection by restoration of streams, wetlands and ponds, and
- increased employment and local economy (e.g. tourism, agriculture, water industry) (EC 2016; Sanz/Gawlik 2014; CIS 2016).

However, there are also some drawbacks, such as high infrastructure and energy costs (EC 2016; Procházková et al. 2023). Human pressures have encouraged more active consideration of AWR as a strategic option to supplement water supplies and protect natural resources (OECD 2015; Ricart 2019). To set the right balance between consumption and water supply, the EU strives towards an improvement in water use efficiency, partially supported by alternative solutions in the water supply.

The most common AWR as defined in the AWARD project are storm- and rainwater harvesting/collecting, greywater reuse, reuse of treated wastewater, aquifer/groundwater recharge and desalination of sea water. In the transition to the circular economy, which is regarded as an important element within the EU Green Deal policy and upcoming Water Resilience Strategy, it has become imperative to ensure water circularity (EC 2019). AWR also are becoming part of the solution to contribute to water quality, for example in the context of fulfilling the objectives of the Water Framework Directive (WFD) and daughter directives.

However, AWR can't only be addressed from a technological point of view. Instead, they raise a wide series of challenges that need to be faced today such as the societal acceptance and accountability. Also, several gaps and barriers to a wider use of AWR exist on the national as well as European levels.

The main gaps and barriers reported in the frame of this report on the national level are:

- Lack of a specific legislative framework for the water reuse/use of rainwater and stormwater: rainwater/stormwater use range from small-scale applications to large-scale projects, and may carry

different pollutants than treated wastewater. A lack of supportive legislation and specific monitoring requirements limit its application.

- Lack of financial incentives for specific or all AWR: the focus is set too strong on desalination, as other AWR uses may need more financial incentives to be economically feasible. This often concerns rainwater/stormwater use and Nature-Based Solutions.
- Insufficient knowledge of the risks and benefits of treated wastewater: The risks from pollutants such emerging pollutants and priority substances hinders water reuse schemes (especially groundwater recharge), as there are many poorly researched and unregulated contaminants.
- Low acceptance of treated wastewater in the public sphere: treated wastewater is in some countries regarded negatively, increasing resistance to water reuse.
- Lack of regulation and financing for small-scale reuse of water, e.g., from households: especially small-scale applications need financial incentives to convince home owners to use them (because they are often not economically attractive otherwise).
- Lack of regulation for high-quality treated wastewater used for irrigating crops such as lettuce: a legislative gap in one country is that unrestricted irrigation does not include specific crops as lettuce that are directly in contact with the water and are eaten raw. For such crops, higher quality water standards need to be drawn up.
- Current water reuse regulation does not cover emerging contaminants: while covered by the recast UWWTD, emerging contaminants are not covered by the Water Reuse Regulation.
- Lack of comprehensive vision to use AWR to reduce pressures on water bodies: while formally incorporated into WFD Programs of Measures, there is no widespread use of AWR to e.g., lessen the quantitative pressure on water bodies (especially groundwater).
- Lack of knowledge and capacity for technical requirements for alternative treatment solutions (such as NBS): The use of NBS for treatment of differently polluted water flows (stormwater, wastewater, greywater) is hindered by the lack of knowledge of technical requirements.

The main policy gaps and barriers identified in the frame of this report on the European level are:

- Lack of legislation on rain- and stormwater use: The standards regulating the quality of rainwater, tailored to its “final destination”, have not been set up at the EU level yet. The standard EN16941-1:2018 “On-site non-potable water systems” defines the minimum requirements for rainwater collection and use of rainwater on site as non-potable water. This excludes the use for drinking water and for food preparation; the use for personal hygiene; and infiltration. However, the standard does not provide answers to a number of emerging issues, e.g., it does not indicate all the risks associated with the collection and use of rainwater. For promoting rainwater (and grey water) use, EU policy instruments related to eco-design of buildings are probably more suitable than water policy instruments.
- Lack of a unified regulatory framework: There is no specific EU Directive for the reuse of urban runoff water. Policies vary significantly between Member States.
- Lack of clarity in the UWWTD regarding reuse of treated wastewater: The Directive indicates the wastewater that has to be collected and the minimum treatment level. It stipulates water reuse when stating "Treated wastewater shall be reused whenever appropriate" (Article 12 UWWTD), but it remains unclear how ”appropriate” is defined in this context. A precise definition could set clear obligations at least for operators of wastewater treatment plants, facilitating the implementation of the necessary measures for water reuse. If “appropriate” would be clearly defined, the reuse of treated wastewater can become mandatory in the circumstances specified by the definition.
- Lack of regulatory and technical guidance: Stakeholders face uncertainty due to a lack of regulatory and technical guidance (e.g. inability to fully treat wastewater and sludge, unstable water quality, low performance of treatment processes, limited technical resources to implement additional treatment technologies).

- Lack of water balances for water used in groundwater recharge measures, especially needed in cities: City-scale groundwater monitoring and subsurface studies constitute an important component of sustainable urban development, allowing systematic assessment of structures and avoiding potentially costly hazards. Urban planning should include water balance studies founded on accurate hydrological and hydrogeological analysis, and include an urban groundwater balance with both natural and man-induced water sources, as well as the entire set of infrastructure elements.
- Lack of quality limits for water used in groundwater recharge measures: The WFD does not fix quality limits for recharged water but specifies that the activity cannot compromise the achievement of the water bodies environmental objectives.
- Lack of knowledge and regulation of Emerging Contaminants: The risks to health and the environment from pollutants such as bacteria, viruses and emerging pollutants and priority substances hinders water reuse schemes (especially groundwater recharge), as there are many poorly researched and unregulated contaminants (such as the effects of boron on crops).
- Monitoring and Reporting Requirements: While the legislation emphasizes water quality monitoring, specific requirements for qualitative and quantitative monitoring alternative water sources (e.g., rainwater tanks, decentralized treatment systems) are lacking.
- Lack of uniform standards for the quality of reused runoff water: Absence of clear criteria for different uses (irrigation, aquifer recharge, industrial uses, etc.).
- Inflexible policy framework: Inflexible and overly demanding regulations hinder compliance and implementation.
- Lack of circular economy framework: Water reuse is not yet mainstreamed in the core water policies and programs.
- Communication challenges and limited public enthusiasm for water reuse: Limited information exchange between politicians and the public impedes informed decision-making and reduces public awareness of water reuse initiatives.
- Lack of harmonized standards: The absence of clear or harmonized standards (e.g. conflicting recommendations and terminology), such as plumbing codes for greywater applications, creates inefficiencies.

One step towards increasing the use of AWR lies in strategic planning, where integrated and trans-sectorial management approaches can trigger changes in the different layers of society. This is exactly where AWARD comes in, embracing and scaling the potential delivered by AWR through the 4 dimensions of sustainable development (technology, economic, social and environmental) to face climate change impacts and propose mitigation measures by taking into account AWR. Therefore, AWARD will provide evidence-based solutions to consider AWR into water supply strategic plans within socio-political engagement.

As such, AWARD contributes to existing and upcoming EU initiatives and strategies to increase water resilience and reduce water-related environmental pressures, such as:

- the Water Resilience Strategy;
- the EU Climate Adaptation Strategy;
- the Circular Economy Action Plan; and
- the Zero Pollution Action Plan.

In AWARD, the focus will be on analysing a selection of AWR, depending on the Demo Cases. The AWR considered are:

- aquifer/groundwater recharge;
- stormwater (harvesting);

- rainwater harvesting[1]; and
- water reuse/reclaimed water.

Desalination, though an important AWR, is not under analysis in the AWARD project, as well as the direct use of greywater[2].

In this report, the attention is on the frameworks in which AWR are operated in Europe, focussing on the legal and regulatory frameworks as well as the financing of AWR. AWR are influenced by regulation/legislation on the European level, but also by national or even sub-national/municipal laws, regulations and standards. Hence, the focus is two-fold: the European framework is analysed in Part A of the report. In Part B, the national/subnational frameworks in the Demo Cases as well as (with a "lighter" approach) in four Lower Danube countries (Moldova, Serbia, Hungary and Bulgaria, which are partners in the Local Water Forums Network) are presented based on local expertise. As such, this report will serve also as a basis for further research and other AWARD products, namely AWR guidelines (subtask 2.2.2) and recommendations and a list of actions (task 2.3) to strengthen AWR use in Europe.

[1] Internationally, "rainwater harvesting" normally refers to precipitation that is collected before it hits the ground and becomes runoff. This is an important distinction to make because "stormwater", which has already become runoff, will generally have different collection systems, contaminants, treatment methods and end uses (IWA 2015).
[2] Greywater can be defined as any water used in homes or office buildings excluding that which contains faecal matter (IWA 2015).

I Approach

The research into the regulatory and legislative frameworks as well as financing conditions presented in this AWARD Deliverable 2.1 is based on a three-way approach.

- A desktop-based analysis formed the basis of the later work, and identified the main regulations of importance, especially on the European level.
- Via a questionnaire, detailed information on the regulatory and legislative frameworks in the Demo Cases and Serbia, Hungary, Moldova and Bulgaria were being solicitated. Interviews have been conducted in September, October and November 2024, which represents the status of the presented results.
- Based on the results so far, targeted interviews were conducted to gain insight into legislative gaps and gaps in financing opportunities.

The questionnaire is attached to this report as Annex I.

Interviews on the Demo Case level have been conducted with:

Italy

- REF Ricerche
- Ministry of Environment and Energy Safety (MASE)
- River Po Basin Authority
- Milan Metropolitan Area
- ATO (Water Authority for urban water cycle, Milano)

Romania

- Romanian Water Association
- INHGA (National Institute for Hydrogeology and Water Management)
- Department of Geography, University of Bucharest
- Park Vacaresti Administration, Municipality of Bucharest
- ALPAB (Park and Lake Administration)

Cyprus

- Institute of Environment and Sustainable Development

Spain

- Water Resources Management Planning, Aguas de Galicia
- Sanitation and Wastewater Treatment, Aguas de Galicia

Interviews at the **European level** have been conducted with:

- European Commission, DG Research
- European Commission, DG Environment, Unit C2
- European Commission, DG Environment, Unit C1

II PART A: regulatory framework for AWR on the European level

The European Commission has been increasingly addressing water-related issues, both quality and quantity. Alternative Water Resources are in this context regarded as an important element for alleviating pressure and surface and groundwater bodies. Besides the use of rain- or stormwater, the AWR mostly discussed – and with the highest potential from a quantity perspective - is treated wastewater. However, currently only 2.5% of treated wastewater is reused in Europe (EC 2016). Treated wastewater may be used for a wide variety of purposes. However, the appropriate use of treated wastewater depends upon its quality and, therefore, the treatment to which it has been subjected. This is significant in assessing and preventing risks and drawbacks of wastewater reuse for health and the environment, in creating a "safe operating space". The opportunities and/or limitations to the extent to which water reuse can be taken forward also depends on the knowledge of the potential benefits and risks to ecosystems, the availability of infrastructure for treatment and distribution of the water as well as costs (of the treated water, but equally important of the cost of "regular" water supply) and energy requirements. Wastewater reuse requires compliance with different related EU regulations and with national laws. Hence, water should be reused in a responsible and sustainable manner because if the liquid residue after water reuse has not been appropriately treated, it may pose a risk to both human health and the environment. Therefore, the EC sets increasingly ambitious targets to promote change to tackle these environmental pressures, and to facilitate efficient wastewater management (CIS 2016; Procházková et al. 2023). Further, the reuse of treated wastewater may encounter resistance from the public, so its use requires adequate public engagement.

Several topics which strongly influence water reuse policy are addressed at the level of the European Union. Water scarcity, for example, is addressed in several documents, directives, and regulations, and water reuse is mentioned as one of the possible solutions. "*A vision would be to provide AWRs, so that economic activities do not need to abstract as much water as today, but leave it for the environment*", as one interviewee put it. As direct discharges of wastewater or insufficient wastewater treatment both significantly impact the environment, the environmental legislation is also important, especially the Water Framework Directive (WFD). Introduced in 2000, the WFD requires European states to achieve a good state in all surface and groundwater bodies by 2027 by prioritizing reductions in wastewater production and discharges of pollutants. In the Common Implementation Strategy (CIS) process accompanying the implementation of the WFD, guidelines were drafted which provide information on integrating water reuse into water planning and management in the context of the WFD (Procházková et al. 2023, CIS 2016). Further back in history, water reuse was also discussed in the Blueprint for Safeguarding European Water, which aims to ensure that a sufficient quantity of good quality water is available throughout the EU to meet the needs of people, the economy, and the environment. The Blueprint identified water reuse as an essential measure that requires the attention of the EU (EC 2012; Procházková et al. 2023).

Some of the most recent efforts include the Circular Economy (CE) plan, which is presented in the 2015 Communication "Closing the loop – An EU action plan for the Circular Economy" and includes a series of actions to increase wastewater reuse (European Commission, 2015). The Circular Economy Action Plan was updated in 2020, stating that the EC will facilitate water reuse and efficiency, including in the industrial processes (European Commission, 2020). An example could be the regulation that sets the minimum water quality and monitoring requirements for the reuse of urban wastewater for irrigation in the agriculture industry (Regulation 2020/741) (Procházková et al. 2023).

II.1 European legislation and regulation

AWR are regulated - to a certain extent - at the European and national/sub-national levels. Regulation can either be applied at a) the "source", i.e., regulating the alternative resource itself and providing quality standards e.g., for reclaimed/cleaned water, or b) at the "final use/final user", i.e., regulating the quality or quantity of the receiving water body (groundwater, surface water, bathing water etc.) or influencing the conditions under which the water is (economically) used.

Figure 1 shows a graphical example of how to determine which Directive or Regulation applies to a water reuse system, assuming potential pathways of the reclaimed water to the environmental matrices (freshwater resources) due to accidental leakages or via run-off from the irrigated field. The figure does not show infiltration and water balances in urban areas through e.g., leaking water mains or sewage systems (Foster and Gogu 2022).

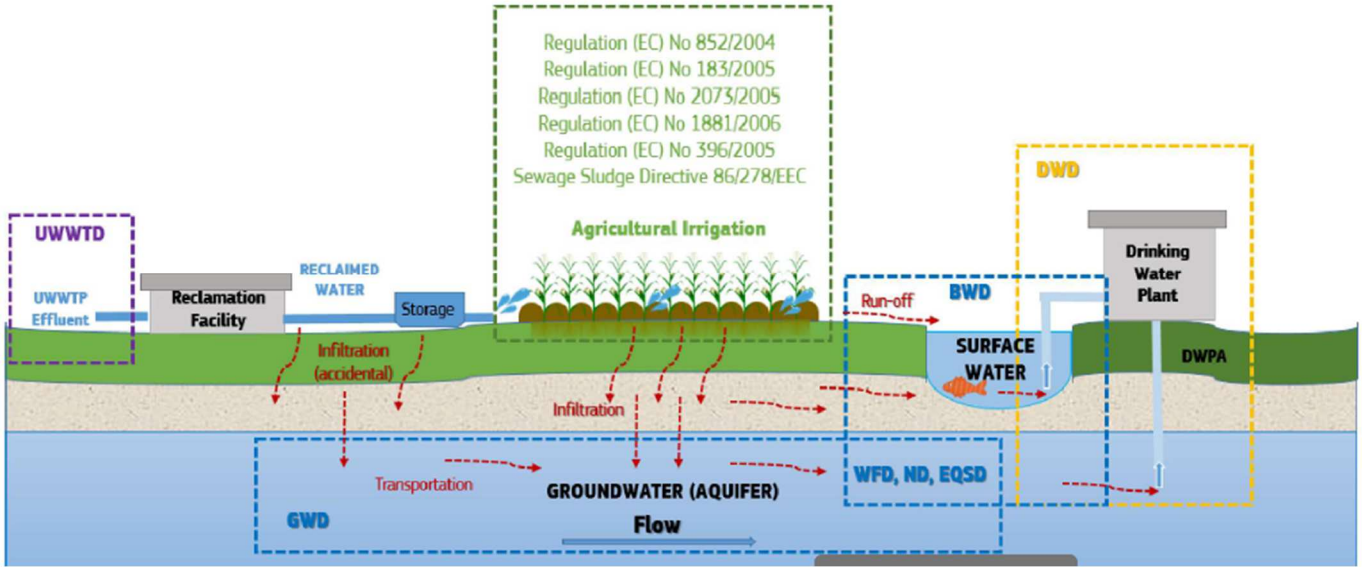

Figure 1: Application of EU Directives and Regulations to water reuse systems

Source: EC 2022c

II.2 Regulation at the European Level – at the "source"

Water Reuse Regulation (Regulation 2020/741)

Water over-abstraction, for irrigation purposes but also for industrial use and urban development, is one of the main threats to the EU water environment, while availability of water of appropriate quality is a critical condition to growth in water-dependent economic sectors and society in general (EC 2018). Consequently, the reuse of treated wastewater for agricultural irrigation is commonly and successfully practiced in several EU Member States. However, current water reuse practices diverge widely across Member States. In some, water reuse is considered an integral and effective component of long-term water resources management due to severe water scarcity (e.g., Cyprus, Greece, Italy, Malta, Portugal and Spain), while in other Member States water reuse is not practised or water reuse projects are rather limited (see figure 1). Some Member States initially "opted out" of implementing the Regulation, but show increased interest presently, due to changing and erratic rainfall pattern also in Member States with sufficient rainfall. All in all, however, water reuse is so far deployed below its potential in the EU (EC 2017; Maffettone/Gawlik 2022).

The Water Reuse Regulation (2022/741) aims to facilitate the uptake of water reuse whenever it is appropriate and cost-efficient, thereby creating an enabling framework for those Member States who wish or need to practise water reuse. Also, it sets uniform minimum water quality requirements for the safe reuse of treated urban wastewater in agricultural irrigation. Harmonised minimum requirements ensure the safety of agricultural produce across the European single market and strengthen stakeholder confidence in using treated wastewater (Sanz/Gawlik 2017; EC Website 2024[3]).

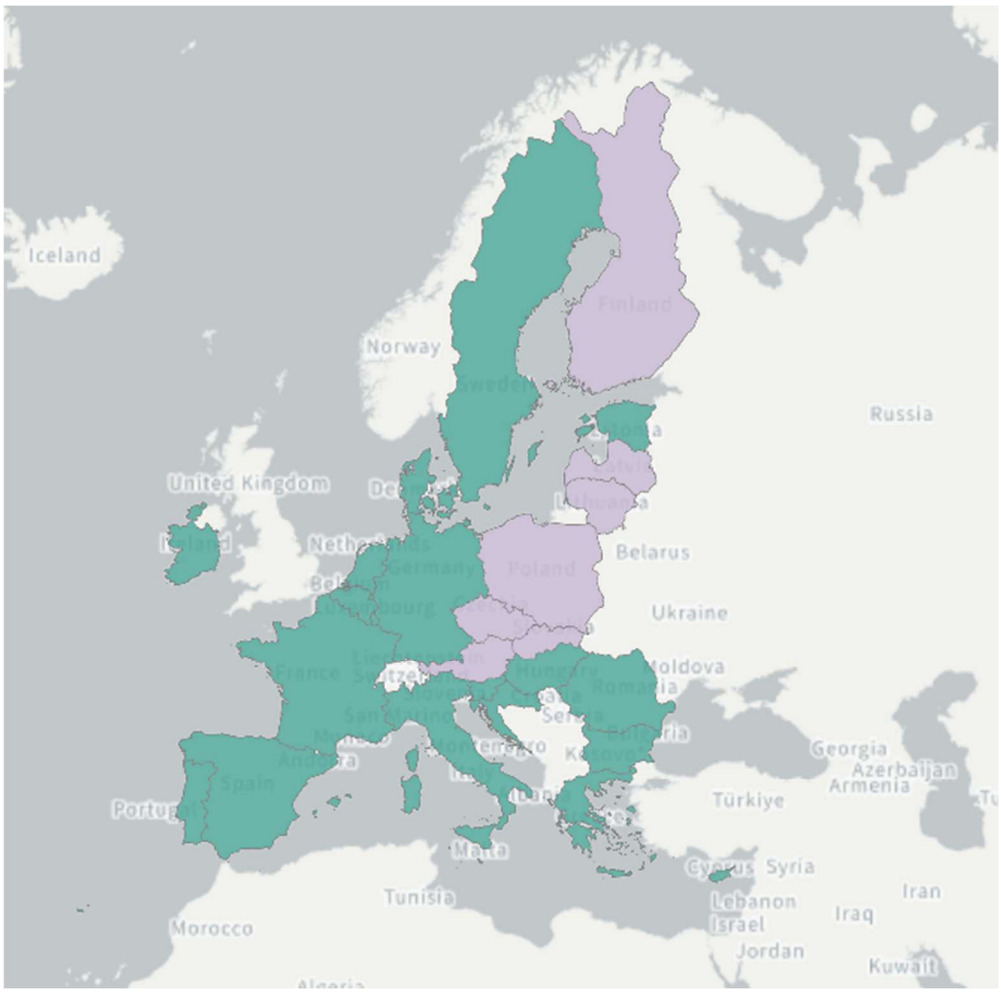

Figure 2 : Member States where water reuse for agricultural irrigation is allowed (April 2024)

Green: Member States where water reuse for agricultural irrigation is allowed.
Violet: Water reuse is allowed or no information has been provided
Source: WISE[4]

When water reuse is applied to agricultural irrigation, the safety of the irrigated crops must be guaranteed. The objective of the EU's food safety policy is to protect consumer health and interests. In order to achieve this objective, the EU ensures that control standards are established and adhered to with regard to the hygiene of food and food products, animal health and welfare, plant health, and prevention of the risk of contamination from external substances. Therefore, the water quality standards for agricultural irrigation using reclaimed water must be consistent with EU food safety regulations (Sanz/Gawlik 2014).

[3] European Commission on Water Reuse : https://environment.ec.europa.eu/topics/water/water-reuse_en
[4] https://water.europa.eu/freshwater/europe-freshwater/water-reuse/map-member-states-where-water-reuse-for-agricultural-irrigation-is-allowed-june-2023

In addition to minimum requirements for water quality, the Regulation also defines uniform minimum monitoring requirements, risk management rules to assess and address potential additional health risks and environmental risks, permitting obligations, and rules on transparency, under which key information on all water reuse projects must be made publicly available (EC Website 2024).

Article 5 and Annex II of the Regulation introduced the obligation for a Risk Management Plan (RMP) to be developed as a condition to set up a water reuse system. The RMP should comprise the identification and management of risks associated with the use of reclaimed water of a specific quality required for particular uses. It must be based on the elements of risk management listed in Annex II of the Regulation, following a systematic approach that includes a structured analysis of the water reuse system, the identification of potential hazards and hazardous events along with the populations and environments at risk and the related exposure routes, and the management of the assessed risks with the use of existing and/or possible preventive measures and barriers, when appropriate, to mitigate them (EC 2024). It also includes communication and cooperation among the parties involved to ensure that corrective actions are taken and communicated opportunely (Maffettone/Gawlik 2022). Full compliance of the reclaimed water with any legislation applicable in the water reuse system area (e.g., Nitrate Vulnerable Zones according to the Nitrates Directive) and the requirements for the hygiene of feed and foodstuff legislations for agricultural irrigation, ensures the protection of the environment as well as of human and animal health. The RMP has to ensure, therefore, that the use of reclaimed water does not lead to a harmful concentration of contaminants in a specific environmental matrix (e.g., groundwater) and that appropriate preventive measures are taken to prevent this (e.g., by appropriate treatments to reduce pollutants within relevant concentration limits, by minimising any accidental release to the surroundings). Therefore, regulatory requirements for a water reuse system need to be identified and documented too. These include, any EU, national and local legislation applied to the specific context, but also other requirements that may oversee the design, installation, maintenance, use and management of reclaimed water, such as permits, operating licences, industry standards and code of practise. There may also be legal and other requirements concerning the individual responsibilities of the actors involved in the system (Maffettone/Gawlik 2022).

Also, any permit issued according to the Regulation (as set out in Article 6(3)), must be based on the water reuse RMP. As set out in Article 6(6), permits must be regularly reviewed and updated whenever necessary (EC 2022c).

The permit must specify, inter alia:

- The reclaimed water quality class(es) and the agricultural use for which the reclaimed water is permitted.
- Conditions on the minimum requirements for water quality and monitoring set out in Section 2 of Annex I, which could include specifications about the type of treatment.
- Any other conditions necessary to eliminate any unacceptable risks to the environment or to human and animal health. These could include information on the exact role, tasks, activities and responsibilities of the other responsible parties in the system; or obligations related to environmental monitoring systems, depending on the outcomes of the risk management plan, and follow-up procedures if negative environmental consequences arise.
- The point of compliance where checks will be carried out to verify that the operator has met its obligations as regards the quality of the reclaimed water (EC 2022c).

The Regulation in Article 9 furthermore requires Member States who practice water reuse for agricultural irrigation to organise general awareness-raising campaigns, which could include promoting the benefits of safe water reuse (EC 2022c).

Member States and the Commission are supported in implementing the Water Reuse Regulation - applying the new rules and structures of the reuse regulation, especially the risk management plans - and supporting water reuse in agriculture and beyond by the CIS Working Group "Water Reuse". Beyond fostering water reuse in general, the Working Group concentrates on four different "strands", depending on the source of wastewater (or raw water for recycling) and on the final use of the reclaimed water:

- Strand 1: municipal wastewater treated in accordance with UWWTD – reclaimed water for agricultural irrigation – implementation of WRR. One issue in this strand is the establishment of "valuation monitoring" of treatment plants, especially for Class A water.
- Strand 2: municipal wastewater treated in accordance with UWWTD – reclaimed water for other applications.
- Strand 3: other wastewater (non UWWTP) – reclaimed water used within a closed system (closed loop or business-to-business).
- Strand 4: other wastewater (non UWWTP) – reclaimed water used outside a system/released in the environment.

Reuse of treated industrial wastewaters is not covered by this Regulation (and is not yet specifically covered by any regulation at the European level, except indirectly by the Industrial Emissions Directive). However, as part of the planned evaluation of the Regulation in 2028, the Commission will assess the feasibility of extending the scope of the Regulation to reclaimed water intended for further specific uses, including reuse for industrial purposes.

Urban Wastewater Treatment Directive (Directive 91/271)

This Directive sets out obligations concerning the collection of wastewaters from urban and certain industrial sources and obligations concerning its treatment. It is, therefore, highly relevant to the reuse of treated wastewater. The Directive aims to protect human health and the environment from the effects of untreated urban wastewater. It requires EU countries to ensure that towns, cities and settlements properly collect and treat wastewater. It aims to protect the environment from the adverse effects of urban wastewater discharges and discharges from certain industrial sectors and ensure that domestic and industrial wastewater is effectively collected, treated and discharged (CIS 2016; EC Website 2024[5]).

The UWWTD requires:

- the collection and treatment of wastewater in all urban areas of more than 2000 people;
- secondary treatment of all discharges from urban areas of more than 2000 people, and more advanced treatment for urban areas of more than 10000 people in catchments with sensitive waters;
- pre-authorisation of all urban wastewater discharges, discharges from the food-processing industry and industrial discharges into urban wastewater collection systems;
- monitoring of the performance of treatment plants and receiving waters; and
- controls of sewage sludge disposal and reuse, and treated wastewater reuse whenever it is appropriate.

With regard to water reuse, Article 12 of the UWWTD requires (imperative requirement) that "treated wastewater shall be reused whenever appropriate" and "disposal routes shall minimize the adverse effects on the environment", with the objective of the protection of the environment from the adverse effects of wastewater discharge (Sanz/Gawlik 2014). Water from wastewater treatment plants destined for reuse is considered a discharge under the UWWTD at the point where it leaves the water treatment plant (after

[5] European Commission on urban wastewater : https://environment.ec.europa.eu/topics/water/urban-wastewater_en

treatment). The UWWTD establishes several requirements relating to discharge. Of relevance to these guidelines are those relating to secondary treatment, more stringent treatment (nutrient removal) and an obligation with respect to meeting requirements of other directives (CIS 2016).

On 26 October 2022, the Commission revised the Directive in line with the results of an evaluation and on the basis of an extensive impact assessment, adapting it to the newest standards. The recast Directive already passed the European Council and European Parliament[6], to enter into force in 2025 (see figure below). A significant number of Delegated Acts will specify elements of the recast Directive in the coming years.

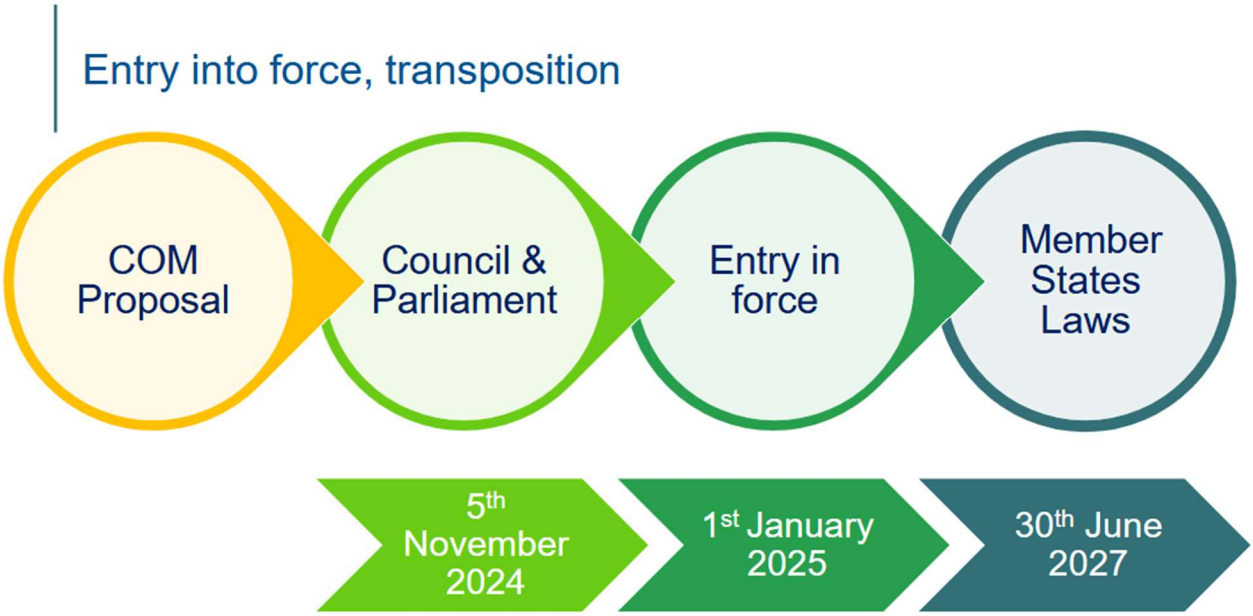

Figure 3: Timetable for revision of UWWTD (Source: EC 2024a)

The revision aims to:

- reduce pollution, energy use and greenhouse gas emissions,
- improve water quality by addressing remaining urban wastewater pollution,
- improve access to sanitation especially for the most vulnerable and marginalised,
- make industry pay to treat micropollutants,
- require EU countries to monitor pathogens in wastewater, and
- lead to a more circular sector.

With regard to AWR, the revision will introduce a new Article 5 which requires the MS to reduce pollution due to rain waters (urban runoff and storm water overflow) by establishing and implementing "Integrated urban wastewater management plans" in all large agglomerations and in those above 10,000 p.e. where there is a risk for the environment or human health[7] (EC 2022a). The revision with regard to regulating rainwater/stormwater use or reuse, the new Directive goes as far as it could. In fact, the recast Directive will "force" MS to consider the topic of water reuse, and green/blue options, before they put new pipes in the ground.

[6] The final version of the recast Directive (dated 27th November 2024) can be found here: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=OJ%3AL_202403019

[7] Until 31st December 2030 or 2035, depending on the case; until 2025, MS have to draw up a list of agglomerations where these conditions apply. This also applies to cases where storm water overflow or urban runoff prevents the fulfilment of the Drinking Water Directive (Directive 2020/2184), the Bathing Waters Directive (Directive 2006/7/EC), the EQS Directive(Directive 2008/105/EC) and the Water Framework Directive (Directive 2000/60/EC).

The indicative content of the plans, as well as their indicative objectives to be adjusted to local circumstances, is based on the best practices in place and is detailed in Annex V, where priority is given to preventive measures including green infrastructures and to optimisation of the existing collecting, storage and treatment systems by better using digitalisation based on clearly defined standards and specifications (EC 2022; EC 2022a). As of June 2024, the plans must incorporate the following elements:

- an analysis of the initial situation of the drainage area of the urban wastewater treatment plant of the concerned agglomeration;
- objectives for the reduction of pollution from storm water overflows and urban runoff;
- the measures to be taken to achieve the objectives accompanied with a clear identification of the actors involved and their responsibilities in the implantation of the integrated plan;

When assessing and deciding which measures to be taken, Member States will have to ensure that their competent authorities consider at least the following:

- preventive measures aiming at avoiding the entry of unpolluted rain waters into collecting systems, including measures promoting natural water retention or rainwater harvesting, and measures increasing green spaces or limiting impermeable surfaces in the agglomerations;
- measures to better manage and optimize the use of existing infrastructure including collecting systems, storage volumes, urban wastewater treatment plants with the aim to ensure that polluted rain waters are collected and treated, and releases of untreated urban wastewater into receiving waters are minimised;
- additional mitigation measures (where necessary to achieve the objectives) including the adaptation of the infrastructure for the collection, storage and treatment of urban wastewater or the creation of new infrastructures with a priority to green infrastructure such as vegetated ditches, treatment wetlands and storage ponds designed in order to support biodiversity.

Furthermore, Member States shall - where relevant – consider water reuse in the context of the development of the integrated urban wastewater management plans (whilst taking into account the need to ensure that the objectives of good ecological and chemical status of the receiving bodies, as defined in Directive 2000/60/EC, are met) (EC 2022a).

II.3 Regulation at the European Level – at the “final use/final user”

Water Framework Directive and “daughter” Directives

The overarching Water Framework Directive (WFD; Directive 2000/60/EC) is one of the key instruments of the EU water policy. The main objective of the Directive and its “daughter directives” (mainly the Environmental Quality Standards Directive 2008/105/EC and the Groundwater Directive 2006/118/EC) is to achieve the good status of water bodies (including marine waters up to one nautical mile from shore), protecting them and fighting against their deterioration (Fatone et al. 2020). Its key objectives are:

- to expand water protection to all waters, and avoid further deterioration;
- to achieve "good status" or “good potential” for all waters by 2015 (latest 2027) by drafting River Basin Management Plans (RBMPs) and Programmes of Measures (PoMs);
- to base water management on river basins and promote a sustainable use of water;
- to combine emission limit values with environmental quality standards;
- to ensure that water prices provide adequate incentives to use water resources efficiently;
- to involve citizens more closely; and
- to streamline legislation (Sanz/Gawlik 2014).

The use of treated wastewater could be regarded as a means of increasing water availability, and can contribute to the good quality and quantity status of water resources. It is therefore considered in some Member States as an option in the PoMs to be established when implementing the WFD (Fatone et al. 2020). Some of the mandatory steps of the WFD are very favourable for strategic water reuse planning, such as the following:

- Article 5 requires an analysis of the characteristics of the river basin district, a review of the environmental impact of human activities, and an economic analysis of water use. This Article 5 analysis forms a well-grounded basis for identifying where treated wastewater reuse can be a useful option to be considered in the PoMs to achieve environmental objectives, without compromising further economic development.
- Article 9 refers to the recovery of costs for water services, including environmental and resource costs, while providing adequate incentives for users to use water resources efficiently, which is essential for long-term reuse of treated wastewater.
- Article 11 refers to the establishment of a PoM, including measures to promote the efficient and sustainable use of water: establishing the framework for water reuse practices could be established as part of the PoM.
- Article 14 refers to the active involvement of all interested parties, including users. Such a broad stakeholder involvement has also been identified as being necessary for water reuse implementation.
- Annex VI (Part B) refers to measures, such as emission controls, efficiency and reuse measures (e.g., the promotion of water-efficient technologies in industry and water-saving irrigation techniques), recreation and restoration of wetland areas, artificial recharge of aquifers, and other relevant measures (Sanz/Gawlik 2014; CIS 2016).

Above all, Member States must ensure that the direct or indirect reuse of treated wastewater does not lead to changes in the chemistry of surface water bodies which would compromise the achievement of the ecological and chemical status objectives, including non-deterioration of status, specified by the WFD and the Priority Substances Directive 2008/105/EC, including as regards the special protection of water bodies used for the abstraction of drinking water. Likewise, Member States need to ensure that the introduction of schemes for the reuse of treated wastewater does not negatively affect the hydrological characteristics of surface water bodies to the extent that they would compromise the objectives specified by the WFD (CIS 2016).

The Groundwater Directive (GD; Directive 2006/118/EC) defines groundwater quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater. The Directive considers local characteristics for setting quality criteria concerning the chemical status of groundwater, in response to the requirements of the WFD, and supports the WFD in implementing the groundwater quality standards by analysing pollution trend studies, enforcing measures to prevent or limit inputs of pollutants into groundwater and granting compliance with nitrates and pesticides EU standards as well as with threshold values defined by Member States (Fatone et al 2020).

Member States may reuse treated wastewater in aquifer recharge as a supplementary measure to contribute to WFD objectives for groundwater, but under some requirements, e.g., that such a recharge is subject to prior authorisation and that the quality of the reused water does not compromise the quality objectives for groundwaters specified by the WFD and GWD. Therefore, any water reuse schemes that involve aquifer recharge needs to ensure that there is adequate planning and assessment and that the appropriate permitting and control measures are in place (CIS 2016).

Bathing Water Directive (2006/7/EC)

The Bathing Water Directive requires Member States to monitor and assess bathing water. The Directive applies to all surface waters that can be used for bathing, except for swimming pools and spa pools, confined waters subject to treatment or used for therapeutic purposes and confined waters artificially separated from surface water and groundwater.

The Directive specifies if bathing water quality can be classified as 'excellent', 'good', 'sufficient' or 'poor', depending on the levels of faecal bacteria detected. Where water is classified as 'poor', EU countries should take certain measures, such as banning bathing or advising against it, providing information to the public, and taking suitable corrective actions. These rules have led to a drastic reduction of untreated or partially treated municipal and industrial wastewater ending up in bathing water. The implementation of the Bathing Water Directive is supported by a broad EU framework of water legislation, including the Water Framework Directive, the Environmental Quality Standards Directive, the Groundwater Directive, the Marine Strategy Framework Directive and the Urban Waste Water Treatment Directive.

The Commission is currently reviewing the Bathing Water Directive. The aim is to examine whether the current rules are still fit for purpose to protect public health and improve water quality or if there is a need to improve the existing framework, notably by addressing new parameters.

Drinking Water Directive (2020/2184/EU)

The recast Drinking Water Directive (DWD) is the EU's main law on drinking water. It concerns the access to and the quality of water intended for human consumption to protect human health. The Drinking Water Directive protects human health with updated water quality standards, tackling pollutants of concern, such as endocrine disruptors and microplastics, and leading to even cleaner water from the tap for all. It addresses the indirect reuse of drinking water, for example through the recharging of aquifers used for the abstraction of water intended for human consumption and the augmentation of surface waters for human consumption, with respect to chemical and biological contaminants (Sanz/Gawlik 2014).

The Directive applies to

- all water, either in its original state or after treatment, intended for drinking, cooking, food preparation or other domestic purposes in both public and private premises, regardless of its origin and whether it is supplied from a distribution network, supplied from a tanker or put into bottles or containers, including spring waters; and
- all water used in any food business for manufacturing, processing, preserving or marketing of products or substances intended for human consumption.

Key features of the revised Directive are:

- reinforced water quality standards, in line or, in some cases, even more stringent than the World Health Organisation (WHO) recommendations;
- tackling emerging pollutants, such as endocrine disruptors and PFAs, as well as microplastics;
- a preventive approach favouring actions to reduce pollution at source by introducing the risk-based approach;
- measures to ensure better access to water, particularly for vulnerable and marginalised groups;
- measures to promote tap water, including in public spaces and restaurants, to reduce (plastic) bottle consumption;
- harmonisation of the quality standards for materials and products in contact with water; and
- measures to reduce water leakages and to increase transparency of the sector.

There are no specific general barriers for water reuse. However, compliance with potable quality to the standards required by the Drinking Water Directive, periodic monitoring of variable alternative water sources (e.g. harvested rainwater) and risk-based approach to water safety need to be adhered to (Fatone et al. 2020).

Other legislation

There is no European legislation/regulations regarding spatial planning/new housing projects to incorporate AWR ("blue cities").

The Nitrates Directive (91/676/EEC) aims to protect water quality across Europe by preventing nitrates from agricultural sources that pollute ground and surface waters and by promoting the use of good farming practices. The Directive aims to reduce water pollution caused by nitrates used in agriculture by monitoring nitrate concentrations of water bodies, designating Nitrate Vulnerable Zones (NVZs) and establishing codes of good agricultural practices and measures to prevent and reduce water pollution from nitrates. The Nitrates Directive requires EU Member States to monitor the quality of waters and to identify areas that drain into polluted waters or at risk of pollution. These concern waters that due to agricultural activities are eutrophic or could contain a concentration of more than 50 mg/l of nitrates. Those areas are defined as NVZs. The provisions of the Nitrates Directive only apply to water reuse in agriculture and its nitrogen content, and only if NVZs are concerned. It does not apply for other purposes of reused water.

The Thematic Strategy for Soil Protection (COM(2006) 231) and the future Soil Protection Directive address the use of reclaimed water for irrigation and soil-aquifer recharge with a view to protecting soils from deterioration.

Directive 2009/128/EC aims to achieve a sustainable use of pesticides in the EU by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of Integrated Pest Management (IPM) and of alternative approaches or techniques, such as non-chemical alternatives to pesticides. EU countries have drawn up National Action Plans to implement the range of actions set out in the Directive. The main actions relate to training of users, advisors and distributors of pesticides, inspection of pesticide application equipment, the prohibition of aerial spraying, limitation of pesticide use in sensitive areas, and information and awareness raising about pesticide risks.

The Sewage Sludge Directive (86/278/EEC) deals with the use of treated wastewater for agriculture regarding the major concerns of contamination of soil, groundwater and agricultural produce with chemical and/or biological hazardous substances, and the health risk for workers and consumers. For this purpose, it prohibits the direct use of untreated sludge, namely the sludge which has not "…undergone biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use" unless it is injected or incorporated into the soil. Further the Directive specifies that sludge must not be applied to soil in which fruit and vegetable crops are growing or grown, or less than ten months before fruit and vegetable crops are to be harvested (Fatone et al. 2020). It would be relevant for water reuse if both reclaimed water as well sewage sludge is being used in the same area.

The Industrial Emissions Directive (2010/75/EU) aims to achieve a high level of protection of human health and the environment taken as a whole by reducing harmful industrial emissions across the EU. Around 52,000 installations are required to operate in accordance with a permit (granted by the authorities in the Member States). This permit should contain conditions set in accordance with the principles and provisions of the Directive. An integrated approach means that permits must take the whole environmental performance of the plant into account. This covers emissions to air, water and land, generation of waste, use of raw materials, energy efficiency, noise, prevention of accidents, and restoration of the site upon closure.

The Environmental Impact Assessment Directive (2014/52/EU amending Directive 2011/92/EU) requires that major building or development projects in the EU must first be assessed for their impact on the environment. This is done before the project can start. An EIA is required for the various projects such as nuclear power stations, long-distance railways, motorways, express roads, waste disposal installations for hazardous waste and dams of a certain capacity. For other projects, including urban or industrial development projects which

could include AWR installations, canalisation and flood relief works, it is up to individual EU Member States to decide if there will be an EIA on a case-by-case basis or by setting specific criteria (such as the location, size or type of project).

The Seveso-III Directive (2012/18/EU) on the control of major-accident hazards involving dangerous substances provides for the relevant framework on risk management measures to prevent major accidents and to limit their consequences. Sectors like the chemical and petrochemical industry, and the fuel wholesale and storage sectors are covered by its scope. Different safety regimes apply, depending on the amount of dangerous substances present, with stricter legal requirements applying to installations handling high amounts.

Other relevant EU law includes that on food hygiene, such as Regulation (EC) No 852/2004 which, inter alia, states that "Food hazards present at the level of primary production should be identified and adequately controlled to ensure the achievement of the objectives of this Regulation". This emphasises the importance of ensuring that food hygiene is considered from the start of the production process, including as regards the quality of water used in that process (CIS 2016). Other requirements are to be found in regulations on the hygiene of foodstuff (Regulation (EC) No 852/2004), on feed hygiene (Regulation (EC) No 183/2005), on microbiological criteria (Regulation (EC) No 2073/200), on maximum contaminants in foodstuff (Regulation (EC) No 1881/2006), on levels of pesticides in food and feed (Regulation (EC) No 396/2005), and on the protection of animal health (Regulations (EC) No 1069/2009 and (EU) No 142/2011) (EC 2022c).

The Freshwaters Fish Directive (2006/44/EC) and the Shellfish Waters Directive (2006/113/EC) relate to water reuse in aquaculture and environmental enhancement, such as stream augmentation.

The Habitats Directive (92/43/EEC) and the Birds Directive (2009/147/EC) address the application of water reuse for environmental enhancement, such as wetlands improvement.

Directive 98/15/EC which amends the UWWTD and clarifies the requirements regarding discharges from urban wastewater treatment plants to sensitive areas subject to eutrophication.

Directive 2009/90/EC pursuant to Directive 2000/60/EC lays down technical specifications for chemical analysis and monitoring of water status to ensure quality and comparability of analytical results generated by laboratories across the EU.

The Floods Directive (2007/60/EC) on the assessment and management of flood risks promotes nature-based solutions to flood risk (e.g., natural retention areas) as viable measures.

II.4 Funding opportunities

Alternative Water Resources are often more costly than "conventional" means of producing water. Hence, water reuse schemes are relatively underdeveloped in the EU owing to a lack of economic attractiveness and perceived low returns on investment, and low investments in AWR also reflect costs comparisons with other water sources (including costs of abstraction from natural water bodies[8]) (CIS 2016). Consequently, the financing framework and external funding are important elements that determine the market share of AWR. Financing water supply is usually analysed in the 3T concept, developed by the OECD Horizontal water programme in order to describe and categorise the three ultimate financial sources of investment for the water sector: Taxes, Tariffs and Transfers (EUREAU 2012).

[8] Although it has to be noted that the cost of conventional water resources is often subsidised or kept low (e.g. for irrigation) (CIS 2016).

- Tariffs: user fees or contributions. Service providers can levy such fees for providing access to a service (e.g., connection charges) and for delivering the service (either a flat charge, a volumetric one, or a combination of both). Additional fees can be derived from meter rentals, penalties etc.
- Taxes: funds raised by national/regional/local governments through the tax base, which are subsequently diverted to the water sector. These are known as subsidies, i.e., a fiscal transfer to an organisation to allow its costs recovery.
- Transfers: payments from foreign sources, such as EU funds, international financing institutions, or private philanthropic funds (Fatone et al. 2020).

Tariffs and taxes are not part of the AWARD analysis of funding opportunities for AWR. Instead, the focus lies on "transfers", mostly in the form of financial support for economic and social development activities, or as grants and loans (with very low rates from public banks). Nevertheless, the importance of tariffs and taxes for financing any water supply activity, including developing AWR, needs to be highlighted, as Water Authorities collect fees for pollution or water abstraction (the higher the costs, the higher the incentive to invest in alternatives), or provide subsidies for water pollution reduction (e.g. wastewater treatment) or water efficiency measures (e.g., AWR). At the same time, adequate pricing of "conventional" fresh water that takes into account, for example, the ecological cost of over-abstraction is an important factor in establishing price equality between fresh water and AWR (CIS 2016; Fatone et al. 2020).

There are many different EU level funding sources which may be used fund AWR schemes. These include: the ERDF and Cohesion Fund, EAFRD, Horizon Europe, LIFE, and EIB Grants. Beside the EU, there are programmes run by the World Bank (WB) and the governments of Iceland, Liechtenstein and Norway (EEA and Norway Grants). Some of the programmes/funds provide grants, some loans. Some are 100% funded, some require co-funding. Some apply to eligible areas/situations, others are universal. Some apply to particular types of recipients. All have different planning and application processes which need to be taken account of in developing and implementing AWR schemes (CIS 2016). A summary of each of the most important funding sources is provided below, followed by an overview table[9].

II.4.1 Cohesion Policy funds

The European Regional Development Fund (ERDF) and the Cohesion Fund (CF) are part of the European Cohesion Policy, which invests between 2021 and 2027 392 billion Euro into rural development and EU economic, social and territorial cohesion by correcting imbalances between regions.

ERDF funds are being allocated according to "policy objectives" (PO), of which PO2 reads as "greener, low-carbon transitioning towards a net zero carbon economy and resilient Europe".

The Cohesion Fund provides support to Member States with a gross national income (GNI) per capita below 90% EU-27 average to strengthen the economic, social and territorial cohesion of the EU. The fund mainly contributes to investments in the field of environment and trans-European networks in the area of transport infrastructure made by public and regional authorities. For the 2021-2027 period, the Cohesion Fund concerns Bulgaria, Czechia, Estonia, Greece, Croatia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Portugal, Romania, Slovakia and Slovenia.

Both the ERDF as well as the CF finance so-called "programmes" in shared responsibility between the European Commission and national and regional authorities in Member States. The Member States' administrations choose which projects to finance and take responsibility for day-to-day management. Such programmes are drawn up for each individual country. In line with the priorities set by Member States and

[9] Main source is the EC´s website dedicated to funding: https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes_en

the Commission in the various programmes, the ERDF and CF can be used for funding AWR schemes, based on their contribution to water efficiency and climate objectives.

II.4.2 European agricultural fund for rural development

The European agricultural fund for rural development (EAFRD) is the "second pillar" of the EU´s Common Agricultural Policy (CAP), with a total allocation of €95.5 billion (2021-2017). This includes €8.1 billion from the next generation EU recovery instrument to help address the challenges posed by the COVID-19 pandemic. The EAFRD) finances the EU's contribution to rural development programmes (RDPs), which consist of measures and projects that contribute to the EU-wide objectives of improving the competitiveness of agriculture, encouraging sustainable management of natural resources and climate action, and achieving a balanced territorial development of rural economies and communities. Programmes are prepared on a national or regional basis, and must work towards specific targets relating to the EU's rural development objectives, which contribute to the Europe 2020 strategy for smart, sustainable and inclusive growth. The most relevant priorities for funding AWR schemes are:

- Enhancing farm viability and competitiveness of all types of agriculture in all regions and promoting innovative farm technologies and the sustainable management of forests.
- Restoring, preserving and enhancing ecosystems related to agriculture and forestry, e.g., restoring, preserving and enhancing biodiversity, including in Natura 2000 areas, and in areas facing natural or other specific constraints, and high nature value farming, as well as the state of European landscapes and improving water management, including fertiliser and pesticide management.
- Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors, including increasing efficiency in water use by agriculture and facilitating the supply and use of renewable sources of energy, of by-products, wastes and residues and of other non-food raw material, for the purposes of the bio-economy.

Under the CAP Strategic Plans, these objectives are realised through interventions which are co-financed by the EAFRD and the national budgets of EU countries. The EAFRD can also provide investment support for rural enterprises and projects through financial instruments, such as loans, guarantees, or equity.

Water reuse schemes for irrigation increase water efficiency use by agriculture, and are an investment in a physical asset, help mitigate drought problems, etc. Therefore, appropriate water reuse schemes could be eligible for support.

II.4.3 Horizon Europe

Horizon Europe is the EU's key funding programme for research and innovation. The programme facilitates collaboration and strengthens the impact of research and innovation in developing, supporting and implementing EU policies while tackling global challenges like climate change. It helps to achieve the UN's Sustainable Development Goals, boosts the EU's competitiveness and growth, and supports the creation and better diffusion of excellent knowledge and technologies.

Specific programmes are grouped into "pillars" and "clusters", and there are five ambitious "missions". Cluster 6 under Pillar 2 (Cluster 6: "Food, Bioeconomy, Natural Resources, Agriculture and Environment") aims at reducing environmental degradation, halting and reversing the decline of biodiversity on land, inland waters and sea and better managing natural resources through transformative changes of the economy and society in both urban and rural areas.

In theory, Horizon Europe can fund research into many aspects of AWR schemes, but does not fund infrastructure investments.

II.4.4 Programme for the Environment and Climate Action

The Programme for the Environment and Climate Action (LIFE) aims to facilitate the shift towards a sustainable, circular, energy-efficient, renewable energy-based, climate-neutral and resilient economy, to protect, restore and improve the quality of the environment, including the air, water and soil, to halt and reverse biodiversity loss and to tackle the degradation of ecosystems. The objectives of the LIFE Programme are implemented via four sub-programmes:

- Nature and Biodiversity
- Circular Economy and Quality of Life
- Climate Change Mitigation and Adaptation
- Clean Energy Transition

Most relevant for AWR is the sub-programme on circular economy, which includes recovery of resources from waste, water, air, noise, soil and chemical management as well as environmental governance. The sub-programme provides mostly action grants for projects implementing innovative and best practice solutions in these areas through the so-called Standard Action Projects (SAP). It also covers the implementation, monitoring and evaluation of EU environmental policy and law through the so-called Strategic Integrated Projects (SIPs).

The sub-programme on nature and biodiversity funds nature conservation projects, in particular in the areas of biodiversity, habitats and species, and could be relevant for funding of projects which combine biodiversity protection and AWR (e.g., restoration of wetlands) and/or Nature-based Solutions.

The "climate change adaptation" subprogram is also of relevance, and here the topics would be No 3 (“Nature-based solutions in the management of land, forests, coasts and marine areas”) or No 4 (“Adapting cities and regions to climate change”). And finally, the "climate change adaptation" subprogram has a new topic in the Mission "Climate neutral and smart cities", which could also be of relevance.

II.4.5 European Investment Bank

The European Investment Bank (EIB) provides loans for investment. In its stated priorities on the environment, types of projects eligible include water supply and wastewater treatment and disposal. Therefore, construction of treatment facilities (including with NBS) for water reuse and distribution systems may be eligible for loans.

II.4.6 World Bank

The World Bank (WB) finances government programmes to support the achievement of “country development objectives”, and supports policy and institutional reforms of national and subnational governments by providing budget financing and global expertise. The WB also finances public projects to build physical and social infrastructure, and develops institutional capacity.

II.4.7 EEA and Norway Grants

The EEA[10] and Norway Grants are funded by Iceland, Liechtenstein and Norway. The Grants have two goals – to contribute to a more equal Europe, both socially and economically – and to strengthen the relations between Iceland, Liechtenstein and Norway, and the 15 Beneficiary States in Europe. The Grants are composed of two funding schemes – the EEA Grants and the Norway Grants. The main difference between

[10] European Economic Association, not to be confused with the European Environment Agency.

the two lies in where the funding comes from and which countries receive the funding. The EEA Grants are allocated to 15 countries in Europe – Bulgaria, Croatia, Czech Republic, Cyprus, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia and Slovenia.

Under the topic "Environment, Energy, Climate Change and Low Carbon Economy", environmental protection and sustainable growth are in the focus of funding, in order to increase the resilience of ecosystems and their services. The Grants support activities such as:

- Environmental strategies, management and protection plans, such as for habitats and species.
- Mapping and assessment of ecosystems and their services.
- Promoting natural heritage as a basis for sustainable tourism and local development.
- Increasing capacity for integrated planning and control.
- Environmental education and awareness-raising.

Funding for AWR would be indirect and not for direct investments. Instead, strategies and planning, as well as capacity building could be eligible for funding.

II.4.8 Swiss National Funds

The second Swiss contribution is a key part of Switzerland's European policy, helping to foster cohesion and stability in Europe as well as to consolidate and develop bilateral relations with partner countries. The CHF 1.302 billion contribution runs until 2029 and will be used to support the countries that joined the EU after 2004 (the EU-13) or countries facing major migration flows. The second Swiss contribution aims to reduce economic and social disparities in Europe and to promote measures to manage migration. The supported countries include Bulgaria, Croatia, Hungary, Poland, and Romania, who have chosen research cooperation with Switzerland as one of their priorities and who are committed to participate in a multilateral call for Joint Research Projects called MAPS – Multilateral Academic Projects.

The following table provides an overview of the above-described funding programmes and organizations.

Table 1: Funding instruments for Alternative Water Resources

Program	Funding Organization	Research	NBS	Infrastructure: Treatment	Infrastructure: Delivery	Irrigation	SUDS	Indirect Funding	Source/detailed information
ERDF	EU	No	Yes	Yes	Yes	No	Yes	Yes	https://ec.europa.eu/regional_policy/funding/erdf_en
CF	EU	No	Yes	Yes	Yes	No	Yes	Yes	https://ec.europa.eu/regional_policy/funding/cohesion-fund_en
EAFRD	EU	No	Yes	No	No	Yes	No	Yes	https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/european-agricultural-fund-rural-development-eafrd_en
Horizon Europe	EU	Yes	No	No	No	No	No	No	https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/horizon-europe_en
LIFE	EU	No	Yes	No	No	No	No	Yes	https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/programme-environment-and-climate-action-life_en
EIB	EU	No	Yes	Yes	Yes	No	No	No	https://www.eib.org/en/projects/topics/energy-natural-resources/index.htm
World Bank	World Bank	No	Yes	Yes	Yes	Yes	No	Yes	https://www.worldbank.org/en/what-we-do/products-and-services/financing-instruments
EEA and Norway Grants	Iceland, Liechtenstein Norway	No	No	No	No	No	No	Yes	https://eeagrants.org/
Swiss National Funds	Switzerland	Yes	No	No	No	No	No	Yes	www.snf.ch

III PART B: regulatory framework for AWR on the national level

This part of the report focusses on the regulatory and policy frameworks for AWR on the national level in the four Demo Case countries Italy, Spain, Romania and Cyprus. Additionally, information has been gathered on four East European countries which are part of the Local Water Forum Network in the Lower Danube basin: Serbia, Bulgaria, Hungary and Moldova.

On the European level, the following key legislation governing the implementation/use of AWR were identified:

- Water Reuse Regulation (Regulation 2020/741/EU)
- Urban Wastewater Treatment Directive (Directive 91/271/EC)
- Water Framework Directive and "daughter" Directives
- Bathing Water Directive (2006/7/EC)
- Drinking Water Directive (2020/2184/EU)

On the national level, the above-mentioned EU Directives are transposed into national laws/regulations. It is assumed that full compliance is achieved at national level in EU countries. Hence (while needing to know how the EU Directives are "legally" implemented on the national level), the focus here is on everything that goes beyond the EU Directives, i.e., everything that applies uniquely to the country analysed. In most cases, the national level is the most relevant policy level, but if relevant, regional or even local (municipality) level regulations are analysed as well.

III.1 Demo Case: Italy

The Italian Demo Case is the city of Milano, situated in the Lombardy region.

National Level Policy

In Italian legislation, a definition of AWR doesn't exist. However, the concept is generally used for treated wastewater. A new Decree (Decreto-Legge 17th October 2024 , n. 153) defines "fine treated water" ("acque affinate") to "legally" distinguish it from wastewater: the idea is to widen the field of application of "acque affinate", to overcome the legal restrictions in the use of treated wastewater. The other major component of AWR is desalinated water, even though the Ministry of the Environment and Energy Safety (MASE) does not expect a significant growth of desalination. Rainwater and greywater are known as AWR, but their use is considered mainly in local urban plans, there are no specific policies at national governmental scale.

The Water Authority for urban water cycle of the city of Milan considers rainwater, treated wastewater and – interestingly – the groundwater surface layer as AWR.

In Italy, the main policy on AWR concerns the reuse of wastewater effluents of urban treatment plants: no national policy on other AWR is currently ongoing. Treated wastewater as AWR is regulated by Ministerial Decree 185/2003, which provides for three types of wastewater reuse:

- Irrigation: for irrigation of crops for both the production of food for human and animal consumption; for non-food purposes, as well as for irrigation of areas intended for greenery or recreational or sports activities.
- Civil: for washing roads in urban centres; for feeding of the heating or cooling systems; for supply of networks (separated from those of drinking water), with the exception the direct use of such water in buildings for civil use, except for unloading systems in sanitary facilities.

- Industrial: as fire, process, washing water and for thermal cycles of industrial processes, with the exclusion of uses that involve a contact between recovered wastewater and food or pharmaceutical products and cosmetics.

The Ministerial Decree 185/2003 also lists quality standards for the three types of wastewater reuse. There is no distinction between the three uses, i.e., the quality standards are the same.

Included are also provisions for obtaining a permit to discharge or reuse wastewater. The permit or authorization is the same whether wastewater is simply discharged or being reused. The authorization is issued by Region, Province or Municipality according to the regional legislation. If a user is reusing a water flow before it is an "official" outflow, no authorization is needed (e.g., an industry that internally recycles water already used or a domestic settlement using rainwater or treated greywater).

Monitoring of outflows are self-monitored by the "owner/manager" of the outflow and subject to the control of Regional Environmental Protection Agencies.

With regard to rainwater and stormwater, the relevant regulations are contained in Legislative Decree 152/2006 (Environmental Code), which, in addition to providing some binding requirements, delegates the regulation of rainwater and runoff to the regions.

Beside MD 185/2003, on the national level the Ministerial Decree 100/2016 provides criteria for the granting of authorization for the artificial recharge or augmentation of groundwater bodies in order to achieve the environmental objectives of the European water legislation (i.e., the WFD). MD 100/2016 envisages a complex approach to authorize artificial groundwater recharge. Every Region should create official lists of a) groundwater bodies allowed to receive recharge, and b) surface water bodies that can be used as "water donors". Such water donors must be in "good chemical status". Even though the law exists since 2016, no Italian Region has yet produced these official lists.

In one interview, it was mentioned that most treated wastewater is presently being discharged into rivers, contributing to water flows that are withdrawn downstream and used for irrigation. Hence, there is already an indirect reuse of wastewater, even if it is not regulated by reuse-specific legislation.

Regional Level Policy

On the regional level, several Italian regions promote the reuse of treated wastewater through technical regulation included in "Water Safeguard Plans", which specify the effluents that must reach certain quality standards (in accordance with the national MD 185/2003) to allow a reuse.

In Lombardy (where the pilot area is included), stormwater management is mandated within the Law of Territorial Government No. 12/2005, which mandates the introduction of regional regulation and which highlights the need to prefer a new approach to water management, particularly rainwater, and also introduces the concept of sustainable urban drainage. Following this law a regulation has been introduced (Regional Regulation 4/2006) regarding cases in which rainwater and runoff must be treated, as it washes over surfaces considered polluted (paved areas of facilities or industrial sites where oil or other contaminants could possibly be found). In 2017 it's also been introduced the RR 7/2017 about hydraulic invariance which is a rather innovative concept in the country. Thanks to this regulation, in expressly identified and delimited cases, this rule of invariance must be applied and the water must then be laminated or infiltrated into the soil.

In the cases where RR 4/2006 is applied, the setting of "discharge priorities" contained in the Regional Regulation 7/2017 on Hydraulic Invariance cannot be applied. These priorities encourage the use of rainwater and stormwater (there is no distinction between the two), as follows:

- Priority 1: The reuse of stored volumes, according to quality constraints and actual possibilities, such as garden watering, grey water, and washing of pavements and cars.
- Priority 2: Infiltration into the soil or surface layers of the subsoil, compatible with the pedological characteristics of the soil and hydrogeological characteristics of the subsoil, with environmental and health regulations, and with the relevant indications contained in the geological, hydrogeological, and seismic component of the Municipal Territorial Governance Plan (PGT).
- Priority 3: Discharge into a natural or artificial surface water body, with flow rate limits specified in Article 8 of the Regulation. Any outflow discharging into a water body has to be authorized and must not deteriorate the status of the water body. The respective permit/authorization may contain specific quality standards.
- Priority 4: Discharge into the sewer system, with flow rate limits specified in Article 8 of the Regulation. Any outflow discharging into a water body has to be authorized and must not deteriorate the status of the water body. The respective permit/authorization may contain specific quality standards.

Local/Municipality Level Policy

At the metropolitan level, the current Metropolitan Territorial Plan of the Metropolitan City of Milan (2021) has taken up the principle of “hydraulic invariance” and in particular the reference to sustainable urban drainage. It supplements the respective building codes and recommends to pursue adaptation to climate change by promoting proper and sustainable stormwater management and to apply the principles of hydraulic invariance and sustainable urban drainage in the following cases:

- building renovation with total demolition;
- new constructions including extensions;
- urban restructuring;
- flooring and finishing works for outdoor spaces exceeding certain square meters;
- appurtenances that involve the construction of a volume of less than 20 percent of the volume of the main building exceeding certain square meters;
- parking lots, rest areas and squares with certain characteristics; and
- green areas superimposed on new slabs.

Several municipalities (a few in Lombardy, most in the rest of Italy) include in their local building codes some suggestions or even prescriptions concerning rainwater harvesting and reuse and/or greywater separation, treatment and reuse. Such tools, however, even when prescriptive are very difficult to enforce and didn’t provide significant changes in the mainstream building industry yet.

The approaches applied most often are the following:

- Incentives and disincentives, that do not enforce, but encourage the use of certain techniques or technologies. Typically, tax deductions or subsidies on infrastructure costs are used to disseminate environmentally friendly technological innovations in construction. However, as water prices are very low in Italy, the financial return period is too long to substantially increase investments in rainwater harvesting and use technologies. An example is the Building Regulation of Bresso (Articles 17.11 and 17.12), situated in the Milan Metropolitan Area.
- Voluntary evaluation of the environmental performance of buildings (energy consumption and other environmental performance indicators), which aims to promote the use of sustainable solutions through a sort of "certification" (voluntary, but recognized by institutions and markets) obtained through the application of assessment protocols that can capture a higher market value for property certificates. This approach has been used first by the City of Bolzano and then by several other cities in the Emilia Romagna region.

AWR and environmental objectives

Many of the environmental directives of the EU include some form of environmental objectives, e.g., the WFD quality and quantity objectives, or the "favourable conservation status" objective of the Habitats Directive. In Italy, some of the River Basin Management Plans (RBMP) and Programs of Measures (PoM) to implement the WFD mention among the possible measures the recourse to AWR (KTM 8) and aquifer recharge (KTM 23).

This is mostly regarded as a reaction to recent scarcity and drought conditions.

AWR are not mentioned in Management Plans drawn according to the Habitats Directive.

Financing AWR in Italy

There is no structured funding system for AWR in Italy. A major problem is the lack of coordination, both horizontally among different sectors (Ministries of Environment, Agriculture, Infrastructures) and vertically (national government, regions, local level). There are national funds by the Ministry of Infrastructures (PNISSI; see below) but there's no coordination with MASE for the criteria to select projects to be financed. Similarly, the Ministries of Agriculture and Regions have their financing programs, but MASE has no decisional role on the allocation of funds. MASE funds are mainly dedicated to flood risk management. By law, 20% of these funds should be dedicated to win-win solutions, aimed at improving, besides flood management, also habitat restoration, water quality, water retention and groundwater recharge, but implementation of such projects is lacking yet.

Some Regions in Italy did finance some investment, however most of the financing to make the wastewater effluent complying with the standards for water reuse is paid by the public utilities providing the service and therefore indirectly by urban users through the water tariff.

In 2023, the the national authority on energy, gas and water tariffs (ARERA) introduced a new tariff in order to strengthen the Integrated Water System and transform it into a resilient and circular system. Therefore, it has formally introduced rainwater management and a significant incentive for reuse into the responsibilities of urban water utilities. For now, the consequences cannot yet be seen as there is a settling-in period, but this could lead to the inclusion of costs for these new services in the investment plans and possibly also in the water tariff.

Also, the Ministry of Infrastructures in 2023 published a "Plan for Infrastructures for Water Safety"[11], which is an additional financial source for infrastructure in the water sector (not specific to certain uses). The plan doesn't explicitly promote AWR, but environmental criteria include "circularity", which could be an argument to prioritize water reuse in the widest sense.

According to the regulations of ARERA, all costs of measures for AWR should/could be covered by urban water tariffs, including the costs to improve wastewater quality to allow reuse for irrigation. There is a debate whereas urban water tariffs should/could cover also the costs of infrastructures to distribute treated water to the final users (the farmers)[12], or whether and how to reform the agricultural water pricing system to cover both the infrastructure costs (operation and maintenance of canals, for example), as well as the resource costs.

[11] https://dgdighe.mit.gov.it/categoria/_investimenti/_Pianificazione/_PNIISSI

[12] Presently, Italian farmers have a very little incentives to pay for reclaimed water, because they pay only very little for "natural" fresh water from other sources (such as groundwater).

The water tariffing system at the national level as regulated by ARERA could include a small amount of money paid per cubic meter by all users to create a common fund to finance innovative demonstrative projects, including AWR projects[13].

There is no specific financing available to support reaching EU environmental objectives through the use of AWR.

Gaps in Policy and Regulation

It Italy, policy gaps are highlighted that relate to a cohesive framework for AWR use on the national level, both in economic as well as technical terms. However, these seem to relate more to storm- and rainwater reuse, which are limited to local plans (mostly in urban contexts)[14]. The policy framework for the reuse of treated wastewater is widely regarded as sufficient (e.g., through RBMPs and Regional Safeguard Plans), lacking implementation in several regions.

The following main issues could be identified:

- Policies to promote rainwater/stormwater reuse are lacking at all levels in Italy. Recently, however, ARERA made a preliminary step by allowing to include urban stormwater management costs in the water tariff. Presently this opens the way for urban water utilities to pay stormwater management measures (including NBS) but in theory also investments for stormwater reuse could be paid through the water tariffs.
- In Italy, a comprehensive economic/financial policy aimed at boosting the use of AWR by increasing the cost of potable water for urban users[15] and of freshwater for other users is missing. Flanking this, urban water management needs to include stormwater management (preferably SUDS and NBS), and the tariffs should incorporate the respective management costs (construction and maintenance).
- Also, a binding rule is needed aimed at creating the physical/technical conditions to allow the use of AWR when economic/financial water policy will make it feasible. These conditions are that different water flows – mainly unpolluted rainwater collected from roofs and other clean paved areas, polluted stormwater collected from the streets and greywater - are kept separate as long as possible, to facilitate an easier treatment and use.

Ministerial Decree 100/2016 on criteria to authorize groundwater recharge doesn't strictly concern rainwater and stormwater, however its misinterpretation may hinder the possibility to boost groundwater recharge and its reuse, as groundwater recharge may occur not using water from an official (surface) water body: in these cases, it cannot be authorized since it doesn't follow strictly what DM 100/2016 envisages.

The use of NBS for treatment of differently polluted water flows (stormwater, wastewater, greywater) is hindered by the lack of knowledge of technical requirements. Capacity building is needed to strengthen such knowledge and support NBS.

At the regional level in Lombardy Region, innovative concepts compared to the national landscape have been included in urban land management, such as "hydraulic invariance". There is a lack of a comprehensive vision of the measures to implement to reduce pressures on water bodies (several ones in Lombardy Region are

[13] The electricity tariffs already finance such a fund. Something similar could possibly be done also at local scale but a national tariffing scheme would be much more effective.

[14] A new Decree expected to be released in the next future will regulate the reuse of any kind of "used" water for irrigation, civil, industrial and environmental purposes, including groundwater recharge. The new concept of "acque affinate" is very important in this contest: those waters could be used for many purposes, including groundwater recharge.

[15] E.g., by a increasing block tariff (under a block tariff scheme, users pay different amounts for different consumption levels).

still far from the “good status” they should achieve according to the WFD) including the recourse to AWR to reduce freshwater abstraction.

Regulation of rainwater/stormwater management should also be harmonized across the Italian Regions. Incentives could be introduced, e.g., allow for a slight increase in construction volume if rainwater or stormwater management systems are being integrated into new housing projects.

III.2 Demo Case: Spain

The Spanish Demo Case is the city of Santiago de Compostela. The focus of this Demo Case is the treatment of the runoff from an industrial park with a NBS (constructed wetland) for reuse inside the industrial park activities

National Level Policy

In Spain, AWR policy focusses mostly on the reuse of wastewater from wastewater treatment plants. Here, Real Decreto 1620/2007, repealed and modified by RD 1085/2024 establishes the legal regime for the reuse of treated water at the national level and governs the promotion, uses and quality standards of reclaimed wastewater. RD 1620/2007 provides quality requirements for regenerated water RD 1085/2024 according to the following uses:

- Urban uses
    - Residential use
    - Private garden irrigation
    - Use in flush toilets
    - Use in services
    - Irrigation of public spaces
    - Street cleaning
    - Fire extinction
    - Industrial vehicles washing
- Agriculture uses
    - Irrigation in case the reclaimed water comes into contact with the eatable part of the product
- Environmental uses
    - Aquifer recharge by percolation
    - Aquifer recharge by direct injection
    - Forest irrigation
    - Other uses such as wetland maintenance etc.

For these uses, the decree establishes “quality classes” which define the threshold values for certain quality parameters.

The MD 1085/2024 also established the frequency for monitoring, also according to the different uses.

Real Decreto 1085/2024 (22nd of October) also amends the RD 1620/2007 by incorporating the provisions, uses and quality standards of the European Regulation 2020/741. The RD also further specifies the urban uses by adding irrigation of private gardens and private vegetable patches as well as public fountains. Regarding the sampling frequency required according to the draft decree, samples will be taken in accordance with the EN ISO 19458 standard or any other national or international standard that guarantees equivalent quality. The quality criteria, the indicators to be measured, as well as the frequencies and control points can be modified depending on the risk with prior authorization from the health authority, and/or the

hydraulic authority, if applicable. However, the RD 1085/2024 does not include stormwater in the definition of Alternative Water Resources (AWR), limiting its utilization.

RD 1085/2024 establishes the system under which to obtain an authorization/permit, which is necessary to use reclaimed/reused water (i.e., without the permit, one is not allowed to use reused/reclaimed water).

As said above, the focus in Spain with regard to AWR is on treated wastewater. Hence, there is no legislation in place that governs the use of rainwater/stormwater.

With the upcoming transposition of the recast European Urban Wastewater Directive, the issue will probably be tackled on the national level. However, the national Real Decreto 665/2023 requests the preparation of a Comprehensive Management Plan for Sanitation Systems (at the national level). This plan encourages and prescribes NBS use, but has no specifics on runoff.

Regional Level Policy

There are no regulations or policies on AWR on the regional level in Spain.

Local/Municipality Level Policy

There are no regulations or policies on AWR on the local level in Spain.

AWR and environmental objectives

There are no plans in Spain to use AWR to reach environmental objectives of EU Directives (e.g., enhance the quantitative status of groundwater bodies through aquifer recharge, or enhance the status of terrestrial aquatic ecosystems by providing reclaimed water to them).

For example, groundwater recharge with reclaimed water is not part of any PoM according to the Water Framework Directive.

Financing AWR in Spain

There is no dedicated funding available for improving the quality of treated wastewater or for complying with standards for treated wastewaters. The financing of such projects usually depends on the regional water body authority or the municipality.

In the interviews, it was proposed to explore funding calls that link and relate AWR not solely with water use and management but also to ecosystem services and climate change adaptation methods. This approach broadens the scope and seeks to align AWR projects with broader funding programs and calls beyond those exclusively related to water treatment.

However, there are sources and programs that finance AWR indirectly:

- Calls for Integrated Territorial Development Strategies (ETI) (https://estrategiasterritorialesintegradas.es/). The beneficiaries are cities.
- The Biodiversity Foundation calls for urban environments (https://fundacion-biodiversidad.es/buscador-de-convocatorias/?_sft_lineas_actuacion_tematicas=entornos-urbanos) The financed projects need to contribute to implementing the National Plan for Adaptation to Climate Change 2021-2030, and hence facilitate water saving and reuse measures.

Gaps in Policy and Regulation

There is no regulation regarding stormwater and runoffs, only for reclaimed water, limiting its application.

A problem would be to apply the criteria for wastewater reclamation regarding monitoring and water quality to rainwater or stormwater, as many NBS are decentralised approaches where it would be impossible economically and technically to fulfil the same level of analytical measurements and frequency as in a centralized wastewater treatment plant. Besides, the pollutants of runoffs are different to wastewater so it does not make sense to apply the same criteria.

Also, rainwater's variable quality complicates reuse. The predominant health-focused approach in current regulations does not adequately address emerging contaminants such as microplastics and hydrocarbons.

It is deemed pertinent by stakeholders to channel stormwater management through Comprehensive Sanitation System Management Plans (Planes Integrales de Gestión del Sistema de Saneamiento, PIGGS) and linking this with local urban planning regulations.

However, there are some open questions regarding the use of rain- or stormwater:

- How to address the decoupling between water production (rainy seasons) and demand (drought periods)?
- Can the performance of Nature-Based Solutions (NBS) consistently produce high-quality water despite variations in pollutant loads, especially in the context of an industrial park?

There is a general lack of standardization in water quality criteria, hindering the implementation of reuse projects.

III.3 Demo Case: Cyprus

The Cypriot Demo Case is located in the Famagusta District.

National Level Policy

In Cyprus, where water is widely reused, the only AWR considered are reclaimed water (from wastewater treatment plants) and desalinated water. They are called “unconventional” or “alternative” water sources. Treated effluent from the urban wastewater treatment plants is reused on a large scale - 25 million cubic meters (MCM) of in 2021, prognosed to rise to 65 MCM by 2026 - for the following purposes:

- irrigation (under the Cypriot Code of Good Agricultural Practice),
- enrichment of underground water (effluent of Pafos and Limassol-Moni WWTPs), and
- pumped into dry beds of rivers for infiltration.

Water reuse in Cyprus is on the national scale mainly regulated through the Water Pollution Control Law (106(I)/2002 to 2013). The law aims at protecting surface waters, groundwater and soil from human and industrial polluting activities and at controlling the disposal of liquid and solid industrial waste. Specific measures are prescribed for the prevention of pollution and the adoption of an overall approach in granting licenses to facilities/enterprises that cause pollution of waters and soil. The law is divided in six parts, of which the second part refers to the protection of waters and soil in general from nitrate pollution caused by agricultural activities, i.e., by the use of fertilizers, manure and recycled water in irrigation. The third part regulates all matters related to the process of issuing permits for disposal of waste to existing and new (industrial and others) facilities that cause pollution by disposing waste in waters and soil. Permits are requested for the operation of WWTP and the distribution of reclaimed water, and can be obtained from the competent authority (the Ministry of Agriculture, Rural Development and Environment) while inspectors appointed by the competent authority perform checks. The end-users have only to sign a form declaring that they will comply with the Code of Good Agricultural Practice (see below).

The national law, which is already in line with the requirements set out in Regulation 2020/741, defines requirements for over 20 parameters, which includes 4 parameters covered in the proposal for the revised UWWTD (E.coli, intestinal nematodes, BOD5 and TSS), together with e.g., chemical oxygen demand (COD), pH, heavy metals and metalloids, electrical conductivity (EC), chlorides, nitrogen and phosphorus. The monitoring frequency defined in the national legislation depends on the parameter but is generally less frequent compared to the EU proposal e.g., the most frequent monitoring is needed for pH (three times per week) while for most parameters monitoring is needed once every 15 days (E.coli, TSS, BOD5, COD, EC, nitrogen and phosphorus).

Also, there is a regulation in Cyprus for agglomeration ≤ 2.000 p.e., the Ministerial Decree of small-scale WWTPs ≤ 2.000 p.e (No. 379/2015), which sets the discharge limits of treated wastewater for all urban wastewater treatment facilities in settlements with an equivalent population of less than 2000 inhabitants. It also sets quality requirements for treated wastewater used for irrigation.

Besides the Water Pollution Control Law, the Cypriotic Code of Good Agricultural Practice (No. 283/2023) includes regulation for the use of reclaimed water and sludge from municipal wastewater. The Code is issued within the framework of the European Directive 91/676/EEC on the protection of waters from nitrate pollution of agricultural origin. In the Nitrate Pollution Vulnerable Zones, as defined by Republic of Cyprus with relevant Decrees of the Minister of Agriculture, Rural Affairs Development and Environment, compliance with the Code is mandatory.

As stated initially, the focus in Cyprus with regard to AWR is on treated wastewater and desalination. Hence, there is no legislation in place that governs the use of rainwater/stormwater. However, in recent years investigations into ways to better use the (scarce) rainwater/stormwater resources have been conducted.

Also, there is a recent urban planning recommendation to introduce a 30%-40% unsealed surface factor in all new buildings and construction projects, so as to enrich the aquifers. This promotes the development of more soil, greenery and permeable surfaces (instead of asphalt or hard surfaces), which, among other things, also lower the temperature.

Regional Level Policy

There are no regulations or policies on AWR on the regional level in Cyprus.

Local/Municipality Level Policy

There are no regulations or policies on AWR on the local level in Cyprus.

AWR and environmental objectives

There are no specific plans in Cyprus to use AWR to reach environmental objectives of EU Directives (e.g., enhance the quantitative status of groundwater bodies through aquifer recharge, or enhance the status of terrestrial aquatic ecosystems by providing reclaimed water to them). However, all WWTP are either reusing the treated water or doing aquifer recharge, also as part of WFD Programs of Measures (PoMs).

Financing AWR in Cyprus

There is no dedicated funding available for improving the quality of treated wastewater or for complying with standards for treated wastewaters.

Funding is available for the construction/upgrade and operation of WWTP or the construction, expansion and maintenance of irrigation networks, through European and national funding.

For rainwater harvesting or using rainwater/stormwater run-off, there is no dedicated funding for now. There are some funds for the control of runoffs, but these are invested only in grey infrastructure (piping), without having a potential reuse in mind.

Gaps in Policy and Regulation

As Cyprus faces limited water resources and the tangible impacts of climate change, the Cypriot state has dedicated significant efforts to exploring more efficient water management strategies. The use of alternative water resources (AWR) is an integral part of this endeavour. Notably, Cyprus has achieved a reclaimed water reuse rate of 95.4%. However, in terms of other AWR, the government has primarily focused on large-scale projects such as the development of additional dams and the expanded implementation of desalination systems.

In recent years, there have been governmental initiatives investigating ways of promoting the greater utilization of rainwater at the domestic level. Despite these efforts, decisions/regulations or recommendations have not been implemented yet to fully realize the potential of rainwater harvesting.

Specific gaps in Cypriot policy on AWR include:

- Legislation in Cyprus does not comprehensively address the diverse potential uses of AWR, but is limited to the reuse of reclaimed water (beside desalinated water). However, it has to be kept in mind that the precipitation in Cyprus is very low, so there is no great potential in the rainwater-stormwater collection and reuse.
- A legislative gap in Cyprus is that unrestricted irrigation does not include specific crops as lettuce that are directly in contact with the water and are eaten raw. This gap could be covered by regulating advanced-higher treatment for this kind of irrigation, as reverse osmosis that could also solve the salinity issues that arise in some areas of Cyprus.
- A legislation that promotes the reuse of shower water for garden irrigation after minimal treatment is also missing and would be helpful, e.g., in residential systems or large hotels, allowing them to irrigate their gardens and courtyards efficiently.
- There is an absence of a detailed regulatory and financing frameworks and guidelines to support the safe and efficient use of AWR such as greywater, rainwater and stormwater. Financing programs to subsidize private individuals for domestic greywater reuse have been largely unsuccessful due to the low subsidy amount (€500).
- The economic policies do not sufficiently promote the use of AWR except the reclaimed water reuse.

III.4 Demo Case: Romania

The Romanian Demo Case is the city of Bucharest.

National Level Policy

Romania does not have a specific, standalone legal definition of "Alternative Water Resources" explicitly stated in its national legislation. However, the concept of AWR is implicitly addressed through various regulations and practices that promote the use of non-traditional water sources to supplement conventional water supplies such as surface water (rivers, lakes) and groundwater. These non-traditional water sources include:

- Reclaimed Water: Treated wastewater that is reused for various purposes such as agricultural irrigation, industrial processes, and landscape irrigation.
- Rainwater Harvesting: The collection and use of rainwater from rooftops or other surfaces for domestic, agricultural, or industrial use.

- Stormwater Management: The capture and use of stormwater runoff for non-potable purposes.
- Desalinisation[16], which is not discussed in the present document.

Wastewater reuse is not a common subject for Romanian circular economy – neither on the national nor the regional/local scale (e.g., in certain cities), is treated wastewater reused for any purpose. Hence not surprisingly, there is no dedicated legislation in place in Romania that governs the reclamation/reuse of water from urban wastewater treatment plants (WWTP) going beyond what the EU Directives (especially the UWWTD and the new Water Reuse Regulation) prescribe. Romanian law does not regulate the water quality of reclaimed water used for specific purposes. The only regulations are provided by Government Decision No 188/2002 for the approval of certain rules on the conditions of discharge of wastewater into the environment, i.e., the general discharge rules. According to these, municipal or industrial wastewater, before being discharged into natural receptors, must be monitored in accordance with the procedures set out in Annex No. 1 to the Decision NTPA-011. Annex 3 of GD No 188/2002 prescribes that the discharge of treated sewage into the network of desalination or irrigation canals or onto agricultural land shall only be carried out under the conditions of proper treatment and only with the consent of the manager/owner, as follows:

- "where sewage water is used for irrigation of agricultural crops, the limits of the quality indicators shall also correlate with the standard for water quality for irrigation of agricultural crops, STAS 9450/83'" and
- "in order to protect water resources against pollution article 9 provides that ' it is recommended to use wastewater and/or nutrient-containing sludge for fertilizing or irrigating agricultural or forestry land, with the agreement of the owners of the land concerned and the approval of the competent land improvement authorities. Depending on the nature of the crop, the opinion of the territorial public health inspectorate shall also be required".

Otherwise, the Government Decision No. 188/2002 nominally incorporates the requirement of Art. 12 of the UWWTD that "treated wastewater shall be reused whenever appropriate" by stating that "purified wastewater will be reused whenever this is possible, with the approval of the competent authorities, depending on the origin and the field of use".

Romanian legislation on irrigation has already been adapted to the EU Regulation 2020/741 on water reuse (by directly transposing the Regulation into national law).

Currently, Romania does not have detailed specific legislation directly regulating the use of rainwater and the implementation of sustainable urban drainage systems (SUDS). However, general principles of sustainable water management are included in existing legislation and local authorities have the possibility to promote rainwater management practices through urban planning and development projects. Rainwater harvesting and nature-based solutions (to run-off and flooding issues) are also mentioned in several non-binding building recommendations. In addition, access to European and national funds can facilitate the implementation of green infrastructure and sustainable solutions in urban areas. There are a number of regulations and initiatives that encourage sustainable rainwater management and the implementation of green infrastructure in urban developments.

With regard to aquifer recharge, the Romanian Water Law 107/1996 contains Article 10, which governs, inter alia, transfers of water, including the recharge of aquifers. Art. 10 (6) prescribes that groundwater reserves may be replenished or supplemented by artificial recharge of groundwater bodies "with water from any

[16] According to the Water Law 107/1996 with subsequent amendments and additions, desalination plants are part of the WFD Programs of Measures, being additional measures used in order to achieve the objectives of water quality protection and aquatic ecosystems and protected areas associated with the watershed. However, there are no known desalination projects in Romania as of 2024.

surface or groundwater source only if the objectives set out in Art. 2.1[17] are not compromised, both for the source and for the artificially recharged groundwater body".

However, the reuse of wastewater and the use of other AWR may change in the future, as Romania addresses these issues in the Sustainable Development Strategy 2030, the Romanian Strategy for the Circular Economy (NSCE) and the National Integrated Urban Development Strategy for Resilient, Green, Inclusive and Competitive Cities 2022-2035. The Sustainable Development Strategy 2030 outlines the national framework for achieving sustainable development goals, which include climate action, sustainable cities and communities, and clean water and sanitation. This strategy emphasizes the management and reuse of stormwater, and promotes increasing water use efficiency in industrial, commercial and agricultural activities, also by expanding the rational reuse of treated and recycled water to achieve the goals of the circular economy. The NSCE is a roadmap for accelerating Romania's transition from a linear to a circular economic model. The strategy gives an overview of the fourteen economic sectors, and identifies the following as having the greatest circular potential:

- Agriculture - regulating water/wastewater reuse in agriculture, optimising water extraction and maximising water reuse. In the context of decreasing climate change and diminishing freshwater resources, treated wastewater can partially cover water needs for irrigation.
- Textiles - waterless dyeing/painting and water reuse in the textile industry.

The implementation of a corresponding Action Plan (adopted in September 2023) provides a framework for this transition. The Action Plan also has information on rainwater harvesting and proposes concrete steps to encourage the use of it, by:

- developing a study to assess the potential of rainwater harvesting and greywater utilization facilities in existing buildings nationwide, both in terms of infrastructure conditions and consumer demand;
- collaborating between academia and the private sector to create tailored solutions for the most common types of buildings that qualify for rainwater harvesting and black/grey water utilization, which could result in the preparation of guidelines in this regard;
- spatial characterisation of rainwater harvesting and black/grey water utilization systems through urban planning documentation;
- conducting a pilot project focusing on the installation of grey water systems in public sector buildings, which can then be used as best practice for the private sector;
- providing incentives for the installation of grey water utilization systems when new buildings are constructed, as this can help reduce fresh water demand and increase water efficiency;
- providing financial incentives for the population and SMEs to purchase and install rainwater storage equipment in existing buildings, following the example of the installation of solar panels under the Green House program, to increase rainwater use, and
- launching information and awareness campaigns on the benefits of rainwater harvesting and rainwater harvesting methods, in collaboration with academia and NGOs.

Regional Level Policy

There are no regulations or policies on AWR on the regional level in Romania.

[17] Which are:
a. preventing damage to all surface water bodies,
b. protecting and improving the quality of surface water bodies in order to achieve good status,
c. protection and improvement of all artificial or heavily modified water bodies with the aim of achieving good ecological potential or good chemical status, and
d. the progressive reduction of pollution due to priority substances and the cessation or phasing out of discharges and losses of priority hazardous substances in accordance with the List of Priority Substances in the field of Water.

Local/Municipality Level Policy

There are no regulations or policies on AWR on the local level in Romania.

AWR and environmental objectives

Currently, Romania does not have explicit plans specifically dedicated to the use of AWR to meet the environmental objectives of EU Directives. Water reuse is mentioned several times in River Basin Management Plans and PoMs, but concern mostly the “promotion of wastewater reuse” or “accessing the feasibility of water reuse” instead of describing concrete projects.

The Water Law 107/1997 with subsequent amendments and completions indicates that for each river basin a Program of Measures needs to be established, outlining Basic and Supplementary Measures (to reach the environmental objectives). The supplementary measures may include: efficiency and reuse measures, inter alia, the promotion of water-efficient technologies in industry and irrigation techniques, which require reduced water consumption; desalination plants, and artificial recharge of aquifers (including with reclaimed water, although this is not explicitly mentioned in the legislation).

The updated Management Plan for the Danube River, Danube Delta, Dobrogea Hydrographic Area and Coastal Waters 2022-2027 emphasizes that in order to protect the groundwater resource in terms of quantity, in the context of global climate change, additional measures are envisaged to identify areas where some groundwater aquifers are or may be affected by drought, by developing research studies and applying models for monitoring the aquifer levels in time and space. Also with a view to meeting water needs, it is planned to identify areas at potential risk of water scarcity and to apply the most efficient methods of artificial recharge of aquifers, possibly by collecting and storing rainwater and using it to artificially recharge aquifers at possible quantitative risk. The results of the respective research projects will allow an assessment of the time needed to achieve the environmental objectives through the implementation of basic measures and/or the possibility of additional measures.

Financing AWR in Romania

There are no funds available in Romania specifically aimed at promoting AWR. However, there are funding opportunities available for improving the quality of treated wastewater and complying with standards for treated wastewaters in Romania. These opportunities come from European Union funds, national government programs, and international financial institutions, providing substantial support for infrastructure investments and modernization efforts.

There is no funding available dedicated to reaching environmental objectives through AWR.

A problem is seen not necessarily in the (non-)availability of funds, but in their accessibility. Additionally, there is insufficient communication regarding water scarcity and the role of AWR. Communication efforts are typically limited to small communities facing resource challenges during the summer, and even then, it is handled at local level. Moreover, some AWR initiatives, such as aquifer recharge through water reuse, could be misunderstood by the public without proper explanation and awareness efforts.

A new funding program is being developed at the regional level, aiming at blue and green infrastructures in building/urban development contexts, such as green roofs, green walls etc. Blue-green infrastructure is a key priority for the regional programs in all eight development regions of Romania (NUTS 2 level) and is supported by European Union funding ((ERDF) for the 2021-2027 programming period. The eight regional programs build on the previous EU-funded Regional Operational Program implemented in 2014-2020 programming period. One is the Regional Program “South Muntenia” which finances: i) development of public parks and gardens, including "pocket parks", urban forests, botanical gardens, existing green areas that could be rehabilitated as BGI; ii) sustainable small-scale drainage systems, including but not limited to permeable

pavements, green roofs and green walls; wetland plain, retention ponds, constructed wetlands utilizing nature-based solutions; iii) rainwater harvesting and construction of retention ponds or other forms of water storage to provide ecosystem services; iv) development of underutilized or abandoned land by bringing the land back to its original state for ecosystem restoration in the form of natural and semi-natural green spaces (forests, shrublands, meadows, wetlands, lakes and rivers etc.); v) afforestation and reforestation of landslide-prone areas surrounding cities and located within the urban limits of towns; vi) creation of green - blue corridors by rehabilitating, regularizing, dredging and landscaping rivers, lakes and canals, including their banks for sustainable use for pedestrians, cyclists, educational activities, etc. and creation of biodiversity spaces. The applicants may be the local authorities or partnerships of local authorities.

Gaps in Policy and Regulation

Romania, and thus its major cities, do not reuse wastewater for irrigation or other purposes, even though there is an upward trend among EU Member States to develop these mechanisms. On the other hand, both at national and local level, there are treatment processes in place to clean wastewater. But the water is not reused.

The main gaps are:

- A lack of a specific legislative framework for the water reuse/use of rainwater/stormwater: The development of a clear legislative framework and regulations is crucial to promote water reuse/use of rainwater in urban areas. They should ensure the protection of public health and safety, setting standards for the quality of reused water and monitoring the systematic implementation of reuse solutions. A system of permits should be integrated to confirm compliance with local and national regulations. The permitting process should involve at least detailed project impact assessments, water quality monitoring plans and environmental protection measures. Planning and building legislation should include specific provisions that promote or even require the integration of water reuse systems in new developments or urban regeneration. Water reuse legislation should set specific water quality standards that must be met for different uses, for green spaces irrigation, industrial use or other non-potable purposes. These standards ensure that reused water is safe and poses no risk to human health or the environment.
- A lack of financial incentives for use of rainwater/water reuse: Current policies lack adequate financial incentives and support mechanisms for AWR development projects, such as subsidies, tax credits or financing programs to encourage development and adoption of AWR.
- Policies and regulations lack mechanisms to foster collaboration with private sector stakeholders in the development and management of AWR.
- There is a lack of specific awareness policies aimed at educating citizens and industries about the importance and benefits of AWR.

The main challenges and practical barriers related to strengthening the circular economy in water and wastewater management in Romania, as identified in the Romanian Strategy for the Circular Economy, include:

- Insufficient and often inadequate public policies to facilitate the transition to the circular economy in the water sector, both in terms of the content of regulatory measures and their practical implementation;
- insufficient knowledge of the risks and benefits of by-products from the water industry, such as sludge and treated water, to lead to acceptance of their use; and
- unsustainable water management practices, which have led to reduced water resources used for irrigation in agriculture or green spaces in urban areas.

III.5 Bulgaria

Bulgaria is still developing a comprehensive framework for AWR, and these efforts are increasingly aligned with broader environmental goals and the country's commitment to sustainable development in Europe.

The desk research performed for the review of selected legislation in Bulgaria revealed that the AWR as defined and selected by AWARD HE are not mentioned specifically in the relevant national legislation. However, the national laws and regulations transposing the EU Directives provide a general framework, referring to AWR indirectly, for example by promoting the "sustainable water use based on a long-term protection of available water resources or multiple-purpose and efficient use and reuse of water resources" or „upon construction of new sites related to the use, conservation of waters, or to protection against water-related damage and loss, as well as for the purposes of more appropriate utilization of water resources".

The Bulgarian Water Law (bg. Закон за водите, dating from 1999, latest amendment as of 2015[18]) and some regulations passed under the Water Law cover the management, protection, and use of water resources, including surface and groundwater. Key provisions relevant to AWR include:

- Permitting and Licensing: Any extraction or use of water resources, including alternative sources like rainwater harvesting or reclaimed water, typically requires a permit or license.
- Water Quality Standards: The law sets out standards for water quality that must be adhered to for various uses, including drinking water, industrial use, and irrigation.
- Environmental Protection: Provisions to protect ecosystems and biodiversity, ensuring that the extraction and use of water do not harm the environment.

The Water Law is the Bulgarian legislation implementing the EU Water Framework Directive and aligning with its objectives as well as with the ones of daughter directives on groundwater and surface water quality and quantity. It establishes regulations for water management, quality, and protection. It addresses surface waters (rivers, lakes, and coastal waters) and groundwater. The Water Law ensures an integrated approach to water management, emphasizing ecological and chemical health. It also sets deadlines for achieving WFD objectives and includes provisions on exemptions.

Bulgaria uses River Basin Management Plans to protect and restore water bodies, aiming for good status (both ecological and chemical). RBMPs outline measures to prevent deterioration and promote sustainable water use. The Water Law also requires setting Environmental Quality Standards for pollutants of national concern. Monitoring these substances contributes to assessing ecological status. Its annexes specify details such as monitoring requirements, assessment criteria, and RBMP contents.

The main available financing sources are provided by:

- Just Transition Fund (JTF): Bulgaria will receive €1.2 billion from the JTF to facilitate a just transition in regions facing socio-economic challenges during the phasing out of coal and reduction of CO2 emissions. The JTF aims to create new jobs, support economic activities, and help Bulgaria achieve its EU 2030 climate and energy targets. It will also contribute to a climate-neutral economy by 2050. The fund will focus on reskilling, upskilling, land rehabilitation, and energy efficiency measures, including support for renewable energy communities.
- EU Cohesion Policy Investments (2021-2027): Bulgaria's €11 billion Cohesion Policy investments will promote competitiveness, cohesion, and environmental sustainability. These funds will contribute to a greener Bulgaria, emphasizing water management, waste, and environmental protection.

[18] https://www.moew.government.bg/en/water/legislation/laws/

- LIFE Strategic Projects: Bulgaria is part of major nature, environment, and climate action projects funded by the EU. Over €233 million will support these projects, which aim to achieve environmental objectives, including water-related initiatives.

Gaps in Policy and Regulation

- Comprehensive Legislation: Lack of comprehensive and coherent legislation specifically addressing AWR. Existing laws might not adequately cover the scope or use of Alternative Water Resources.
- Regulatory Standards and Guidelines: Regulations on the quality standards for treated wastewater for reuse in agriculture or industry might be lacking or not aligned with international best practices.
- Coordination among national and regional regulatory Agencies: Lack of coordination among various government agencies and stakeholders involved in water management, climate change, and environmental protection. This can lead to fragmented efforts and inefficiencies in addressing alternative water resources.

III.6 Serbia

The management of surface and groundwater, including aquifer recharge, is regulated under the Water Law (sr. Zakon o vodama, last amendment 2015[19]). This law outlines the framework for managing water resources sustainably, including protecting and improving the quality of aquifers. Specific provisions might address artificial recharge techniques, conditions for permitting, and monitoring impacts.

For example, the Water Law defines water resources to include surface water, groundwater, and alternative sources such as rainwater, greywater, and reclaimed water. It covers all activities related to the management, use, and protection of these water resources.

The Water Law of Serbia regulates the protection, use, and management of water resources. It covers all aspects of water management, including:

- Water supply.
- Wastewater treatment.
- Protection of water resources.
- Prevention of water pollution.
- Use of alternative water sources such as rainwater, greywater, and reclaimed water (except groundwater from which useful mineral raw materials and geothermal energy is obtained).

The Water Law specifies the quality standards that alternative water sources must meet for various uses. The Serbian Water Law requires permits for the use of alternative water sources to ensure they are used in a manner that protects public health and the environment. It mandates specific organizations to regular monitoring and reporting of the quality and quantity of alternative water sources used.

The law includes provisions for financial and technical support to encourage the use of alternative water sources. This may include:

- Subsidies or grants for installing rainwater harvesting systems or greywater recycling systems.
- Technical assistance and guidance on best practices for the use of alternative water sources.

The Serbian Environmental Law[20] provides a framework for protecting the environment, including water resources. It emphasizes sustainable development, pollution prevention, and the conservation of natural

[19] https://faolex.fao.org/docs/pdf/srb155330.pdf
[20] https://practiceguides.chambers.com/practice-guides/environmental-law-2023/serbia

resources. It sets up specific quality standards for different uses of alternative water sources, ensuring they meet safety and environmental protection requirements and defines the necessary treatment processes and permissible uses for alternative water sources. For example, reclaimed water must be treated to meet certain standards before it can be used for irrigation or industrial purposes. The law requires permits and licenses for activities involving alternative water sources to ensure they comply with environmental regulations and standards.

The Environmental Law stipulates:

- Permitting for Use: Requiring permits for the use of alternative water sources to ensure they are used sustainably and safely.
- Licensing for Treatment Facilities: Requiring licenses for facilities that treat and possible distribution of alternative water sources, ensuring they meet regulatory standards.
- Regular Inspections: Conducting inspections of facilities and activities involving alternative water sources to ensure compliance with quality standards and regulations.
- Monitoring Water Quality: Monitoring the quality of alternative water sources to ensure they meet the required standards.
- Penalties for Non-Compliance: Imposing penalties for violations of environmental regulations, such as using alternative water sources without proper treatment or permits.

The Law on Utility Services (dating 2004) encourages the collection and use of rainwater for non-potable purposes such as irrigation, industrial processes, and flushing toilets, supports the treatment and reuse of greywater (wastewater from baths, sinks, washing machines) for purposes such as irrigation and toilet flushing and promotes the use of treated wastewater for irrigation, industrial processes, and other non-potable uses. The law sets standards for the quality of reclaimed water to ensure it is safe for these purposes.

Further Serbian legislation includes provisions for the management of rainwater and stormwater, focusing on mitigating flood risks, protecting water quality, and ensuring efficient water use. Local building codes and urban planning regulations often integrate rainwater harvesting systems and infrastructure to manage stormwater runoff effectively.

The Serbian legislation stipulates (general) standards for treating wastewater to a level that allows safe reuse for agricultural irrigation, industrial processes, or other non-potable purposes. Regulations also ensure that reclaimed water use does not pose risks to public health or the environment.

Serbia's approach to integrating AWR with its environmental objectives includes several key initiatives:

- Infrastructure and Technological Investment: Serbia invests in upgrading water networks and treatment plants, including infrastructure to support water conservation and the use of alternative water sources. This includes promoting technologies that ensure the sustainable use of water resources.
- EU Harmonization and Pollution Control: The country aims to align with EU environmental standards, emphasizing pollution reduction and the adoption of clean technologies. This not only protects water resources but also contributes to Serbia’s economic and ecological resilience.
- Sustainable Development and Climate Adaptation: Serbia's strategy focuses on sustainable development, ensuring that water resources are used efficiently and remain available for future generations. This includes mitigating the impacts of climate change through responsible water management and ecosystem protection.

Several key gaps in the Serbian legislative framework for AWR have been identified:

- Lack of Specific Regulations for AWR: As publicly presented, current regulations may not adequately cover all aspects of alternative water sources such as rainwater harvesting.
- Cohesive Integration with existing Water Laws: It is a need for integrating policies for AWR with existing water management laws.
- Standards and Guidelines: technical standards and guidelines for the design, installation, and maintenance of systems for harvesting and reusing alternative water sources and quality standards for different uses of alternative water resources need to be defined more sharply.
- Urban Planning Policies: Integrating the use of alternative water resources into urban planning policies to promote sustainable city development.
- Infrastructure Development: Encouraging the development of infrastructure that supports the collection, storage, and distribution of alternative water resources

III.7 Hungary

There is no definition of AWR in the Hungarian water legislation. As such, regulation on AWR is not specific, but indirectly governed by the water legislation.

However, in the National Water Strategy (from 2017; referred to as Nemzeti Vízstratégia or Kvassay Jeno Terv[21]), AWR are an important aspect of water management, especially considering the challenges posed by climate change, water scarcity, and increasing demands on water resources. The plan outlines several AWR and strategies for sustainable water management.

These includes:

- Waste water reuse
- Rainwater harvesting
- Grey water reuse
- Artificial recharge of Aquifers
- Water retention measures
- Others (desalination, transboundary water management with neighbouring countries as Romania, etc.)

The Water Strategy also encourages the development of "best practice" guidelines for the use of water retention, the development of good practices for the utilization of locally produced water resources (rainwater management) and for changing the disposal practices of treated wastewater. It also emphasizes the necessity to strengthen the harmony between regional and local water management (rolling development plans), and to implement an approach focused on water retention, water utilization, and rainwater management instead of the current drainage-centred practice. Also, it promotes the development of municipal stormwater management.

The Water Management Act (Act LVII of 1995 on Water Management; last amendment 2015[22]) is the main law governing water management in Hungary, including the management of both conventional and AWR. It covers the following areas: Underground and surface waters; Reservoirs; Beds and Banks of surface waters; Conditions of waterflows and water courses; the quantity and quality of water banks and water courses; the use, conservation and management of water resources. Section 2 of the Act covers the Hungarian Government duties in relation with water sector and water management. Section 4 of the Act regulates the activities of water supply and sewage companies. Provisions on water resource management are mentioned

[21] https://www.vizugy.hu/vizstrategia/documents/997966DE-9F6F-4624-91C5-3336153778D9/Nemzeti-Vizstrategia.pdf
[22] https://faolex.fao.org/docs/pdf/hun5203.pdf

in Section 5 of the Act (water protection, regulations on water ways, prevention of damages on water quality, potable water supply and use of the mineral and medicinal waters).

The Government Decree No. 123/1997 (VII. 18.) on the Protection of Water Resources includes guidelines for the protection of groundwater and surface water, and it promotes practices that reduce water consumption and enhance water quality, including the use of AWR.

Another Government Decree, on Protection of Groundwater resources (No. 219/2004) supports practices such as managed aquifer recharge, which is a method of using AWR to replenish groundwater supplies.

Finally, Government Decree no 220/2004 on the protection of surface waters encourages to reduce the impact on surface waters with methods such as the use of treated water and other AWR.

The Decree provides rules for the conservation and maintenance of surface water quality, the achievement of good water conditions and ensuring the necessary conditions for conservation and survival of aquatic, wetlands and watersides habitats and living organisms.

The Decree contain the rules and obligations for the emitters and on emissions of waste waters. Articles in the Decree deals with authorisation of wastewater emissions, inspection and control of emissions, data for reporting, etc.

Local governments in Hungary may have additional regulations that promote the use of alternative water resources, particularly in urban planning and building codes. These regulations can include requirements for rainwater harvesting systems in new buildings or incentives for greywater recycling.

There are specific funding opportunities available in Hungary for investments in AWR. These funding sources aim to support sustainable water management, promote the use of innovative water technologies, and ensure compliance with environmental and climate objectives. The main funding sources include:

- EU funding
    - Cohesion funds (financial support for environmental projects, including water management). Hungary has used these funds to finance various projects related to wastewater treatment, water recycling, and the development of infrastructure for alternative water resources).
    - The European Regional Development Fund supports regional development initiatives, including projects focused on water management and the use of AWR.
    - The Rural Development Programe as part of the Common Agricultural Policy provides funding for agricultural and rural development projects. It includes support for sustainable water management practices in agriculture, such as irrigation efficiency and rainwater harvesting systems).
- The National Environment Protection Fund (OKTA ,Országos Környezetvédelmi és Természetvédelmi Alap) provides financial support for projects that contribute to environmental protection and sustainable water management in Hungary. This includes investments in AWR, such as wastewater treatment, rainwater harvesting, and water reuse technologies).
- Green Climate Fund (not specific to Hungary).
- Horizon EUROPE.
- National and regional environmental programmes (Hungary's national and regional development programs often include components related to environmental sustainability and water management. These programs can provide funding for projects that involve AWR, especially in regions facing water scarcity or environmental challenges).
- Climate Action Program (Hungary has initiatives and programs specifically aimed at climate action, which include funding for projects that contribute to water conservation, adaptation to climate change, and the use of AWR).

- Public Private Partnerships.

Several key gaps in the Hungarian legislative framework for AWR have been identified:

- Lack of comprehensive regulatory and legislative system: The current legal framework primarily focuses on traditional water resources, such as surface and groundwater. While there are regulations governing water quality and wastewater treatment, a comprehensive legal framework specifically dedicated to AWR is still lacking. The current system needs more clarifications on AWR.
- Water quality standards: There are limited water quality standards and regulations regarding AWR and their use for different purposes. Clear and specific water quality standards are needed for different types of AWR to ensure safe and sustainable usage.
- Gaps on rainwater harvesting and grey water reuse: Rainwater harvesting and greywater reuse are not widely regulated in Hungary. While some local municipalities may have guidelines, there is no unified national regulation that governs these practices/technologies. National legislation is needed to standardize the practices of rainwater harvesting and greywater reuse, including installation standards, water quality criteria, and usage restrictions.
- Waste water reuse framework: Wastewater reuse is still relatively underdeveloped in Hungary, partly due to regulatory uncertainties. While there are EU guidelines that Hungary follows, there is a lack of detailed national regulations that govern the safe and effective reuse of treated wastewater.
- Project funding mechanisms: Although there are some funding opportunities available, the economic incentives specifically targeted at encouraging the use of AWR are limited.

III.8 Moldova

The Republic of Moldova's national legislation does not explicitly categorize AWR as a separate topic within the national water framework. The Moldova Water Law (ro. Legea Apelor, last updated 2024[23]) and associated regulations to this one, allows AWR management, as part of a broader strategy for sustainable water resource management. This includes the use of „non-traditional“ water sources to complement conventional supplies and address challenges related to water scarcity and environmental protection.

The Water Law covers all activities related to the management, use, and protection of water resources. It encourages the development and implementation of adequate alternative methods for treating wastewater and reducing water pollution.

The use of AWR in Moldova is primarily motivated by the need to address water scarcity, adapt to climate change, support agricultural and other economic activities, protect the environment, and align with European water management standards. These efforts help ensure a more sustainable and resilient water supply for the country's present and future needs.

Another important law it is the Law 303/2013, regulating public water services offered to the whole territory of Moldova. The purpose of this law is to create the legal framework for the establishment, organization, administration, regulation and monitoring of the operation of the public drinking water supply, technological, sewage and industrial wastewater service in conditions of accessibility, availability, reliability, continuity, competitiveness, transparency, in compliance with quality, security and environmental protection standards.

Several key gaps in the Moldovan legislative framework for AWR have been identified:

- Comprehensive water legislation: While Moldova has made progress in updating its water management laws, the legal framework is less comprehensive compared to the EU. The country’s

[23] https://www.legis.md/cautare/getResults?doc_id=141581&lang=ro

Water Law addresses general water resource management, but specific regulations on AWR, such as treated wastewater reuse, are less detailed and not as rigorously implemented.

- Water Quality Standards: Moldova's standards for water quality, including those for AWR, are not as detailed or stringent as the EU's. There is a need for more specific guidelines and monitoring mechanisms to ensure that AWR meet safety and quality standards equivalent to those in the EU.
- Citizen engagement: Citizens´ engagement in water management, including the use of AWR, is less developed in Moldova. Efforts to engage stakeholders and the public in decision-making processes related to water resources are still evolving, and there is room for improvement in fostering a participatory approach.

IV Conclusion – policy gaps, funding and financial framework

A special focus of AWARD, and especially of Work Package 2 with this Deliverable 2.1, is the question of how the use of Alternative Water Resources can be strengthened on the European as well as the national levels. On the national level, challenges and possible solutions for wider AWR usage mostly relate to national policies and funding mechanisms. Gaps in these have been identified through targeted interviews in the respective countries and Demo Cases, for the national as well as regional/local levels, and are described in the respective sections above.

IV.1 Gaps and barriers identified in the four AWARD Demo Case Countries

The following table provides an overview of the gaps and barriers identified by stakeholders and experts in the four AWARD Demo Cases, organised into broader categories. Details on the issues listed in the table are to be found in the Demo Case sections above.

Barrier/gap	Cyprus	Romania	Spain	Italy
Lack of a specific legislative framework for the water reuse/use of rainwater and stormwater	y	y	y	y
Lack of financial incentives for specific AWR (mostly rainwater or stormwater)	y	y		
Lack of financial incentives for some or all AWR	y	y		y
Insufficient knowledge of the risks and benefits of treated wastewater		y		
Low acceptance of treated wastewater in the public sphere		y		
Lack of regulation and financing for small-scale reuse of water, e.g., from households	y			y
Lack of regulation for high-quality treated wastewater used for irrigating crops such as lettuce	y			
Current water reuse regulation does not cover emerging contaminants	y	y	y	y
Lack of comprehensive vision to use AWR to reduce pressures on water bodies				y
Lack of knowledge and capacity for technical requirements for alternative treatment solutions (such as NBS)	y	y		y

Table 2: Barriers and gaps to increased use of AWR on the national level (Demo Cases)

There are also policy gaps in the legislation and funding/financing structure on the European level, hindering further AWR uptake on the national level.

For example, despite the existing provisions in both the WFD and UWWTD, water reuse has not been systematically and sufficiently considered in integrated water management planning, either as a practical solution in the broader water management or in the elaboration and implementation of River Basin Management Plans or in the design and location of wastewater treatment plants. Cost of adaptation of existing plants and conveying water to places of reuse is generally higher than if taken into consideration at the initial stage of building wastewater treatment plants and conveyance networks (EC 2018).

These have also been identified through interviews on the European level, targeting officials and policy experts of the European Commission. Additionally, some Demo Case stakeholders have also been interviewed, obtaining “national views” on European policy and funding gaps.

Barriers have to be reduced, and gaps need to be closed if AWR technologies and methods are to be adopted on a larger and more effective scale than at present, developing the huge eco-innovation potential in terms of technologies and services related to water reuse and alternative supply in industry, agriculture and urban sectors (Sanz/Gawlik 2014).

Beside policy and financing issues, barriers of other nature can also be important. For example, technically feasible water reuse projects often do not get implemented due to institutional, economic, and organisational barriers, or poor public perception and education. These non-technical barriers are a limitation to the expansion of water reuse planning and AWR uptake. A basic driver of reluctance to use wastewater, and barrier to wastewater treatment and planned reuse, is the lack of effective collection and treatment systems for faecal matter and sewage, which is widespread almost everywhere. Additional barriers include public perceptions that may drive fear of the dangers of consuming food irrigated with reclaimed water (Sanz/Gawlik 2014, EC 2016).

A note regarding the financing of AWR: new, unconventional or alternative water resources are often more costly than "conventional" means of producing water. Hence, low investments in AWR also reflect costs comparisons with other water sources (CIS 2016, EC 2016). Consequently, the financing framework – including the water pricing regime - and external funding for AWR and for conventional water sources are important elements that determine the market share of AWR (Hochstrat et al. 2006). The focus of this report, however, does not lie on pricing policies. Nevertheless, the importance of water pricing for financing any water supply activity, including developing AWR, needs to be highlighted and will be further analysed in upcoming AWARD publications.

IV.2 Policy Gaps on the European Level

The following policy gaps to the uptake of Alternative Water Resources – excluding desalination - have been obtained by classic desktop research, by several interviews with national (in the Demo Cases and several other East European countries) and European-level policy experts and practitioners, as well as by collaborating with two other Horizon Europe projects belonging to the same thematic cluster, RECREATE and MARCLAIMED.

Policy Gap	**Source (EU-Level/Demo Case or other national level/ literature)**
Lack of legislation on rain- and stormwater use: Harvesting and using rainwater has been widely used for different purposes such as irrigation, toilet flush, cooling, etc. However, the standards regulating the quality of rainwater, tailored to its "final destination", have not been set up at the EU level yet. The standard EN16941-1:2018 "On-site non-potable water systems" defines the minimum requirements for rainwater collection and use of rainwater on site as non-potable water. This excludes the use for drinking water and for food preparation; the use for personal hygiene; and infiltration. However, the standard does not provide answers to a number of emerging issues, e.g., it does not indicate all the risks associated with the collection and use of rainwater. First-flush separation is not considered even though it has a massive effect on the quality. Bacteriological contamination is another issue that is not well represented in relation to the use. Furthermore, the standard only provides a very general section concerning water quality,	Demo Case Level (Italy, Romania, Bulgaria); BIO 2015

numeric values for the qualitative parameters are not provided (EQS are needed). For promoting rainwater (and grey water) use, EU policy instruments related to eco-design of buildings are probably more suitable than water policy instruments. Urban Water Management should include stormwater and water tariffs should include costs of stormwater management (investments and O&M).	
Lack of a unified regulatory framework: There is no specific EU Directive for the reuse of urban runoff water. Policies vary significantly between Member States.	Demo Cases (Spain)
Lack of clarity in the UWWTD regarding reuse of treated wastewater: The Directive indicates the wastewater that has to be collected and the minimum treatment level, thus giving a first rough estimate of the quality parameter of wastewater treatment plant effluents. At the same time it stipulates water reuse when stating "Treated wastewater shall be reused whenever appropriate" (Article 12 UWWTD), but it remains unclear how ”appropriate” is defined in this context. At the moment, the use of the ”appropriate” term leaves room for different interpretations, which may lead to inconsistent applications between EU Member States. A precise definition could set clear obligations at least for operators of wastewater treatment plants, facilitating the implementation of the necessary measures for water reuse. If “appropriate” would be clearly defined, the reuse of treated wastewater can become mandatory in the circumstances specified by the definition.	Demo Cases (Romania)
Lack of regulatory and technical guidance: Stakeholders face uncertainty due to a lack of regulatory and technical guidance (e.g. inability to fully treat wastewater and sludge, unstable water quality, low performance of treatment processes, limited technical resources to implement additional treatment technologies).	Petsani/Suarez 2025; Demo Cases (Romania)
Lack of water balances for water used in groundwater recharge measures, especially needed in cities: City-scale groundwater monitoring and subsurface studies constitute an important component of sustainable urban development, allowing systematic assessment of structures and avoiding potentially costly hazards. Urban planning should include water balance studies founded on accurate hydrological and hydrogeological analysis, and include an urban groundwater balance with both natural and man-induced water sources, as well as the entire set of infrastructure elements.	Demo Cases (Romania)
Lack of quality limits for water used in groundwater recharge measures: The WFD does not fix quality limits for recharged water but specifies that the activity cannot compromise the achievement of the water bodies environmental objectives (Article 11(3f) states that “controls, including a requirement for prior authorisation of artificial recharge or augmentation of groundwater bodies are mandatory. The water used may be derived from any surface water or groundwater, provided that the use of the source does not compromise the achievement of the environmental objectives established for the source or the recharged or augmented body of groundwater”).	Demo Cases (Romania)
Lack of knowledge and regulation of Emerging Contaminants: The risks to health and the environment from pollutants such as bacteria, viruses and emerging pollutants and priority substances such as those already	Petsani/Suarez 2025; EC 2016

detected occasionally in discharges from water treatment plants (and in high concentrations) hinders water reuse schemes (especially groundwater recharge), as there are many poorly researched and unregulated contaminants (such as the effects of boron on crops).	
Monitoring and Reporting Requirements: While the legislation emphasizes water quality monitoring, specific requirements for qualitative and quantitative monitoring alternative water sources (e.g., rainwater tanks, decentralized treatment systems) are lacking. Establishing consistent monitoring protocols and reporting mechanisms would improve accountability and data collection.	Demo Cases (Spain, Romania); National Level (Bulgaria)
Lack of uniform standards for the quality of reused runoff water: Absence of clear criteria for different uses (irrigation, aquifer recharge, industrial uses, etc.).	Demo Cases (Spain)
Inflexible policy framework: Inflexible and overly demanding regulations hinder compliance and implementation. E.g., it is cheaper to discharge wastewater into rivers or seas under Directive 271/91 than to treat it further for reuse, reducing incentives for water reclamation.	Petsani/Suarez 2025
Lack of circular economy framework: Water reuse is not yet mainstreamed in the core water policies and programs. There is the need for a "Strategic Plan on Water Use and Reuse", e.g., covering the next 20 years. Without such a long-term strategy, the long-term economic viability of innovative water technologies remains uncertain.	EU-Level; Petsani/Suarez 2025
Communication challenges and limited public enthusiasm for water reuse: Limited information exchange between politicians and the public impedes informed decision-making and reduces public awareness of water reuse initiatives.	Demo Cases (Spain): National Level (Bulgaria); Petsani/Suarez 2025; Sanz/Gawlik 2014
Lack of harmonised standards: The absence of clear or harmonised standards (e.g. conflicting recommendations and terminology), such as plumbing codes for greywater applications, creates inefficiencies. A link between AWR and the EU Taxonomy would be needed.	EU-Level; Sapiano 2024; Ramm 2024

Table 3: Policy Gaps to the Uptake of AWR on the European Level

IV.3 Gaps in the funding & financing framework

Similar to the policy gaps above, funding and financing issues hindering the uptake of Alternative Water Resources have been obtained by classic desktop research, by several interviews with national (in the Demo Cases and several other East European countries) and European-level policy experts and practitioners, as well as by collaborating with two other Horizon Europe projects belonging to the same thematic cluster, RECREATE and MARCLAIMED.

Several of the points above are repeated in the table below, as these points are policy gaps that also touch on funding and financing of AWR solutions.

Gap in the funding & financing framework	**Source (EU-Level/Demo Case or other national level/ literature)**
Poorly developed business models for water reuse schemes, and markets for reclaimed water: There is a general lack of financial incentives for reuse schemes (lack of intelligent pricing system, lack of	Sanz/Gawlik 2014; Salgado Fagundes/Marques 2023; Bui et al. 2019; Sapiano 2024;

market demand due to cheaper alternatives, low financial attractiveness, extensive payback periods, missing long-term perspective).	Petsani/Suarez 2025; Ramm 2024
Lack of financial support to reach environmental objectives (WFD) through AWR: There is no specific financing available to support reaching EU environmental objectives through the use of AWR.	Demo Cases (Spain, Romania)
Focus of financing too much on desalination: Needed are specific financial lines dedicated to implement demonstrative, technical and economically transparent projects covering all AWR, to increase the knowledge on possible solution for AWR use.	Demo Cases (Italy)
Lack of legislation on rain- and stormwater use: For promoting rainwater (and grey water) use, EU policy instruments related to eco-design of buildings are probably more suitable than water policy instruments. Urban Water Management should include stormwater and water tariffs should include costs of stormwater management (investments and O&M).	Demo Case Level (Italy, Romania, Bulgaria); BIO 2015
Lack of legislation on rain- and stormwater use: Harmonized legislation on the (re-)use of rain- and stormwater is needed on the European level (quality standards, incentive schemes etc.). For rainwater (and grey water use), EU policy instruments related to eco-design of buildings are probably more suitable than water policy instruments.	Demo Case Level; BIO 2015

Table 4: Gaps in the funding and financing framework

IV.4 Recommendations

A key focus of AWARD, particularly within Work Package 2 and Deliverable 2.1, is examining how the adoption of AWR can be enhanced both at the European and national levels. To achieve this, AWARD puts a focus on policy gaps, and gaps in the funding/financial framework, both on the national as well as European levels. These gaps have been identified through targeted interviews conducted in the relevant countries and Demo Cases, as well as with representatives of the European Commission.

While the gaps themselves are presented above, several recommendations to close them were also being formulated in the interviews:

- Water tariffs should include costs of stormwater management (investment costs and O&M).
- Strengthen and promote best practice examples, guidance and practitioner´s handbooks.
- The introduction of a “rainwater fee” on the extension of sealed surface (i.e., a monetary amount charged for increasing sealed surface areas) could be a powerful tool to reduce soil sealing and promote rainwater collection and infiltration through SUDS and NBS: why do not establish such “rainwater fee” as an obligation at EU level?
- Include into EU legislation a “discharge hierarchy” similar to the one adopted in the UK regarding urban stormwater (Priority 1: Discharge into the ground; Priority 2: Discharge to a surface water body; Priority 3: Discharge to a surface water sewer; Priority 4: Discharge to a combined sewer).
- New or renovated building should envisage two different water distribution lines (potable and not potable), as black water and grey water collection networks must be separated until out of the building to ease treatment and reuse.
- The existing legislation primarily focuses on agricultural irrigation as an alternative water use. However, other critical uses, such as industrial processes, urban landscaping, and non-potable purposes (e.g., toilet flushing, cooling systems), are not adequately addressed. Expanding the scope to cover these uses would enhance water efficiency and resilience.

- The absence of Environmental Quality Standards (EQS) specifically tailored for rainwater and stormwater reuse is a gap. EQS provide essential guidelines for water quality, ensuring safety and environmental protection. Developing EQS for these sources would promote sustainable urban water management.
- Regulations related to AWR should be better integrated with urban planning and building codes. This includes incentivizing rainwater harvesting systems, greywater reuse, and green infrastructure in construction projects. Clear guidelines and incentives can drive adoption.
- Incentives and Financing Mechanisms: The legislation could enhance incentives for adopting AWR. Financial support, tax breaks, or subsidies for implementing rainwater harvesting, stormwater management, and greywater reuse systems would encourage their widespread adoption.
- Legislation should explicitly address climate change adaptation strategies related to water resources. Considering changing precipitation patterns, extreme weather events, and water scarcity, regulations should encourage adaptive practices like rainwater harvesting and stormwater management. In the interviews, it was proposed to explore funding calls that link and relate AWR not solely with water use and management but also to ecosystem services and climate change adaptation methods. This approach broadens the scope and seeks to align AWR projects with broader funding programs and calls beyond those exclusively related to water treatment.
- Strengthen communication activities to increase stakeholder participation and knowledge in AWR use on different levels (especially of treated wastewater use and on groundwater quantity monitoring).

V References

BIO (2015). Optimising water reuse in the EU, Final report – Part I, Prepared for the European Commission.

Bui, A., Burnham, A., Zieburtz, W. (2019). Survey results provide water reuse cost allocations and pricing guidance. J Am Water Works Assn 111(11):60–63. https://doi.org/10.1002/awwa.1397

Cipolletta, G., Gozde Ozbayram, E., Eusebi, A. L., Akyol, C., Malamis, S., Mino, E., Fatone, F. (2021). Policy and legislative barriers to close water-related loops in innovative small water and wastewater systems in Europe: a critical analysis. Journal of Cleaner Production. Volume 288, 15 March 2021, 125604.

CIS (2016). Common Implementation Strategy for the Water Framework Directive and the Floods Directive. Guidelines on Integrating Water Reuse into Water Planning and Management in the context of the WFD.

EC (2007). Addressing the challenge of water scarcity and droughts in the European Union. COM(2007)414.

EC (2012). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A Blueprint to Safeguard Europe's Water Resources. COM (2012)673.

EC (2016). EU-level instruments on water reuse. Final report to support the Commission's Impact Assessment.

EC (2017). Characterization of unplanned water reuse in the EU. Final Report.

EC (2018). Commission Staff Working Document. Impact Assessment accompanying the document "Proposal for a Regulation of the European Parliament and of the Council on minimum requirements for water reuse". SWD(2018) 249 final.

EC (2019). A European Green Deal, striving to be the first climate-neutral continent. Priorities 2019-2024. Available at: https://ec.europa.eu/info/strategy/ priorities-2019-2024/european-green-deal_en

EC (2022). Study to support the Impact Assessment of the Urban Waste Water Treatment Directive. Final Report.

EC (2022a). Proposal for a Directive of the European Parliament and of the Council concerning urban wastewater treatment (recast). COM(2022) 541 final.

EC (2022b). Annexes to the Proposal for a Directive of the European Parliament and of the Council concerning urban wastewater treatment (recast). COM(2022) 541 final.

EC (2022c). Commission Notice. Guidelines to support the application of Regulation 2020/741 on minimum requirements for water reuse (2022/C 298/01).

EC (2024). Annex to the Commission Delegated Regulation supplementing Regulation (EU) 2020/741 of the European Parliament and of the Council with regard to technical specifications of the key elements of risk management.

EC (2024a). Implementation of the revised Urban Wastewater Treatment Directive. Presentation of DG Environment, Unit C2, at the 2024 Meeting of the Water and Marine Directors in Budapest.

EUREAU (2012). "3Ts" - Tariffs, taxes and transfers in the European water sector. Short guide.

Fatone, F., Eusebi, A. L., Cipolletta, G., Akyol, C. (2020). HYDROUSA water loops in the context of the EU and international policy (including Innovation Deal). Deliverable: D40 of HYDROUSA project.

Foster, S., Gogu, C. R. (2022). Groundwater Assessment and Management for sustainable water-supply and coordinated subsurface drainage: A Guidebook for Water Utilities & Municipal Authorities, IWA Publishing, ISBN: 9781789063103, EISBN: 9781789063110, ePub: 9781789063127, doi.org/10.2166/9781789063110

Hochstrat, R., Wintgens, T., Melin, T., Jeffrey P. (2006). Assessing the European wastewater reclamation and reuse potential-a scenario analysis. Desalination, 188, 1–8.

IWA (2015). Alternative Water Resources: A Review of Concepts, Solutions and Experiences. International Water Association, Alternative Water Resources Cluster.

Maffettone R., Gawlik B.M. (2022). Technical Guidance - Water Reuse Risk Management for Agricultural Irrigation Schemes in Europe, Publications Office of the European Union, Luxembourg, doi:10.2760/590804, JRC129596

OECD (2015). Principles on Water Governance Welcomed by Ministers at the OECD Ministerial Council Meeting on 4 June 2015. Directorate for Public Governance and Territorial Development, Organization for Economic Cooperation and Development: Paris, France, 2015.

Petsani, E., Suarez, I. (2025). Mapping Regulations, Drivers, Barriers, and Risks in Alternative Water Reuse Across National and Regional Levels WP1 – Task 1.2. ICLEI. No URL available.

Procházková, M., Touš, M., Horňák, D., Miklas, V., Vondra, M., Máša, V. (2023). Industrial wastewater in the context of European Union water reuse legislation and goals. Journal of Cleaner Production, Volume 426, 2023, 139037, ISSN 0959-6526, https://doi.org/10.1016/j.jclepro.2023.139037.

Ramm, K. (2024). Water Recovery and Reuse. Presentation at the WFD CIS WG Water Reuse meeting 18 June 2024. https://circabc.europa.eu/ui/group/9ab5926d-bed4-4322-9aa7-9964bbe8312d/library/5cd7ce52-a30e-4d68-b29d-3e19f351358d/details

Ricart S (2019). Challenges on European Irrigation Governance: From Alternative Water Resources to Key Stakeholders' Involvement, University of Alicante, Research Article, Volume 3 Issue 2, https://rua.ua.es/dspace/bitstream/10045/90948/1/2019_Ricart_JEcol&NatResour.pdf

Salgado Fagundes, T., Marques, R. C. (2023). Challenges of recycled water pricing. Utilities Policy 82:101569. https://doi.org/10.1016/j.jup.2023.101569.

Sanz, L. A., Gawlik, B. M. (2014). Water Reuse in Europe. Relevant guidelines, needs for and barriers to innovation- A synoptic overview. JRC Science and Policy Reports.

Sanz, L.A., Gawlik, B. M. (2017). Minimum quality requirements for water reuse in agricultural irrigation and aquifer recharge - Towards a legal instrument on water reuse at EU level. EUR 28962 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-77175-0, doi:10.2760/804116, JRC109291.

Sapiano, M. (2024). Gaps and Bottlenecks for mainstreaming Greywater Reuse in Water Management Policies Outcomes of the NAWAMED Project Policy Assessment. Presentation at the WFD CIS WG Water Reuse meeting 18 June 2024. https://circabc.europa.eu/ui/group/9ab5926d-bed4-4322-9aa7-9964bbe8312d/library/efeacf13-634d-427f-b55f-44500798d734/details

Schuetze, T. (2013). "Rainwater harvesting and management - Policy and regulations in Germany". Water Science & Technology Water Supply 13(2):376. DOI: 10.2166/ws.2013.035.

UN-Water (2020). UN-Water Analytical Brief on Unconventional Water Resources. Geneva, Switzerland.

Wild, T., Fuchs, G., Davis, M. (2024). Sitting in our own soup? Combined sewers, climate change and nature-based solutions for urban water management in Berlin. Nature-Based Solutions 5 (2024) 100113. https://doi.org/10.1016/j.nbsj.2024.100113.

VI Annex I: the questionnaire

WP 2.1 – Deliverable 2.1 interviews

Aim: 3-5 interviews at the European level, and 2-4 interviews in each Demo Case

Duration: 15-45 minutes per interview

Style: semi-structured interview

Note to the interviewer: We don't need a full transliteration of the interview (i.e., a sentence-by-sentence report); instead, **use the short form on page 2** of this document to report on main findings; one per interview, please).

European level: InterSus

Demo Case level: Demo Case partner

Main objective: get first-hand information **from practitioners and important stakeholders** on policy gaps and gaps in the regulatory framework for AWR, as well as best practice and shortcomings in funding opportunities.

→that means: please select people that experience gaps in policy and/or funding on a practical level, i.e., working with AWR projects etc. This can also be people from the Demo Case practitioners.

Guiding questions (you don´t have to strictly adhere to these – only a guidance):

1) There are gaps in the legislation on the European level (e.g., no other uses are covered except agricultural irrigation, no EQS for rainwater/stormwater use). Which gaps should be closed to improve AWR use in the EU?
2) Which policies should be brought forward to strengthen AWR?
3) Which format would be best – directive, regulation, something else?
4) Funding: where do you see the most relevant gaps in funding opportunities?
5) How could better funding be organized (e.g., under which program/fund, in which form etc.)?
6) Pricing: what could be done with regard to pricing of water services to facilitate AWR use?
7) How could that be organized (e.g., stricter application of Article 9 WFD etc.)?

Interview record form

Demo Case:

Date of the interview:

Who led the interview:

Who was being interviewed:

Main findings:

A) On policy/regulation gaps:

B) On funding opportunities/gaps in funding:

AWARD

Alternative Water Resources and Deliberation processes to renew water supply strategic planning

@AWARD_HEU

https:/www.awardproject.eu/

AWARDproject@oieau.fr

Funded by the European Union