WaterWise Hub

Deliverable 2.1

Navigating the Policy Landscape

WaterWise

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Abbreviations

AL	Albania
AKIS	Agricultural Knowledge and Innovation Systems
CA	Consortium Agreement
CAP	Common Agricultural Policy
CE	Circular Economy
DWD	Drinking Water Directive
EC	European Commission
EL	Greece
EPR	Extended Producer Responsibility
GA	Grant Agreement
IED	Industrial Emission Directive
MD	Moldova
MK	North Macedonia
MQMC	Mining, Quarrying, Manufacturing, Construction economic sectors
NECP	National Energy and Climate Plan
PC	Project Coordinator
POIM	Program for Big Infrastructure development (2021-2027)
PPP	Public Private Partnership
QH	Quadruple Helix
QHCs	Quadruple Helix Collaborations
R&I	Research and Innovation
RBMP	River Basin Management Plans
RO	Romania
RS	Serbia
RRF	Recovery and Resilience Facility
UA	Ukraine
UWWTD	Urban Wastewater Treatment Directive
UWWTP	Urban Waste Water Treatment Plant
WCE	Water Circular Economy
WFD	Water Framework Directive
WIDERA	Widening Participation and Strengthening the European Research Area
WP	Work package
WPL	Work package Leader
WSS	Water Supply and Sanitation

Executive Summary

This Deliverable (D2.1) presents a comprehensive policy mapping of the Circular Economy in the Water sector at both EU level and in the participating countries (Greece, Romania, Serbia, Albania, North Macedonia, Moldova, Ukraine) with particular focus on Widening countries.

It reports current challenges and obstacles in the implementation of innovations in several water intensive sectors such as urban, rural, agriculture, industry and tourism.

The deliverable is based on a desktop study and data produced by the project partners and semi-structured interviews. The analysis maps the regulatory environments of two Widening countries (Greece, Romania) and five associated partners (Albania, Moldova, North Macedonia, Serbia, Ukraine). **Validated by the WaterWise Quadruple Helix Think Tank**, the study identifies an Implementation Gap: while alignment with the EU Acquis (WFD, UWWTD) is advancing legally, practical infrastructure and enforcement remain fragmented.

Key findings reveal a **dual-speed evolution**. Urban centres are equipped with Waste Water Treatment Plans but face pressure to be modernized, integrate digital twins and energy neutrality. Conversely, rural areas suffer from lack of infrastructure where centralized models are often economically unviable. Here, the report decentralized solutions supported by remote digital monitoring, to bridge the service divide.

To navigate these barriers, D2.1 proposes a targeted Action Plan focused on three pillars:

- Digitalization: Promoting real-time monitoring to enable remote management of decentralized systems.
- Standardization: Establishing clear quality protocols for water and sludge reuse to mitigate risk for private investors.
- Market Creation: Utilizing Public Procurement and Environmental Permits to drive demand for circular products, such as reclaimed water and recovered nutrients.

By identifying these specific regulatory gateways and bottlenecks, this document lays the foundation for the Hub's future pilot demonstrations and investment strategies, ensuring that WaterWise innovations are not just technically feasible, but also in line with the current legal framework and economically scalable.

Deliverable 2.1 is intended to serve as a living reference document throughout the project lifecycle. While it provides a snapshot of the ecosystem at an early stage of the project, its findings are designed to be revisited, validated and refined through later activities, stakeholder engagement processes and pilot actions.

In this sense, the deliverable establishes a common analytical baseline for the consortium, reducing fragmentation across Work Packages and ensuring that all subsequent strategic and operational decisions are grounded in a shared understanding of ecosystem realities.

1 Introduction: Mapping the Regulatory Framework for Circular Water Solutions

1.1 Context

The transition to a Circular Economy (CE) in the water sector is no longer a technological challenge alone; it is fundamentally a governance challenge. The WaterWise Hub project was established with the mission to augment centralized water systems with decentralized, circular solutions across South-East Europe, with a specific focus on WaterWise Hub partner countries[1], of Greece and Romania, extending to the broader Balkan and Eastern Partnership region.

The transition from linear water management to a circular model requires a supportive legislative environment. Currently, the regulatory landscape is often fragmented, with national laws that were designed for centralized, linear systems usually acting as barriers to decentralized energy and nutrients recovery, water recycling and reuse.

Therefore, the mandate of Task 2.2, and by extension, this deliverable, is to perform a policy mapping exercise. This involves auditing the current legal frameworks in the project's participating widening countries to determine not just what the laws are, but how they function (or fail to function) for innovators in the water sector.

1.2 Purpose of this deliverable

The objective of this report is to translate the complex framework of EU and national legislation into a strategic navigation tool for potential innovation end users who need to navigate the regulatory environment to adopt circular water solutions; industries, water utilities and public authorities. This deliverable provides a practical navigation guide to the policy and regulatory landscape that shapes the uptake of circular and distributed water solutions in Europe. It is produced under WP2 Task 2.2 of WaterWise Hub, which conducts a desktop assessment of EU and national **policies measures that enable or hinder innovation**, with a particular focus on Widening countries and the needs of end users such as utilities, industries and public authorities.

Geographically, the primary focus is EL and RO, expanded through the Thinktank to Albania, Moldova, North Macedonia, Serbia and Ukraine so that national practices and competent authorities are captured alongside EU obligations.

Findings are sourced from official legal texts, government portals and Commission communications, and have been validated through the WaterWise Quadruple Helix Thinktank to capture what happens in practice as well as on paper. The extracts will feed the FundFinder Portal taxonomy under WP3 and inform pilot pre planning and siting criteria under WP4, creating a consistent thread from policy mapping to investment and demonstration.

[1] WIDERA, or Widening Participation and Strengthening the European Research Area, is a key pillar of Horizon Europe aimed at reducing R&I disparities across EU member states and associated countries. It supports widening countries, those with lower R&I performance, through targeted funding to build research capacity and enhance the European Research Area (ERA)

Specifically, this deliverable addresses three core requirements of Task 2.2:

- **Policy Mapping**: To document the transposition of key EU Policies (e.g., Water Framework Directive, Urban Wastewater Treatment Directive) into the national legal frameworks of Greece, Romania, Serbia, Albania, North Macedonia, Moldova, Ukraine.
- **Navigation Recommendations:** To provide actionable policy guidance. This ensures that the innovations developed later in the project are aligned with current legal possibilities and that the consortium knows exactly which policy changes to advocate for.

1.3 Contribution to the Excellence Hub Mission

As an Excellence Hub, WaterWise is expected to go beyond project-based cooperation and act as a structural connector across research, policy, business and society. Deliverable 2.1 directly supports this ambition by addressing two interlinked objectives:

First, it seeks **to identify gaps, bottlenecks and underexploited opportunities** that hinder the transition towards circular and regenerative water systems. These may relate to regulatory barriers, limited technology uptake, insufficient access to finance, skills mismatches, weak linkages between research and market, or lack of cross-regional coordination.

Second, it **provides a strategic rationale for the Hub's intervention logic**, ensuring that the WaterWise Hub positions itself where it can generate the highest added value, both during and beyond the project lifetime.

1.4 Alignment with Circular Economy and EU Policy Objectives

Deliverable 2.1 is explicitly anchored in the principles of the circular economy applied to water systems, including resource efficiency, closed-loop processes, reuse and recovery, and systemic innovation across sectors. Rather than focusing on isolated technologies, the deliverable adopts a systems perspective, recognising water as a key enabler within broader circular economy value chains (e.g. energy, agriculture, industry, urban development).

The analytical framework and findings of Deliverable 2.1 are aligned with a broad set of European Union policy frameworks and strategic initiatives, ensuring relevance, coherence and long-term impact. In particular, the deliverable contributes to and is informed by the European Green Deal, EU Circular Economy Action Plan, EU Water Framework Directive, EU Zero Pollution Action Plan etc.

This alignment ensures that the WaterWise Hub's future actions are policy-relevant, scalable and aligned with EU priorities, strengthening their credibility and uptake potential.

2 Methodology

2.1 Methodology presentation

The methodology for Deliverable 2.1 followed a multi-stage, collaborative approach designed to bridge the gap between high-level EU directives and local implementation realities. This framework ensures that the WaterWise Excellence Hub acts as a structural connector between research, policy, and practice.

Important to flag up here that the national teams played a major role in identifying, collecting, and collating policies and regulations from their countries. They also provided **summary translations of many documents**, ensuring that local legislative nuances (which are often inaccessible in English) were accurately captured and synthesized into the Hub's knowledge base. This internal mobilization allowed for a mapping of the policy landscape that would be impossible through central desk research alone.

This deliverable **adopts a multi-level, mixed-method and participatory research approach**, aligned with Horizon Europe principles for transparency, traceability and co-creation. The method bridges conceptual policy analysis with applied evaluation of regulatory and governance systems, combining systematic review of institutional and policy documents, structured policy mapping, expert input and cross-country comparison. The analytical design is structured around the following steps as shown in Figure 1 below. This methodology ensures consistency across the seven national cases, integrating formal policy analysis with expert-derived insights and enabling structured comparison of policy frameworks supporting the transition to a circular water economy. The sequential workflow applied under Deliverable 2.1 is presented below.

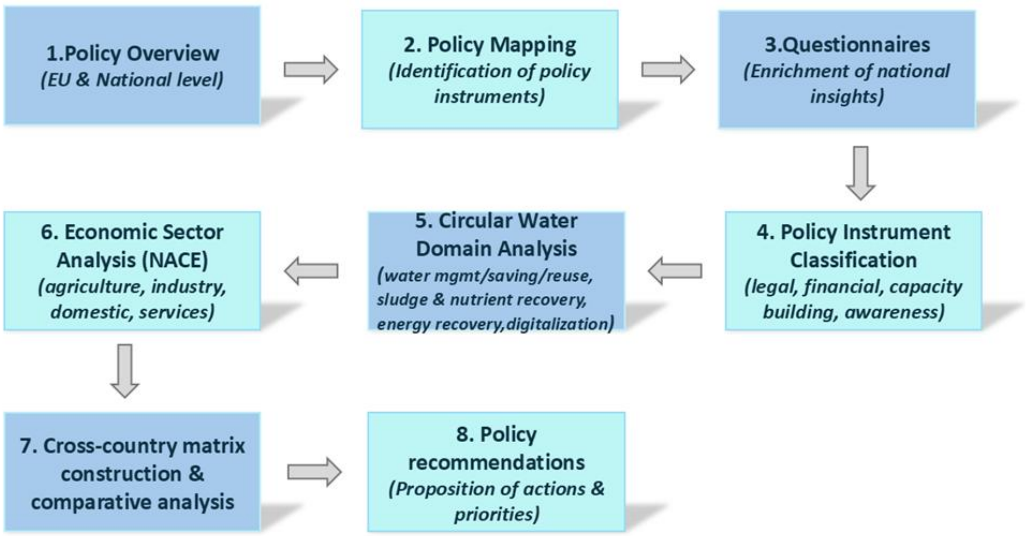

Figure 1: Methodological workflow for EU and national policy analysis

2.1.1 Legislative audit (desktop study)

The primary phase of our methodology involves a comprehensive Desktop Study, serving as the baseline audit for the WaterWise Hub. In alignment with Task 2.2, this research is structured to map the multi-level governance framework governing the circular water economy. We transition from a macro-level analysis of the EU acquis, focusing on the Water Reuse Regulation (EU 2020/741) and the Urban Wastewater Treatment Directive (UWWTD), to the national transpositions in the participating countries.

To ensure contextual relevance to our Excellence Hub mission, the desktop study is segmented into four technical domains: Urban, Rural (Agriculture), Industrial, and Tourism. This allows us to identify policy “silos" where regulations for one sector (e.g., public health) might accidentally block innovation in another (e.g., industrial sludge reuse). The findings of this phase identifies the formal barriers that WaterWise Hub must navigate.

2.1.2 Policy inventories (surveys)

A survey was distributed to the project partners to compile a comprehensive inventory of laws, policies, and policy instruments at the national level that currently, or are expected to, regulate water in the CE. To ensure no barriers were overlooked, the scope was not limited to primary legislation; partners were tasked with identifying any regulatory mechanism that currently enables or hinders alignment with EU policies. Project partners filled out these surveys by themselves or with consultation of stakeholders and regional experts. The survey responses were analysed per country.

2.1.3 Semi-structured interviews

Online, semi-structured interviews were held with selected partners from all Waterwise Hub countries. These interviews focused on

- contextualisation of the written survey responses, gaining a deeper understanding of the situation in each country;
- identification of key gaps, challenges, and opportunities in each country;
- assessment of viable technologies and their applicability in the national context.

In so doing, the interviews provided input for T2.2 (assessment of the policy landscape) and T2.3 (technology assessment).

2.2 Public policy analysis

Public policy analysis provides the conceptual foundation for examining how institutional frameworks shape the transition towards a Circular Water Economy. In the WaterWise Hub context, understanding how policies are formulated, implemented, and interact across governance levels **is essential for identifying enablers and barriers to innovation uptake and water circularity.**

This section sets out core definitions, key policy instruments and the evolution of policy analysis as a field, providing the analytical lens in this deliverable. It also outlines the methodological approach and explains that the adopted methodology is demonstrated and synthesised in the results through structured matrices and cross-country comparison.

2.2.1 Definition of Public Policies

Public policies are deliberate actions undertaken by public authorities to address collective challenges through regulatory, distributive, or redistributive mechanisms. They represent both political intent and institutional capacity, translating societal goals into concrete interventions and outcomes.

According to Dye (1972), public policy encompasses ''*what governments choose to do or not to do''* [2] while Lasswell (1951) conceptualised policy as a functional and problem-solving process[3]. More recent scholars, such as Howlett, Ramesh and Perl (2009), emphasise the governance dimension of policymaking, integrating participation, legitimacy, and coordination among multiple actors[4].

Within the European Union (EU), public policy operates in a multi-level governance framework, involving the EU institutions, Member States, and regional/local authorities[5]. This multi-level character is particularly relevant to environmental and water-related domains, where competences are shared and coordinated across levels.

In the context of the circular economy for water, public policies define how regulatory, economic, and innovation-oriented instruments are combined to promote sustainable water use, resource efficiency, and resilience. Understanding their nature and structure is therefore essential for mapping how EU and national frameworks shape water reuse, efficiency, and innovation adoption.

2.2.2 Public Policy Implementation – Instruments

The implementation of public policies is operationalized through a combination of regulatory, economic, informational, and voluntary instruments. Each instrument type serves a distinct function in influencing actor behaviour, steering resource allocation, and supporting compliance or innovation.

- **Legal and regulatory instruments**, such as laws, directives, and environmental standards, set the foundation for compliance and legal certainty. They define the rules of conduct and ensure legal certainty.

[2] Dye, T. (1972). Understanding Public Policy. Prentice Hall, 1972.

[3] Lasswell, H. (1951). The Policy Orientation. Stanford University Press.

[4] Howlett, M., Ramesh, M. & Perl, A. (2009). *Studying Public Policy: Principles and Processes.* Oxford University Press.

[5] https://ec.europa.eu/regional_policy/en/information/publications/brochures/2019/urban-agenda-for-the-eu-multi-level-governance-in-action

In the water sector, the Water Framework Directive (WFD) and Water Reuse Regulation are key examples of how binding norms guide sustainable water use, enforce quality thresholds, and set obligations for Member States and operators[6][7].

- **Financial instruments** involve market-based incentives or disincentives, such as subsidies, environmental taxes, tradable permits, or compensation schemes.

  The Common Agricultural Policy (CAP) mobilizes financial tools like *eco-schemes* and *agri-environmental measures* to promote resource-efficient irrigation, reuse of treated wastewater, and nutrient recycling in agriculture[8].

- **Informational or communicative instruments** are designed to influence behavior and policy outcomes through knowledge dissemination, awareness campaigns, and technical support.

  Examples include platforms like AKIS (Agricultural Knowledge and Innovation Systems), and Horizon-funded projects, which foster the uptake of circular water practices[9][10].

- **Voluntary instruments** that rely on non-binding agreements such as codes of conduct, self-regulation, and private sector commitments. While not enforceable by law, they enhance flexibility and stakeholder engagement, especially when used in combination with other tools. They can also prepare the ground for future regulatory action by piloting new practices[11].

Policy integration and the role of instrument mixes

Sustainability transitions depend on the strategic combination of instruments across sectors and governance levels.

In the water domain, the EU applies this integrated approach through a set of complementary measures:

- Regulatory foundations (e.g. WFD, Water Reuse Regulation).
- Economic incentives (e.g. CAP eco-schemes, cohesion policy funds).
- Innovation and knowledge support (e.g. HORIZON Europe, AKIS).

Such multi-instrumental policy design enables both compliance-based and innovation-driven pathways toward sustainable and circular water use[12].

For the needs for our analysis the following four groups of Policy Instruments were selected:

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6 https://eur-lex.europa.eu/eli/reg/2020/741/oj/eng
7 https://eur-lex.europa.eu/eli/dir/2000/60/oj/eng
8 https://agriculture.ec.europa.eu/cap-my-country/cap-strategic-plans_en
9 https://eu-cap-network.ec.europa.eu/support/innovation-knowledge-exchange-eip-agri/akis_en
10 ec_rtd_horizon-europe-strategic-plan-2021-24.pdf
11 OECD (2020). *Better Regulation Toolkit for Public Sector Innovation*. Paris.
12 Karoline S. Rogge, Kristin Reichardt, Policy mixes for sustainability transitions: An extended concept and framework for analysis, Research Policy, Volume 45, Issue 8, 2016, Link.

- **Legal and regulatory instruments:** which for the needs of our analysis integrate the prescription of control-inspection-monitoring mechanism and possible penalties of non-compliance
- **Financial instruments:** economic incentives, subsidies, fines, green taxes etc. The economic incentives can also be used in order to mainstream best practices that are not yet mandatory by the regulatory framework (e.g. fund only projects that apply stricter quality criteria than the mandatory) in a voluntary base.
- **Capacity Building instruments:** actions that empower the relevant stakeholders such as attribution of clear jurisdiction, specialised manpower/personnel, Lifelong Learning, access to innovation, active involvement in the decision-making process, adequate financial resources
- **Public Awareness:** is essential to fostering informed communities who understand that water is a finite public resource affecting their standard of living. Furthermore, water reuse practices necessitate a mentality swift from the end-users and therefore public acceptance is a prerequisite for a Water Circular Economy.)

Within this deliverable, the analysis considers **not only individual instruments but also how they interact**. Building on this approach, the present deliverable adopts a structured analytical framework that translates the concept of policy mixes into a practical assessment tool. Specifically, policies are classified according to the four core instrument categories and then assessed across circular-water domains and key economic sectors. This enables us to identify not only the presence of instruments, but also the balance, complementarities and gaps within national policy mixes.

2.3 Historical Evolution of Policy Analysis

The field of public policy has evolved from linear and top-down models to dynamic, systemic approaches, better suited to today's governance challenges.

- **Classical policy cycle:** Originally conceptualized as a step-by-step process — agenda setting, formulation, implementation, evaluation, and termination — this model offered a structured but overly simplistic representation of how policies are made and evolve[13].
- **Contemporary perspectives:** Current frameworks view policy-making as a complex, iterative, and adaptive process, shaped by multiple actors, shifting priorities, and feedback loops. Governance is increasingly networked, involving public, private, and civil society actors across different levels[14].
- **Modern analytical tools include**:

[13] Ronit, Karsten, and Tony Porter, 'Harold D. Lasswell, The Decision Process: Seven Categories of Functional Analysis', in Martin Lodge, Edward C. Page, and Steven J. Balla (eds), The Oxford Handbook of Classics in Public Policy and Administration, Oxford Handbooks (2015; online edn, Oxford Academic, 7 July 2016), link.

[14] Howlett, M., Ramesh, M. & Perl, A. (2009). *Studying Public Policy : Policy Cycles and Policy Subsystems*. Oxford University Press.(NO DOI available)

- **Policy mix analysis**: Examines how different instruments interact (synergies, gaps, trade-offs), especially important for sustainability transitions.
- **Participatory policy analysis**: Integrates stakeholder knowledge and values, improving legitimacy and responsiveness.
- **Data-driven policy intelligence**: Employs digital tools (e.g., GIS, big data analytics, real-time monitoring) to inform and adapt decisions based on evidence[15].

These methodological evolutions align with EU strategies like the European Green Deal and Circular Economy Action Plan, which require **cross-sectoral coordination, policy learning, and long-term resilience**.

2.4 Circular Water Domain Analysis

In order to assess how policies support circular water innovation and implementation, a domain-based analytical framework is applied. Circular water strategies aim to reduce water consumption through efficiency, maximise reuse and recover valuable resources, while ensuring that core water services and governance structures are in place (Morseletto et al).

In order for these domains to be successful, basic integrated water management, (drinking) water provision and sanitation need to be in place. The four domains are defined as follows:

- **Basic water management, provision and sanitation**
  - Drinking water supply, urban/industrial wastewater treatment
  - Environmental requirements for wastewater discharge
  - Integrated water management and river basin management
- **Water saving**
  - Efficiency, infrastructure leakage prevention, hose bans, etc.
  - Technologies for water-efficient production processes
- **Water reuse**
  - Wastewater treatment for agricultural, industrial or domestic use
  - Industrial symbiosis (reuse between companies)
  - Direct and indirect reuse as well as reuse after treatment
- **Nutrient and energy recovery**
  - Reuse of brine/sludge for agricultural purposes
  - Energy recovery (heat/steam, May also include district heating)
  - Extraction of nutrients and other materials from wastewater/sludge (e.g. metals)

[15] https://www.oecd.org/en/publications/the-oecd-digital-government-policy-framework_f64fed2a-en.html

In addition to these elements of CW, we place additional emphasis on **digitalization** as a key mechanism towards circular solutions. This includes the development of smart metering, digital twins, data sharing and other systems in the water sector.

Based on surveys distributed among the WWH country partners and follow-up interviews (see Chapter 4), we assessed to what extent the country policies address the four domains of circular water innovation (basic water management, water saving, water reuse, and nutrient and energy recovery) and digitalization, identifying enabling and hindering conditions for each domain.

Moreover, we categorized the policy field per domain as either:

- **Generic** (i.e. general reference to the importance of circular water or setting broad sustainability goals without specific requirements, incentives, or mechanisms attached to them);
- **Specific** (i.e. stipulating provisions, targets, requirements, and/or legal and financial frameworks).

Table 1: Circular Water Domains

Domain	Description
Basic Water Management (BWM)	Drinking water supply, sanitation, wastewater treatment, river-basin management & discharge standards
Water Saving (WS)	Efficiency measures, leakage reduction, demand management, water-efficient technologies
Water Reuse (WR)	Agricultural, industrial and urban reuse, including industrial symbiosis and direct/indirect reuse
Nutrient Recovery (NR)	Extraction and reuse of nutrients and materials form wastewater and sludge streams
Energy Recovery (EnR)	Heat and biogas recovery from wastewater treatment and water systems
Digitalisation (DIG)	Smart monitoring, automation, data-driven optimisation and digital water technologies

This domain framework forms the analytical backbone for the subsequent policy mapping and matrix-based comparison, ensuring that EU and national policies are assessed consistently across the entire circular water cycle and enabling the identification of thematic gaps, strengths and innovation opportunities.

2.4.1 Matrix-Based Policy Assessment

To operationalize the analytical framework described above, EU and national policy measures were coded across three dimensions: circular-water domains, policy instrument categories and key economic sectors. **The resulting matrices enable a harmonized and transparent comparison** of policy coverage, coherence and implementation patterns across the seven participating countries.

The matrix approach supports three complementary objectives:

- **Domain coverage analysis** – identifying whether policies address all stages of the circular-water cycle (basic services, saving, reuse, recovery, energy, digitalisation)
- **Instrument balance assessment** – examining the mix of legal & regulatory, financial, informational and voluntary instruments supporting circular-water transition
- **Sectoral alignment mapping** – linking policies to NACE-aligned economic sectors (agriculture, MQMC, energy production, domestic/municipal, services) to evaluate sectoral focus and cross-sector synergies.

This structured methodology enables the systematic identification of policy strengths, critical gaps, differences in implementation maturity and opportunities for cross-country learning. To ensure clarity and comparability, findings are organised along the same three analytical dimensions. Based on this approach, the matrices apply consistent coding logic across all participating countries, allowing policies and recommendations to be clearly mapped and contrasted according to their thematic focus, policy instruments employed and sectoral relevance.

To translate the analysis into an actionable roadmap, each policy recommendation has been codified based on the specific policy domains required for its successful implementation. Drawing on the governance framework established in Section 2.2, we utilize four primary instrument codes:

- **L – Legal & Regulatory**: Measures requiring legislative change, new standards, or stricter enforcement (e.g., binding water reuse targets).
- **F – Financial:** Measures requiring economic incentives, subsidies, tariffs, or penalties (e.g., funding for irrigation networks).
- **C – Capacity Building:** Measures requiring training, institutional strengthening, or technical upskilling (e.g., training operators on digital twins).
- **P – Public Awareness:** Measures requiring stakeholder engagement and social acceptance campaigns (e.g., educating farmers on the safety of reclaimed water).

The codified results are discussed in Chapter 6.

2.5 Validation framework

The Validation Framework represents the final test for the findings of Task 2.2, ensuring that the policy mapping and recommendations are practically viable for regional stakeholders. In the context of a Horizon Europe Excellence Hub, validation is not merely an internal quality check.

The results of the survey analysis and qualitative analysis of the interviews are reported in country-specific chapters. The project partners were then asked to read and review the chapter corresponding to their country of origin, enabling them to correct mistakes and add additional information. The results of the study were presented during the 1st Waterwise Hub Think Tank meeting on December 11th, 2025, where participants were asked to prioritize the policy recommendations listed in this report in chapter 6. Selected results from the meeting are presented in Annex I. Both external participants covering the Quadruple Helix parts and WaterWise Hub project partners participated in the meeting.

3 European Union Policy Context

The historical evolution of policy analysis in European water resources management shifted from fragmented, use-specific regulations to integrated, ecosystem-based frameworks, driven by public health concerns, environmental degradation, and EU integration goals[16,17].

The Sectoral and Fragmented Era (1970s early 1990s)

Initial EU water policies focused on public health protection and harmonizing rules for the common market. Key directives from 1975-1980 set standards for drinking water (COM 75/440), bathing water (COM 76/160), and discharges of dangerous substances (COM 76/464), using quality objectives and emission limits. These measures triggered administrative reforms in member states, improved monitoring, and raised public awareness, though implementation varied due to national discretion and costs. Early European water legislation was primarily reactive, focusing on specific "end-of-pipe" solutions or requirements for specific water uses[18].

The Integrated River Basin Management Era (2000 – 2010s)

The Water Framework Directive (WFD): Adopted in 2000, the WFD established a holistic framework that treats aquatic ecosystems as a single unit. It introduced the "one-out-all-out" principle, meaning a water body is only considered to be in "good status" if every single chemical and biological parameter meets the required standard.

The Modern Era: Resilience, Circularity, and New Pollutants (2019-Present)

Current policy analysis is driven by the European Green Deal and the Zero Pollution Action Plan, focusing on climate adaptation and emerging threats. Water policy in the European Union has evolved to address increasing environmental pressures, climate impacts, and resource inefficiencies across Member States and neighbouring countries. Initially focused on pollution control and regulatory compliance, EU water policy has gradually shifted towards a more integrated approach linking water management with climate action, agriculture, circular economy, and regional development. This transition reflects the need for resilient and efficient water systems capable of responding to water scarcity, droughts, pollution, and ecosystem degradation. Recent EU initiatives emphasise cross-sectoral coordination, innovation, digitalisation, and the uptake of circular practices to reduce freshwater demand, promote reuse, and enhance resource recovery.

For the WaterWise Hub partner countries, understanding this evolving policy landscape is essential for aligning national and regional actions with EU priorities, strengthening implementation capacity, and accelerating the transition to a circular water economy. This section provides an overview of how EU water-related policies have developed, how circularity principles have been integrated, and which financial instruments support implementation.

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[16] Evolution of EU water policy: a critical assessment and a hopeful perspective Kallis, G.; Nijkamp, P. - link

[17] The water policies of European institutions (1970s to the present), link

[18] Fitness check of WFD, GWD, EQSD, FD, SWD(2019) 439 final, link

3.1 Strategic Context of the South-East Europe Region

3.1.1 Demographic Trends: The Urban-Rural Divide

Available demographic data reveal fundamental impacts water management planning. While the EU-27 population has shown resilience and steady growth, expanding by 6.0% from 424 million in 2000 to nearly 450 million in 2024, the regions targeted by the WaterWise Hub are facing a demographic reduction as shown in Figure 2.

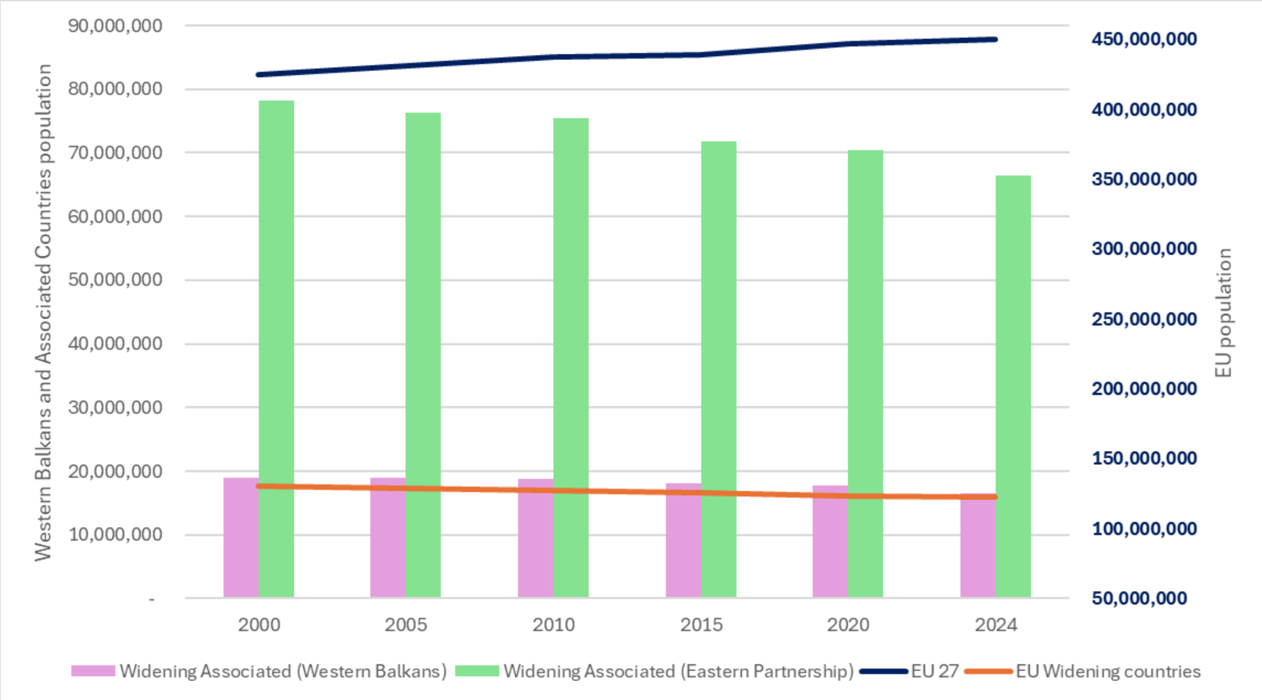

Figure 2: Demographic developments of European Union, widening countries and interest areas of WaterWise Hub partner countries.

EU Widening Countries: Despite the benefits of EU membership, this group (which includes Greece and Romania) has seen a population decline of 6.1%, losing nearly 8 million inhabitants since 2000.

The Western Balkans: The decline accelerates in the Associated Countries of the Western Balkans (including Serbia, Albania, and North Macedonia), which have contracted by 12.5%.

The Eastern Partnership: The most dramatic drop is observed in the Eastern Partnership region (including Moldova and Ukraine), which has faced a 15.1% decrease, reduced by nearly 12 million people in two decades.

Across the 15 EU widening countries (Bulgaria, Croatia, Cyprus, Czechia, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia, Slovenia), urban population share averaged 67.8% in 2000, rising to 72.9% by 2024, a net gain of 5.1 %, while rural share fell from 32.2% to 27.1%., reflecting accelerated urbanization driven by net internal migration, post-accession labor mobility, and agglomeration economies[19,20].

For the water sector, these demographic shifts represent a critical sustainability challenge manifesting in two ways: First, in established urban centres with legacy infrastructure, utilities face the "Oversized Infrastructure Trap." Networks designed decades ago for growing populations now suffer from under-utilization, leading to technical issues (e.g., water stagnation) and spiralling maintenance costs per capita. Second, and perhaps more critically for the WaterWise Hub, rural and developing regions face a "Planning Trap." As these regions move to increase service coverage, there is a risk of designing new, centralized infrastructure. This could lock shrinking communities into expensive systems they will not be able to afford to maintain in the future.

This data validates WaterWise Hub's adaptive approach. This data validates WaterWise Hub's adaptive approach. In growing urban centers, we focus on digital efficiency to manage density and optimize existing networks. In contrast, for shrinking rural and semi-rural areas, expensive centralized infrastructure is often unjustifiable. Here, the demographic reality calls for decentralized and modular systems, where nature-based solutions are frequently strong candidates. Crucially, digital solutions act as the enabler for this decentralized model, allowing for cost-effective remote monitoring and maintenance of these distributed assets.

3.1.2 The investment challenge

While transforming centralized legacy systems is undeniably capital-intensive, requiring upgrades to treatment plants and new distribution networks, circular solutions can conversely offer a cost-effective alternative to traditional infrastructure renewal. In specific contexts, particularly where aging infrastructure requires expensive rehabilitation, decentralized reuse and recovery may present a lower capital option than total renewal. The socioeconomic reality of South-East Europe is defined by an investment gap and the actual funding available from national budgets or tariffs. Large upfront capital needs for wastewater treatment upgrades and water reuse schemes often require blended finance, long payback periods, and stable policy signals to attract private sector investment. This slows project initiation and scales of reuse across regions[21].

A primary challenge in Greece and Romania is the competition for capital between complying with basic EU directives and investing in advanced circular innovations. While EU policy drives towards advanced circularity (reuse, symbiosis), the local investment landscape is dominated by the need to close basic infrastructure gaps. As highlighted in the 12th Technical Assessment of UWWTD Implementation [22](2024), significant capital is still required in these regions to achieve full compliance with basic wastewater collection and treatment. Consequently, public utilities

[19] Rural population (% of total population) – EU, World Bank, link

[20] Urban population (% of total population) – EU, World Bank, link

[21] Circular Economy and Water sector challenges in Greece, Contribution of JASPERS to the development of sustainable investments, JASPERS Stakeholders' meeting 2022, link

[22] 12th technical assessment of UWWTD implementation (2023-2024), link

are forced to channel their limited resources into meeting mandatory basic compliance targets to avoid EU sanctions, leaving no financial capacity for voluntary circular innovations.

Greece faces water scarcity in some regions and a need to modernize WWTPs and distribution networks; regulatory clarity and targeted EU funding are essential to scale water reuse and sludge/resource recovery at a practical pace. Romania exhibits aging infrastructure and relatively high distribution losses; high investment volumes, better regulatory alignment, and PPP-friendly models are needed to unlock circular water investments and reuse pathways.

3.1.3 Innovation Landscape: The Widening Gap

While GDP is growing, there is a significant investment gap in environmental infrastructure compared to the EU average, creating a dependency on EU Cohesion Funds for water projects for the widening countries. The innovation landscape for water-relevant sectors across the EU widening countries is primarily characterized by a significant struggle to achieve resource efficiency and circularity, with most nations falling into the Moderate or Emerging Innovator categories[23].

Resource Productivity and Efficiency Performance in resource productivity, a key proxy for the efficient use of water and raw materials, is highly polarized. Malta is a notable outlier, excelling with 159.1% of the EU average. Conversely, the majority of the group faces severe deficits: Romania (15.5%), Bulgaria (13.5%), and Estonia (24.8%) record some of the lowest efficiencies in the EU, indicating that these economies remain highly resource intensive.

Circular material use rates, which underpin sustainable water and sewerage management (NACE E), are generally low. Czechia is the only country in this group to slightly exceed the EU average at 11.7%. Most others lag significantly, with Romania (1.4%), Portugal (2.9%), Lithuania (4%), and Bulgaria (4.1%) showing minimal recirculation of materials. Greece faces particularly acute challenges, recycling only 17% of municipal waste compared to the EU average of 49%.

While Greece and Romania have integrated water management into their strategic recovery plans, they currently lag the European Union average in the circular material use rate, which is a primary driver for sustainable water and sewerage activities (NACE E)[24],[25]. Greece is classified as a Moderate Innovator, yet it encounters systemic challenges in resource recirculation, while as an Emerging Innovator and exhibits some of the most significant resource challenges in the EU.

In the western Balkans region Serbia is the most advanced innovator, performing at 51.5% of the EU average[26], Albania performs at 37.9% of the EU innovation average, showing a steady increase since 2018 [27]and North Macedonia North performs at 40.0% of the EU average, following a positive growth trend since 2018. In summary, while Serbia has the most advanced policy roadmap for circularity, it currently has the most intensive and inefficient use of resources.

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[23] European innovation scoreboard 2025, European Commission, link

[24] European innovation scoreboard 2025, Country profile Greece, link

[25] European innovation scoreboard 2025, Country profile Romania, link

[26] European innovation scoreboard 2025, Country profile Serbia, link

[27] European innovation scoreboard 2025, Country profile Albania, link

Albania shows the highest relative efficiency in production, while North Macedonia is experiencing the fastest rate of improvement in its resource usage despite an overall declining environmental trend[28].

In summary, the region faces a circularity gap. While there are visible gains in digital adoption, these efforts are largely focused on administrative efficiency and regulatory compliance rather than circular resource loops; the transition to sustainable resource management remains hindered by low investment and a lack of specialized labor.

3.2 Historical Overview of EU water policies

The European Union has progressively developed a comprehensive policy framework to ensure sustainable water management and strengthen resilience to climate and resource pressures.

Since the early 2000s, EU water policy has evolved from pollution control to an integrated, ecosystem-based approach linking environmental protection, agriculture and climate adaptation.

The Water Framework Directive (WFD) marked a major shift by introducing river basin management planning, ecological and chemical status objectives, participatory governance, and the ‘polluter pays’ principle. Complementing this, the Urban Waste Water Treatment Directive (UWWTD) set the foundation for wastewater collection, treatment, and discharge standards across the EU, while the Nitrates Directive and the Groundwater Directive strengthened water quality protection and created enabling conditions for safe reuse.

The Blueprint to Safeguard Europe’s Water Resources[29] reviewed the performance of EU water policy, identified implementation gaps across Member States, and outlined a long-term strategic vision for improving water efficiency, knowledge-based decision-making, and resilience. It also highlighted innovation, demand management, and economic instruments as key levers for sustainable water governance.

As the impacts of climate change became more apparent, the policy framework was expanded to manage extremes. The 2007 Floods Directive moved beyond local flood protection toward a basin-wide risk management approach focused on prevention, preparedness, and protection[30]. This was supported by "daughter directives" like the Groundwater Directive (2006) and the Environmental Quality Standards Directive (2008), which further refined the definitions of chemical and quantitative status. By the late 2010s, evaluations like the REFIT programme confirmed that while these policies had significantly improved water quality, implementation gaps remained, particularly regarding nutrient losses and emerging pollutants[31].

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[28] European innovation scoreboard 2025, Country profile North Macedonia, link

[29] A Blueprint to Safeguard Europe's Water Resources, link

[30] FITNESS CHECK of WFD, GWD, EQSD, FD, 2019, SWD(2019) 439 final , link

[31] UWWTD, 10th Implementation Report,2020, link

In the modern era, European water policy is increasingly driven by the European Green Deal and the Zero Pollution Action Plan[32]. Current governance has moved toward building systemic water resilience[33]. Key recent developments include the 2020 Water Reuse Regulation, which promotes the use of treated wastewater for agricultural irrigation to alleviate water stress, and the 2020 Drinking Water Directive recast, which introduced a proactive, risk-based approach to safety from catchment to tap. The 2024 UWWTD recast further modernized the framework by introducing Extended Producer Responsibility (EPR), requiring the pharmaceutical and cosmetics industries to fund the removal of micropollutants, and setting a target for the wastewater sector to achieve energy neutrality by 2045

Since 2019, EU policies have increasingly integrated circularity, climate neutrality, and resource efficiency principles. The European Green Deal positioned water sustainability as a core pillar of the EU's climate and circular-economy transition, followed by the Circular Economy Action Plan (CEAP), which promotes water reuse, nutrient and resource recovery, and circular water systems across sectors. The Water Reuse Regulation, applicable since June 2023, provides harmonized minimum requirements for safe water reuse in agriculture, supporting adaptation to water scarcity and improving resilience to climate impacts.

Sustainability and circularity principles have also been embedded in agricultural policy through the Common Agricultural Policy (CAP) 2023–2027, linking financial support to performance, sustainable irrigation, and resource conservation. The revised CAP also strengthens advisory services and innovation uptake through AKIS structures, supporting knowledge transfer and capacity building for circular water practices.

The Directive (EU) 2024/3019, recast UWWTD significantly modernizes European wastewater management by aligning it with the European Green Deal's zero pollution and climate neutrality ambitions. A primary development is the lowering of the population threshold for mandatory wastewater collection and treatment to include agglomerations of 1,000 p.e. and above by 2035. The Directive introduces tiered implementation for advanced treatment: tertiary treatment for nutrient removal (Nitrogen and Phosphorus) must be achieved in larger facilities (>150,000 p.e.) by 2039, and quaternary treatment for a broad spectrum of micropollutants must be operational by 2045. Smaller plants (>10,000 p.e.) must comply if discharging into sensitive or risk-prone areas. To finance quaternary treatment, an Extended Producer Responsibility (EPR) scheme requires the pharmaceutical and cosmetics industries to cover at least 80% of the costs. Crucially, the wastewater sector must now focus on energy neutrality at the national level, with a binding target of 100% renewable energy generation by 2045. This shift is supported by mandatory energy audits for larger facilities starting in 2028. Finally, the recast UWWTD enhances governance and circularity by requiring the systematic promotion of water reuse and the recovery of resources like phosphorus from sludge.

[32] Pathway to a Healthy Planet for All, EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil', COM(2021) 400 final

[33] Communication From The Commission To The European, Parliament, The Council, The European Economic And Social, Committee And The Committee Of The Regions, European Water Resilience Strategy, COM(2025) 280 final.

The Table 2 below summarises the evolution of key EU water-related policy milestones, illustrating how legislative and strategic frameworks have progressively integrated circularity, climate neutrality and sustainable resource management.

Table 2 - Key EU Policy Milestones Promoting Sustainable Water Use

Year	Policy Milestone	Key Contribution
1991	Urban Waste Water Treatment Directive (UWWTD)	Establishes minimum standards for wastewater collection, treatment and discharge across the EU
1991	Nitrates Directive	Protects water bodies from agricultural nitrate pollution; enables safer water resources & reuse compatible environments
2000	Water Framework Directive (WFD)	Introduces river-basin management, ecological and chemical objectives & the 'polluter pays' principle
2006	Groundwater Directive (GWD)	Protects groundwater quality and supports safe managed aquifer recharge & indirect reuse
2012	Blueprint to Safeguard Europe's Water Resources	Reviews implementation of EU water law; sets long-term vision for efficiency, innovation and resilience
2015	1st Circular Economy Action Plan	Mandated the creation of the Water Reuse Regulation
2019	European Green Deal	Establishes the overarching strategy for climate neutrality, embedding water sustainability in EU policy
2020	Circular Economy Action Plan (CEAP)	Promotes water reuse, resource recovery and circular water systems across sectors and triggered the UWWTD Recast
2020	Water Reuse Regulation (EU 2020/741)	Defines harmonised minimum requirements for safe reuse of treated wastewater in agriculture
2023	Common Agricultural Policy (CAP 2023-2027)	Policy Links financial support to environmental performance, sustainable irrigation and resource conservation
2024	Recast UWWTD	Expands scope; introduces micropollutant removal, resource, recovery, energy & digital requirements, enabling circular wastewater systems
2025	EU Water Resilience Strategy	Promotes diversified water sources including water reuse; strengthens adaptation, circularity & system resilience
2026	Circular Economy Act	To accelerate market demand for secondary materials (including reclaimed water)

3.3 Integration of circular economy principles in relevant policies

The EU has progressively embedded the principles of the circular economy into its environmental and sectoral policy frameworks, ensuring that water resources are used efficiently, safely, and sustainably. Within this context, circularity in water management aims to reduce waste generation, reuse treated wastewater and recover resources such as energy and nutrients from sludge and other by-products.

The transition toward circular water systems is guided by a set of key EU legislative and policy instruments, which jointly promote the ‘reduce-reuse-recover’ model across sectors.

3.3.1 Core Policy Instruments

The Circular Economy Action Plan (CEAP), adopted in 2020 under the European Green Deal, represents a key policy milestone. It promotes the closing of resource loops across production and consumption systems and explicitly identifies water reuse, recovery, and recycling as priorities for sustainable industry and agriculture[34]. This cross-sectoral approach encourages synergies between water management, waste treatment, and resource recovery, thereby fostering innovation and reducing dependence on freshwater abstraction.

Building on the CEAP, the forthcoming Circular Economy Act (expected in 2026) is designed to strengthen synergies and ensure greater alignment across multiple EU legislative and regulatory instruments, further embedding circular principles throughout the European policy landscape[35].

Although the Water Framework Directive (WFD) predates the CEAP, it laid the groundwork for integrating circular economy thinking into EU water policy through its focus on sustainable water cycles and pollution prevention. The subsequent Water Reuse Regulation (EU 2020/741) operationalises these principles by establishing a harmonised framework for the safe reuse of treated wastewater in agriculture-transforming wastewater from a disposal challenge into a valuable resource that contributes to water efficiency and resilience.

Within the Common Agricultural Policy (CAP), circularity is advanced via eco-schemes and conditionality requirements that incentivise efficient irrigation, nutrient recycling, and soil-water conservation. These mechanisms promote the closing of water and nutrient loops while supporting climate adaptation and sustainable agricultural productivity[36].

At a broader level, the European Green Deal and its related initiatives-such as the Zero Pollution Action Plan- extend the application of circular principles beyond agriculture and water management to the wider economy. By linking water reuse, pollution control, and resource efficiency, they foster the systemic integration of circular economy principles into regional development and industrial innovation[37].

3.3.2 Relevance of EU Policy to the Circular Water Economy

The EU policy architecture outlined above directly supports the transition to a circular water economy, where water is managed as a renewable and valuable resource rather than a disposable input. Circularity in water management requires breaking sectoral silos and integrating policies across agriculture, environment, industry, and urban planning.

[34] EUR-Lex - 52020DC0098 - EN - EUR-Lex

[35] https://environment.ec.europa.eu/news/commission-launches-consultation-upcoming-circular-economy-act-2025-08-01_en

[36] https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance/key-policy-objectives-cap-2023-27_en

[37] https://environment.ec.europa.eu/strategy/zero-pollution-action-plan_en

EU policy frameworks increasingly embody this systemic logic. The Circular Economy Action Plan (2020) and European Green Deal (2019)[38] provide the strategic foundation, while the Water Reuse Regulation (EU 2020/741) operationalizes water reuse as a key component of sustainable resource cycles. The Urban Waste Water Treatment Directive (91/271/EEC) and its ongoing recast further reinforce nutrient recovery, energy efficiency, and digital monitoring in line with circularity principles. The CAP 2023–2027 complements these efforts by incentivizing sustainable irrigation, nutrient recycling, and precision water management.

Taken together, these instruments embed circularity principles within EU and national governance, linking environmental protection, innovation and economic resilience.

3.3.3 Economic Instruments and Funding Mechanisms

The European Union supports sustainable water management and the integration of circular economy principles through a wide range of economic instruments, incentives, and funding mechanisms. These tools aim to internalize environmental costs, promote efficient resource use, and encourage innovation in water and resource management.

At the policy level, the Common Agricultural Policy (CAP) remains a major driver of sustainable water use. Since the 2003 reform, cross-compliance and Good Agricultural and Environmental Conditions (GAEC) have linked direct payments to environmentally responsible practices, though they do not impose compulsory water reuse obligations. Under the 2023-2027 CAP Strategic Plan, *eco-schemes* and *agri-environmental* measures provide financial support for actions that enhance irrigation efficiency, promote nutrient recycling, and improve soil-water conservation. Moreover, the CAP supports farmers' training and private investment in sustainable irrigation and water reuse initiatives, thereby contributing indirectly to the EU's green transition.

Research and innovation are supported through the Horizon Europe Framework Program (2021-2027), which funds technologies for water reuse, digital monitoring, and nature-based solutions within clusters as *Climate, Energy and Mobility* and *Food, Bioeconomy, Natural Resources, Agriculture and Environment*[39].

Further financial support is provided through the Cohesion Policy funds, particularly the European Regional Development Fund (ERDF) and the Cohesion Fund, which co-finance investments in wastewater treatment, water reuse systems, and flood resilience. These funds promote balanced regional development while embedding circular and sustainable water management principles [40].

The NextGenerationEU recovery instrument also contributes to this agenda by financing green and digital transitions. Through the Recovery and Resilience Facility (RRF), Member States implement reforms and investments that enhance water efficiency, infrastructure modernisation, and resilient resource management-strengthening Europe's capacity to cope

[38] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

[39] https://eur-lex.europa.eu/EN/legal-content/summary/horizon-europe-the-framework-programme-for-research-and-innovation-laying-down-its-rules-for-participation-and-dissemination.html

[40] https://ec.europa.eu/regional_policy/2021-2027_en

with droughts, pollution, and resource scarcity[41]. According to the European Parliamentary Research Service (EPRS, 2024), at least €12.92 billion of Recovery and Resilience Facility (RRF) funding across 14-15 Member States is allocated to sustainable water-management measures, with an additional €13 billion projected through cohesion funding by 2027.

Although the RRF does not provide a dedicated budget line exclusively for water reuse or circular water systems, several Member States (including Greece and Romania) have included investments in wastewater treatment upgrades, sludge management, desalination and digital water monitoring systems, which enable safe water reuse and circular water practices.

In Greece, RRF-supported measures for sustainable water management amount to €463 million (1.3% of the RRP), including specific wastewater treatment and water-efficiency investments that support future reuse applications. The most recent RRF Annual Report (2025) confirms continued investment in green and water-related infrastructure, noting that €367 billion has already been disbursed, with water efficiency and resilience measures identified among the priority areas for implementation under national recovery plans[42].

According to Greece's 2025 Annual Progress Report on the Recovery and Resilience Plan[43], implementation of green transition investments- including actions on water efficiency and wastewater infrastructure- is progressing as planned. The report highlights that integrated water-management measures constitute an essential component of the green transition, contributing to both environmental protection and climate resilience.

Together, these instruments form a coherent EU approach that links regulation, innovation and finance, ensuring that circular-water objectives are embedded in both policy design and economic implementation frameworks across Member States.

3.3.4 The EU Blue Deal: Towards a Strategic Water Investment Framework

The EU Blue Deal, proposed by the European Economic and Social Committee (EESC) in 2023, represents the next strategic step in advancing sustainable and resilient water management across the European Union. While not yet an official EU policy, it has been widely recognised as a catalyst for the forthcoming EU Water Resilience Strategy. It also complements the Water Framework Directive (WFD), the Common Agricultural Policy (CAP), and the European Green Deal, placing water at the centre of Europe's green and digital transitions.

The initiative calls for a comprehensive European water strategy to address water scarcity, droughts, floods, and pollution, while promoting water reuse as a standard practice, circular resource management, and infrastructure modernisation. It also proposes the creation of a European Water Fund to support investments, research, and cross-border cooperation in sustainable water systems[44].

[41] https://commission.europa.eu/business-economy-euro/economic-recovery/recovery-and-resilience-facility_en
[42] Sustainable water management in recovery and resilience plans
[43] Greece | Annual_Progress_Report_2025
[44] https://www.eesc.europa.eu/en/initiatives/eu-blue-deal

Once endorsed at EU level, the EU Blue Deal is expected to become the ’water pillar’ of the Green Deal, ensuring that Europe’s pathway to climate neutrality equally enhances long-term water security, resilience and investment coherence across Member States.

4 Country-Level Results in WaterWise Hub Partners

4.1 State of play

As climate-driven water scarcity intensifies across the Balkan and Danube regions, aligning with EU circular economy standards moves from a regulatory requirement to an urgent resilience imperative. This analysis maps the landscape of water reuse and industrial symbiosis in WaterWise Hub partners countries, identifying critical infrastructure gaps and high-impact innovation opportunities.

4.1.1 The Widening Countries: Greece and Romania

Greece and Romania represent two distinct stages of the European water management transition. While Greece works to refine a relatively mature but legally pressured system, Romania is engaged in an emergency-scale build-out of basic infrastructure to meet EU requirements.

Greece is characterized by a significant performance gap between its advanced legal frameworks and localized implementation hurdles. The country faces intense pressure from the Court of Justice of the European Union (CJEU) due to non-compliance with the UWWTD[45]. To bridge this gap, the Greece 2.0 (RRF) and Cohesion Funds have allocated over €6 billion to wastewater infrastructure since the mid-1990s. Strategic priorities include a 10% reduction in water abstraction by 2030 and a national methodology to identify "C priority" agglomerations (2,000–10,000 p.e.) for targeted upgrades. Circularity is guided by the National Action Plan for Circular Economy (NAPCE 2021-2025), with Axis 1 focusing on production. Despite a legal framework supporting reuse (JMD 145116/2011), the current reuse rate remains low at 5%.

Romania faces a critical implementation gap in the EU, having failed to meet its final Directive deadline of 31 December 2018. The Romanian PNRR[46] (RRF) is tasked with addressing massive financial requirements. The OECD estimates that Romania must more than double its current expenditure on water supply and sanitation to achieve compliance. Annual investment needs are estimated at €400 million for collection and €132 million for treatment. While Romania adopted a National Strategy for the Circular Economy in 2022, water reuse remains negligible at under 1%.

4.1.2 Regional champions, status of Associated and Non-EU Partners

The status of environment and climate reform for the project countries, focusing on water reuse, industrial symbiosis, and circularity is mainly based on the EU 2025 Enlargement package

[45] Service request supporting the evaluation of Directive 91/271/EEC concerning urban waste water treatment, Evaluative Study, 2019, link

[46] Romania's recovery and resilience plan, link

reports[47] focusing on progress reporting under Chapter 27 Environment and climate change, a key policy area in the EU accession process[48].

Albania[49] is in the early stages of aligning its water and waste rules with EU standards. A significant step was the entry into force of the Law on water resources and the Law on the marine environment protection strategy in October 2024. While the EU is providing over €50 million for water sector protection and energy efficiency, actual services for water and sewerage remain low. There are clear opportunities for Albania to grow its circular economy through cleaner technology value chains, supported by over €30 million in dedicated EU funding.

Serbia[50] has reached a good level of preparation regarding the environmental acquis but faces fragmented institutional management in the water sector. Recent progress includes new laws on Strategic Environmental Assessment and the control of major industrial accidents involving dangerous substances. However, Serbia still needs to adopt a new Water Law and a specific Law on Drinking Water. There is a major opportunity to implement Extended Producer Responsibility (EPR) and the "polluter pays" principle to manage waste streams more effectively.

North Macedonia[51] has made limited progress during this period, despite adopting a new law on industrial emissions in September 2025. Construction is underway for a large wastewater treatment plant in Skopje to serve nearly 500,000 people. Critically, the sources state there has been "no progress" on aligning with EU rules for water reuse. The circular economy is currently described as "stagnating" due to low awareness and a lack of infrastructure.

Moldova[52] is moving from an early stage to having "some level of preparation". In June 2025, it adopted a law on environmental liability to address damage repair. While the National Energy and Climate Plan (NECP) was approved in February 2025, Moldova still needs to align with nine different EU Directives related to water quality. A program to promote a green and circular economy exists, but domestic recycling and wastewater capacity remain underdeveloped.

Ukraine[53] has shown good progress despite the ongoing conflict. It adopted a framework law on climate policy in late 2024 and a law on integrated industrial pollution prevention. River basin management plans were also completed. A key gap remains the adoption of a formal Circular Economy Strategy and Action Plan. The DREAM digital platform is now being used to track reconstruction projects, ensuring transparency in building new water and sanitation infrastructure.

[47] EU enlargement package 2025, link

[48] Chapters of the acquis, link

[49] 2025 Enlargement Package Albania, link

[50] 2025 Enlargement Package Serbia, link

[51] 2025 Enlargement Package North Macedonia, link

[52] 2025 Enlargement Package Moldova, link

[53] 2025 Enlargement Package Ukraine, link

In summary, these countries are successfully passing new laws, but the main challenge is **moving from legislation to building the actual pipes and treatment plants supporting circular water systems.**

4.2 Greece

To ensure consistent evaluation across all seven countries, this analysis applies the Circular Water Domain Framework defined in Section 2.4. National policy landscapes are assessed against five core innovation areas essential for a Water Circular Economy. Policies are classified as either Generic (broad sustainability goals without specific targets) or Specific (clear provisions and binding requirements). Finally, the analysis identifies Enabling Conditions that facilitate uptake and Hindering Conditions (e.g., regulatory bottlenecks) that block progress. This structured approach highlights the specific Policy and Policy Implementation Gaps concerning Circular Water Economy the WaterWise Hub must address. Table 3 presents policy conditions in Greece.

Table 3: Policy conditions per water-CE innovation domain in Greece

Circular water innovation domain	Specific, Generic or no policy	Enabling conditions	Hindering conditions
Basic water management, provision and sanitation	Specific	Comprehensive legal frameworks for integrated water management.	The monitoring and inspection mechanisms need improvement
Water saving	Specific	Existing policies and financial incentives for water saving in irrigation and drinking water supply. Existing national water pricing mechanism.	High percentage of Unbilled water.
Water reuse	Specific	Specific national water reuse regulation and quality standards exist from 2011, for all uses except drinking water.	The monitoring and inspection mechanisms need improvement. High cost of treatment.
Nutrient and energy recovery	Specific	Energy recovery is required in all new WWTP and retrofitting. Specific regulation for sludge reuse exists.	Nutrient recovery not yet applied, the produced compost and/or Sanitized Sludge is used only for landscaping of waste land fields and carries rehabilitation.

4.2.1 General Information

Greece, as a member of the EU since 1981 to adopt the relevant EU policies mentioned above and also benefit from EU funding for the construction of water and wastewater networks and treatment facilities and subsidies for the construction of private rural, agricultural, industrial and tourist wastewater treatment facilities. Table 4 presents the adoption of relevant EU policies in Greece.

Table 4 Adoption of relevant EU policies in Greece

EU Policy	Greek policy document	Year of first adoption*
Environmental Impact Assessment Directive (85/337/EEC)	Law 1960/1986 on Environmental Impact Assessment	1986
DWD (98/83/EC) (2020/2184/EC)	Joint Ministerial Decision no Y2/2600/2001 on the quality of water intended for human consumption Joint Ministerial Decision no Δ1(δ)/Γ.Π.οικ.27829/15.05.2023 on the quality of water intended for human consumption	2001
UWWTD	Joint Ministerial Decision no 5673/400/1997 concerning urban wastewater treatment	1997
WFD	Law 3199/2003 Protection and management of water (Transposition of 2000/60/EU)	2003
IED	"Joint Ministerial Decision no 36060/1155 /E.103/2013 setting the standards and procedures for integrated pollution prevention and control in accordance with IED Directive EU 2010/75	2013
Water Reuse Regulation	National pre-existing quality standards for water reuse Ministerial decision 191002/2013, amendment of the joint Ministerial decision 145116/2011 on the standards and procedures for the reuse of treated waste water	2011

**The year of first adoption refers to the first policy document even if this was later on amended in anyway or replaced by a new policy document with the same scope or an enlarged on*

Greece has the fourth worst Water exploitation index plus (WEI+) in EU (33,6%) according to 2022 data[54] and more than 80% of water abstractions concerns the agricultural sector. In this context water reuse is very important for Greece to achieve water resilience and adapt to climate change.

Greece's water policies are fully harmonized with the European Union's environmental directives and National strategies on the circular economy, climate adaptation, and sustainable development all emphasize water reuse, pollution reduction, and resource efficiency. These strategies align with EU objectives such as achieving zero pollution and energy independence by 2050. Monitoring and inspection need improvement so as to accelerate the implementation of these policies.

For Greece the following five Policy Sectors were deemed pertinent for our Policy Analysis:

- Urban Water
- Rural Water (vs Urban): Includes geographically all activities outside of urban areas that can not be connected to a collective sewage system.
- Agricultural Water

[54] Water scarcity conditions in Europe, EEA, 2025 - link

- Industrial Water
- Tourism water

Further two additional Policy Sectors were identified that influence horizontally all five mentioned above Policy Sectors

- Water Reuse
- Digitalisation

4.2.2 Urban Wastewater Treatment policies and practice

Greece has adopted the UWWTD in 1997 and benefited of EU funding for the construction of sewage collection systems and UWWTP. According to the 12th Technical Assessment[55], reflecting data from 2020, Greece has reached a high level of implementation of the Urban Waste Water Treatment Directive (UWWTD). Out of 480 agglomerations generating a total load of 11.9 million population equivalents (p.e.), 449 (94%) are fully compliant, representing 98% of the generated waste water load. Greece operates 244 treatment plants, the vast majority of which (237) are equipped for more stringent treatment. Major cities like Athens (5.2 million p.e.) and Thessaloniki (900,000 p.e.) are fully compliant for collection and treatment. Regionally, five out of thirteen NUTS 2 regions have reached 100% compliance.

Despite these successes, challenges remain. 31 agglomerations were still non-compliant in 2020, and the country identifies a need for EUR 2.15 billion in investments between 2016 and 2027 to maintain and reach full compliance. Currently, Greece's expected annual investment is EUR 17 per inhabitant, which is significantly below the EU average of EUR 35. Additionally, only 2% of treated waste water is currently reused, primarily for irrigation.

However, the National Operational Plan for Waste Water (ΕΘΝΙΚΟ ΕΠΙΧΕΙΡΗΣΙΑΚΟ ΣΧΕΔΙΟ ΔΙΑΧΕΙΡΙΣΗΣ ΛΥΜΑΤΩΝ ΟΙΚΙΣΜΩΝ ΠΡΟΤΕΡΑΙΟΤΗΤΑΣ ΟΔΗΓΙΑΣ 91/271/ΕΟΚ)[56], issued in January 2021, states that:

- 5 out of 19 priority A urban agglomerations are not in full compliance with UWWTD
- 10 out of 64 priority B urban agglomerations are not in full compliance with UWWTD
- 255 out of 399 priority C urban settlements are not in full compliance with UWWTD

The necessary cost for infrastructure, studies and maintenance in order for all UWWTP to be fully compliant with the UWWTD was estimated in 2.395.477.451 €.

All the UWWTP reported in Greece dispose of secondary treatment (207 UWWTP with Biological treatment with nitrogen and phosphorus removal and 30 with Biological treatment).[57]

UWWTP discharging to a sensitive water body also dispose of tertiary treatment (disinfection). No national official data are available yet on the water and sludge reuse but all new / refurbished

[55] 12th Technical assessment of information on the implementation of Council Directive 91/271/EEC, link

[56] www.mou.gr/elibrary/NationalPlanWaste.pdf

[57] https://water.europa.eu/freshwater/countries/uwwt/greece

UWWTP disposing a tertiary treatment are dotted with a “reclaimed water” reservoir and an internal industrial water network meant also for irrigation within the UWWTP site.

Under the 2014-2021 ERDF, in Greece, no reclaimed water aqueducts and distribution networks were funded. The eligible infrastructure for EU funding included only the tertiary treatment (and refurbishment and upgrade of existing UWWTP), the internal reclaimed water network and reservoir. External aqueducts and distribution networks had to be funded by national funds.

4.2.3 Rural Waste Water Treatment policies and practice

The rural sector was selected as contrary to the urban sector. It includes all activities outside of urban agglomerations and it is a cohesive policy sector for our analysis because different wastewater treatment policies and practices apply. It is also a sector where decentralised treatment solutions are economically preferred.

In Greece most of the population is concentrated in large urban centres. According to the 2021 national census Greece has 10,5 million inhabitants from which approximately 4 million leave in the Athens Metropolitan Area (~ 38%), 1 million leave in the Thessaloniki Metropolitan Area (~9,5%) and another 1,16 million (~11%) leave in 8 municipalities of more than 100,000 inhabitants (Ioannina, Larissa, Volos, Chalkida, Patras, Rhodes, Heraclion, Chania). The rest of the population, approximately 4,34 M (~41%) is scattered in many small cities and rural areas. This unequal distribution of the population is the reasons that Greece has a very high number of priority C urban settlements (total of 399).

In Greece, rural municipalities can have a large number of settlements/villages with less than 1000 inhabitants that are spread many kilometers apart. From 1997 and onwards the national policy focused on the construction of sewage networks in urban areas and “dense rural areas” which could also comprise areas of seasonal dwellings, intense agricultural and other economic activities and industrial areas. The decision of the construction or not of a collective sewage network was based on technical criteria and the local geography. For instance, in many touristic areas, even small villages dispose of a collective sewage system and a UWWTP as well.

If an activity/dwelling is connected to a collective sewage network then the UWWTD treatment requirements apply.

In areas where no collective sewage network exist (yet) the house/activity owners are obligated to construct a watertight septic tank and when it is full to pay themselves the expenses for a chartered tanker vehicle to carry their sewage in the near-by UWWTP. Many UWWTP all over Greece, even in the Metropolitan area of Athens and Thessaloniki, are dimensioned so as to have a separate intake of septic sewage. In some cases, the municipal Water and Waste Companies offer also this tanker vehicle service.

According to the activity, the distance from the closest UWWTP and the capacities of the UWWTP, a municipality/ municipal water and waste water company can decide not to connect some activities to the collective network nor to the UWWTP. Every UWWTP has issued their own regulation.

Existing and new activities and houses that cannot be connected to collective sewage network nor send their sewage by tanker vehicles to UWWTP, have to be equipped by autonomous mini treatment systems (Individual Appropriate Systems) and can dispose of their treated sewage only by subsoil disposal. The construction of this individual treatment system is a prerequisite for their construction permit and activity permit (if one is foreseen for this economic activity). Individuals can reuse treated wastewater if they fulfill the quality criteria of the national wastewater reuse regulation, but as these criteria are stricter than the criteria of subsoil disposal only few activities choose to practice wastewater reuse (irrigation of hotel gardens, etc.).

Historically, many Greek municipalities have chosen, by political and social criteria, to connect as many activities as possible to UWWTP so as to have a centralized control over sewage treatment, avoid illegal untreated sewage disposal and lower the cost for sewage treatment for local inhabitants and important economic activities for the local economy.

In the last two decades small collective treatment solutions have also seen the day in Greece also funded by EU and national sources. These solutions can be applied in settlements of less than 1000 inhabitants and concern both nature-based solutions (e.g. reed-beds) and small compact treatment systems that are remotely controlled.

4.2.4 Agricultural Wastewater Treatment policies and practice

As stated above some municipalities have chosen to connect to UWWTP some agricultural activities and small farms that produce sewage similar to urban sewage. Agricultural activities and farms that cannot connect to UWWTP have to treat their own sewage on their own expenses; Public authorities do not have the obligation to offer agricultural wastewater treatment services.

The Greek Environmental Impact Assessment procedure stipulates that according to the size of a farm (number animals, etc.) specific sewage treatment requirements apply. These requirements are issued with the Environmental Permit of agricultural activity. Usually, agricultural treatment installations are subsidized by CAP funds.

An official system of environmental inspections exists in Greece, but individual sewage treatment systems are inspected rarely and are often perceived as sources of pollution. The RBMP also report on many agricultural activities and their wastewater as sources of pollution for the waterbodies.

In many areas some specific agricultural activities do not dispose yet treatment systems either because they are deemed not as “very polluting” activities (seasonal agricultural activities, use of traditional methods, small scale activities) and do not need environmental permits, either because the strict implementation of the environmental protection legislation would render them not profitable. For these activities the local public authorities are trying to find more sustainable and affordable collective treatment solutions and many of these activities, through the years, stop to exist because of the modernization of the agricultural sector: construction of larger scale farms and agricultural units, retirement of farmers and lack of new farmers etc.

Many research studies have proven the economic benefits of agricultural sewage valorization and co-treatment with other waste/wastewater but as the cost of infrastructure is considerable the Greek government has chosen not to undertake this responsibility on national level.[58]

4.2.5 Industrial Waste Water Treatment policies and practice

In the same spirit with the agricultural sector, some municipalities have chosen to connect to UWWTP some small industrial activities and small manufactures that produce sewage similar to urban sewage. Intramuros, within cities boundaries, some small manufacture activities are difficult to be regulated. The company owners declare the economic activity for fiscal and permitting purposes but do not fully declare all procedures that can produce industrial wastewater. In these cases, the local authorities have to treat the industrial wastewater within the UWWTP.

Industries and manufactures cannot connect industrial wastewater to UWWTP, they can connect only sewage similar to urban sewage. Industrial wastewater has to be treated on site or offsite by the industry itself at their own expenses. Special contractors and specialised units exist that deal with industrial wastewater treatment.

The Greek Environmental Impact Assessment procedure stipulates that according to the size and the activity of an Industry/manufacture specific sewage treatment requirements apply. These requirements are issued with the Environmental Permit of the activity. For Industrial Activities the Environmental Permitting procedure has fully adopted the IED Directive and for industries with important Environmental Impacts the Environmental Permit also stipulates periodical monitoring of the produced waste (and liquid waste and sludge) and on-line reporting of the results through the national Electronic Waste Registry[59].

The data from the annual reports are also send to the EU Registry on Industrial Sites (EU Registry) and the European Pollutant Release and Transfer Register (E-PRTR).

Greece is in the process of de-industrialisation; this can also be seen in the official IED implementation analysis published in 2021 and concerning the years 2015-2018[60]. In this report we can see that Greece has reported only 306 installations in the EU Registry in 2017. Traditional industrial activities are in decline in Greece.

In the recent years some new activities are in expansion that are less polluting and water consuming: logistic-centres, datacentres, solar and wind power plants parks.

An official system of environmental inspections exists in Greece, but individual sewage treatment systems are inspected rarely and are often perceived as sources of pollution. The RBMPs also report many industrial activities and their wastewater as sources of pollution for the

[58] Collective agricultural sewage treatment was proposed as a measure in some of the first RBMP for rural areas with severe pollution problems were due to agricultural activities (2011-2014) but was never implemented and finally abandoned in the 1st (2017) and 2nd (2024) Revision of RBMP.

[59] https://wrm.ypeka.gr/

[60] https://circabc.europa.eu/ui/group/06f33a94-9829-4eee-b187-21bb783a0fbf/library/8fbeca17-20c4-4407-99c2-2077df8f3baa/details

waterbodies. So in practice we see that in some cases industrial activities need public funding and public collective infrastructure in order to treat adequately their wastewater.

4.2.6 Tourism Wastewater Treatment policies and practice

Tourism is characterised as a main national industry in Greece. Greece disposes from massive holiday resorts to individual short term rooms location dispersed all over the country. In many areas, mainly rural, visitors are more numerous than permanent inhabitants and whole settlements have a seasonal character.

Official Tourism establishments: resorts, hotels and small units (even with few rooms or one renting villa) need a permit. The permitting procedure stipulates for all tourism establishments to be connected to UWWTP either to treat wastewater on their own expenses. Larger hotels and resort are required to follow the Greek Environmental Impact Assessment procedure.

The most frequent applied wastewater treatment on tourism establishments is the installation of **a compact wastewater treatment unit** and **subsoil dispersion of the treated effluents**. These installations can be subsidised. The installation, maintenance and good operation of these private installation units are prerequisites for the tourism establishment permit.

4.2.7 Water reuse policies and practice

Because of water scarcity in many areas in Greece, traditionally rainwater harvesting was practiced and in some cases this rainwater harvesting was done at community level.

Treated wastewater started to be available after the adoption of the UWWTD and after the construction and operation of secondary and tertiary treatment. Because of Greece's geography most UWWTP discharge into the sea, with special submarine diffusers, and lower treatment requirements apply. Therefore in most UWWTP the treated water was of low quality for reuse.

The need for water reuse regulation stemmed out of the need to regulate the private sector as stated above: rural activities, agricultural activities, industrial activities, tourism. These private activities are not permitted to dispose of treated waste water neither directly to surface waterbodies nor to groundwater bodies. For direct disposal more strict monitoring protocols apply. The most frequent practice imposed by the permitting authorities is on-site treatment and then subsoil disposal of the effluent, a practice also called subsoil irrigation. The irrigation/disposal system must be installed close to the surface with no direct contact with the groundwater.

The first reuse regulation was issued in 2011 and then amended in 2013 and gave the minimum quality requirements for: irrigation, groundwater replenishment, urban and peri-urban use and industrial use. Especially for industrial wastewater the reuse was possible only for industrial use, subsoil irrigation and groundwater replenishment. Because of this legal framework from 2011 it became compulsory for most private activities that could not connect to a UWWTP to practice water reuse even if it was very basic: on-site treatment and subsoil disposal. Economic activities that didn't dispose the necessary space for subsoil disposal or/and had an economic interest (water savings) or marketing interest (present an ecological company profile) took a step further and practiced reuse for surface irrigation, urban and peri-urban use and industrial use, practices that demanded a higher level of treatment.

Under the 2014-2021 ERDF, in Greece, water reuse was deemed as eligible infrastructure only in cases of **WWTP discharging into a sensitive water body**. A water reuse plan was also necessary detailing the possible nearby uses of the reclaimed water. No reclaimed water aqueducts and distribution networks were funded. External aqueducts and distribution networks had to be funded by national funds.

The Regulation (EU) 2020/741 on minimum requirements for water reuse has come into effect only recently on 26/6/2023 and local stakeholders did not have the time to respond. It is stricter than the 2011 reuse regulation but covers only the agricultural irrigation so for all other uses the Greek regulation still applies.

Energy recovery from sludge digestion is practiced in large WWTP. Under the 2014-2021 ERDF and the current 2021-2027 ERDF systematic energy recovery in WWTP and the use of Renewable Energy (P/V panels) is funded for all new WWTP and retrofit of existing WWTP in order to obtain lower energy consumption.

4.2.8 Digitalisation of the water sector

Greece was one of the last countries in the sectors of digitalisation in the EU according to the Digital Economy and Society Index (DESI)[61]. The first national policy paper for the Digital Transition dates from 2000 (Law 2860/2000) and is the implementation plan for the EU funding program "Third Community Support Framework (CSF III) (2000-2006)". With this law the public company "Information Society S.A." was founded which overviewed and implemented many of the actions for the digitalisation of the public and the private sector. The EU funding for the digital transition was continuous from 2000 till today. During the Covid-19 lock-down the digitalisation made notable progress in Greece and the recent law 4727/2020 made the use of digital tools compulsory for the Greek administration. The Greek Recovery and Resilience Facility (RRF)-Greece 2.0 attributes 23.3% of the total funds to the digital transformation[62]. These EU and National policies and funding policies start to produce results, and Greece is improving in the targets set by the EU Digital Decade policy programme 2030.

As far it concerns the water sector no official data is available. The funding mechanisms also fund the digitalisation of the water sector (implementation of SCADA systems, telemetry, tele-control, monitoring of flow and pressure, monitoring of quality parameters, automation etc.). The level of digitalisation of water and wastewater companies/services is very diverse as Greece disposes more than 100 Municipal Water and Wastewater companies and even more municipal water services. The level of digitalisation varies from simple PLC systems to sophisticated SCADA systems and home smart meters. Especially the WWTP have benefited from the digitalisation and now almost all new electromechanical WWTP equipment is required to be monitored and

[61] https://digital-decade-desi.digital-strategy.ec.europa.eu/datasets/e-gov-2013-2019/charts

[62] Digital Economy and Society Index (DESI) 2022

controlled remotely. In small settlements, the operators can now install small WWTP that are fully automated and remotely controlled (the control centre is usually based in another WWTP nearby).

4.2.9 Hindering and enabling policies, challenges and obstacles

In general, existing policies are enabling the water circular economy:

- The UWWTP regulations are promoting wastewater collection and treatment plants
- The CAP is promoting agricultural wastewater treatment
- The Environmental Impact Assessment, the IED and Environmental Permitting is promoting the decentralised treatment of rural, tourism and industrial wastewater
- The Digital Transition is favouring more efficient water treatment facilities and enables the remote operation of decentralised treatment units.
- Pre-existing Greek regulation on water-reuse (2011) is promoting the water-reuse for all uses except drinking water (e.g. irrigation, industrial, urban non-potable use).

However, there are some specific aspects of their implementation that are hindering the implementation of Circular Water Economy.

- The primary obstacles to implementing the enabling policies are challenges related to environmental inspections. Increased regulatory requirements result in higher treatment costs, which often face resistance from both individuals and companies when stricter standards lead to additional expenses.
- The second hindering condition is the cost aspect. The Water-reuse regulation stipulates a higher level of treatment, but no market exist for the reclaimed water. There is a lack of funding (EU and national funds) explicit for the extra treatment necessary and also for the necessary distribution systems for reclaimed water.
- The absence of a well-developed market is a primary factor contributing to the lack of established practices in sludge reuse and nutrient recovery. Sludge generated from urban wastewater treatment plants is processed to meet agricultural standards; however, it is typically disposed of in landfills or utilized for landscaping purposes.

In Table 5 the enabling and hindering dimensions of policies are presented while in Table 6 we link policy instruments with their target domains.

Table 5: Policies and specific aspects of their implementation that are hindering and enabling the implementation of Circular Water Economy

Relevant Policy and specific aspects of implementation	Enabling (✓) Hindering (X)
UWWTP Implementation	✓
CAP Implementation	✓
The Environmental Impact Assessment, the IED and Environmental Permitting is promoting the decentralised treatment of rural, tourism and industrial wastewater	✓
Inspection processes and monitoring of individual non-public WW facilities (existing but not efficient)	X
Digital Transition	✓
Water Reuse Regulation Implementation	✓
High cost of Water Reuse Regulation (high treatment costs in relation with the quality of existing WWTP effluents)	X
Lack of funding mechanisms for the Implementation of Water Reuse regulation	X
Sustainable tourism	✓
Circular Economy – Green Public Procurement (no measures taken to create a market for reclaimed water, sludge and nutrients from WW)	X

Table 6: Policy matrix linking policy instruments and target domains

Target domain / Policy instrument	Urban	Rural	Agricultural	Industrial	Tourism
WFD	X	X	X	X	X
DWD	X	X			X
UWWTP	X				
EIA/IED*	X	X	X	X	X
Water Reuse	X	X	X	X	X
Digitalisation	X	X	X	X	X

**IED was grouped with the Environmental Impacts Assessment, as it is by the EIA process that the IED is implemented*

4.2.10 Policy navigation recommendations

Greece has a 98% rate of compliance with UWWTD. Public collective systems are well established, and many are in the process of retrofitting and expansion to reach higher levels of treatment.

Private, individual or corporate decentralized treatment systems are also in expansion as a result of stricter permitting procedures and new economic activities. The tourism sector leads the way of innovation because of water scarcity but also because of environmental branding and marketing.Greek policy should take advantage of the digital transition and implement policies favoring real-time remote monitoring of treated effluents from collective and decentralized systems both public and private. This would improve the conformity rates but also push unit operators to improve the treatment methods and boost innovation uptake.The promotion and funding of the digital transition in the water sector will also make economically feasible the construction of more decentralized systems operated remotely.

Irrigation with reclaimed water can only be promoted if the necessary distribution networks are also funded so as to make reclaimed water available in the fields.

Creating a market for the treated sludge and reclaimed nutrients needs deeper policy changes which will make compulsory the use of these materials, or a minimum percentage of them in Green Public Procurement and in the Environmental Permitting of specific private sector activities.

4.3 Romania

To ensure consistent evaluation across all seven countries, this analysis applies the Circular Water Domain Framework defined in Section 2.4. National policy landscapes are assessed against five core innovation areas essential for a Water Circular Economy. Policies are classified as either Generic (broad sustainability goals without specific targets) or Specific (clear provisions and binding requirements). Finally, the analysis identifies Enabling Conditions that facilitate uptake and Hindering Conditions (e.g., regulatory bottlenecks) that block progress. This structured approach highlights the specific Policy and Policy Implementation Gaps concerning Circular Water Economy the WaterWise Hub must address. Table 8 presents policy conditions in Romania.

Table 7: Policy conditions per CW innovation domain in Romania

Circular water innovation domain	Specific, Generic or no policy	Enabling conditions	Hindering conditions
Basic water management, provision and sanitation	Specific	Comprehensive legal frameworks for integrated water management.	Limited infrastructure in rural areas
Water saving	Generic	Water saving is acknowledged as part of the national sustainability and circular economy strategies.	Few specific sector-based requirements and lack of incentives for water saving.
Water reuse	Generic	Generic reference to EU water reuse directives is embedded in national policy.	Few specific requirements and lack of incentives for reuse.
Nutrient and energy recovery	Generic	Renewable energy is a key part of the national sustainability strategy.	Few specific water-related provisions for nutrient and energy recovery.

4.3.1 General Information

Romania is a member of the EU since 2007 adopting the relevant EU policies mentioned above and also benefiting from EU funding for the construction of water and wastewater networks and treatment facilities and subsidies for the construction of municipal, agricultural, industrial and tourist wastewater treatment facilities. A timeline of the adoption of EU legislation is presented in Table 9 below.

Table 8: Adoption of relevant EU policies in Romania

EU Policy	Romanian policy document	Year of adoption
Environmental Impact Assessment Directive (85/337/EEC)	Government Decision no 445/2009 Order no 135/2010 Law no 292/2018	2009
DWD (98/83/EC) (2020/2184/EC)	Ordinance no 7/2023 replacing Law 458/2002 Law 241/2006	2002

EU Policy	Romanian policy document	Year of adoption
UWWTD	Water Law no 107/1996 amended by Law no 122/2020 GD 188/2002 as subsequently amended and supplemented. Law 241/2006 GD 1010/2024 for the approval of the National Strategy on adaptation to climate change for the period 2024–2030, with a perspective toward 2050	1996
WFD	Water Law no 107/1996 amended by Law no 122/2020	1996
IED	Law no 278/2013, amended by Government Emergency Ordinance no 101/2017 and by Law 141/2023	2013
CAP	GD 1570/2022 as subsequently amended and supplemented. GD 1571/2022 as subsequently amended and supplemented. Strategic National Plan CAP 2023-2027	2022
Water Reuse Regulation	Government Emergency Ordinance no 52/2023 GD 927/2023	2023

Romania has the six worst Water exploitation index plus (WEI+) in EU (32.5%) according to 2022 data[63]. In this context water reuse is very important for Romania to achieve water resilience and adapt to climate change.

For Romania the following Policy Sectors were deemed pertinent for our Policy Analysis:

- Urban Water
- Rural Water (vs Urban): Includes geographically all activities outside of urban areas that cannot be connected to a collective sewage system.
- Agricultural Water
- Industrial Water
- Tourism water

Further additional Policy Sectors were identified that also present an important influence.

- Water Reuse
- Digitalisation

In addition to the core directives and strategies analysed above, Romania's policy framework for water and circularity also includes several complementary official documents. These cover, among others, the Bathing Water Directive 2006/7/EC, the Groundwater Directive 2006/118/EC and its national implementation acts, the Floods Directive 2007/60/EC and associated flood risk management plans, as well as the Marine Strategy Framework Directive 2008/56/EC and national coastal protection and pollution control measures. Relevant technical standards such as SR EN 1008:2003 (water for concrete) and ISO 16075-1:2020 (guidelines for the use of treated wastewater for irrigation) also provide supporting specifications for safe water reuse and protection of receiving environments.

[63] Water scarcity conditions in Europe, EEA, 2025 - link

4.3.2 Urban waste water treatment policies and practice

Urban wastewater treatment facilities have improved in recent years and present opportunities for water reuse and energy recovery. Some large WWTPs are being upgraded with modern technologies and digital monitoring systems, supported by dedicated funding schemes for sustainable infrastructure. Rural wastewater management remains underdeveloped. Progress in wastewater treatment, particularly in tertiary treatment, has been slow over the past three decades. The absence of sufficient infrastructure in rural communities is one of the greatest challenges to expanding circular water practices. A more centralized or regionally integrated wastewater management model could provide greater efficiency and sustainability but remains largely unrealized.

From the 673 UWWTP reported in Romania 186 are biological treatment with nitrogen and phosphorus removal, 460 are with biological treatment and 27 are with primary treatment[64].

The new obligations assumed by Directive (EU) 2024/3019 on urban waste water treatment, including the introduction of a fourth treatment stage for the removal of micropollutants, involve considerable investments that cannot be supported exclusively from national sources or from tariffs paid by consumers. Romania needs more than 30 billion euros just to ensure access to basic services in rural areas, and the investments needed to modernize wastewater treatment plants in the context of the new directive are estimated at another 3 billion euros. In addition, the ongoing infringement procedures indicate the need to accelerate investments in non-compliant agglomerations, which cannot be achieved without non-reimbursable funds[65,66].

4.3.3 Rural waste water treatment policies and practice

Romania is characterized by insufficient access to water services in rural areas. Only 19% of residential rural area population were connected to sewage system in 2024.

For small towns and large villages in the range of 2,000-10,000 p.e., the most common solution is the implementation of compact or modular wastewater treatment plants (WWTPs). These are prefabricated, containerized, or site-assembled systems that are more cost-effective and faster to build than large-scale concrete plants. The most widely adopted technologies in these plants include:

- Sequencing Batch Reactors (SBR**):** This is a very popular technology for this scale. It's flexible, handles variable loads well (common in smaller communities), and produces a high-quality effluent.
- Moving Bed Biofilm Reactors (MBBR)
- Conventional Activated Sludge (CAS): This traditional method, often in a compact "extended aeration" form, is also used in larger communities or where more communities are collected.

[64] https://insse.ro/cms/en/content/water-supply-2024

[65] https://www.ara.ro/sp/documente-generale/dw/2713_6955_01_position-paper-en

[66] https://water.europa.eu/freshwater/countries/uwwt/romania

For small villages, rural areas, and isolated settlements, (< 2,000 PE) centralized sewerage and treatment are often not economically or technically viable. The strategy here is focused on decentralized solutions.

- Small-Scale SBR & Activated Sludge Plants**:** Even for communities at the lower end of this range (e.g., 500 - 2,000 PE), smaller versions of the modular SBR and activated sludge plants are sometimes installed.
- Individual Adequate Systems (IAS)**:** For the most isolated properties or smallest hamlets, the focus is on on-site treatment. This is a key part of Romania's national strategy to comply with EU directives. These systems include:
    - Advanced septic tanks
    - Compact individual treatment plants

However, IAS enforcement is weak, and inadequate monitoring and registration of individual systems is widely recognized as a compliance gap under the UWWTD in Romania.
The choice of technology is dependent on the extent of lobby of the supplier to the ones deciding the investment.
Similar with Greece, in areas where no collective sewage network exist the house/activity owners are obligated to construct a septic tank and when it is full to pay themselves the expenses for a chartered tanker vehicle to carry their sewage in the nearby UWWTP.

In practice, the absence of inspection mechanisms and the lack of a national IAS registry limit the ability to monitor environmental impacts and compliance with EU obligations

4.3.4 Wastewater Treatment for Agricultural Use

In 2024, the volume of water supplied was 3,053,260.6 thousand m^3, about 914,538 thousand m^3 more than in 2023. The sharpest rise was reported in agriculture, the amount of water supplied increasing by 660,617 thousand m^3.

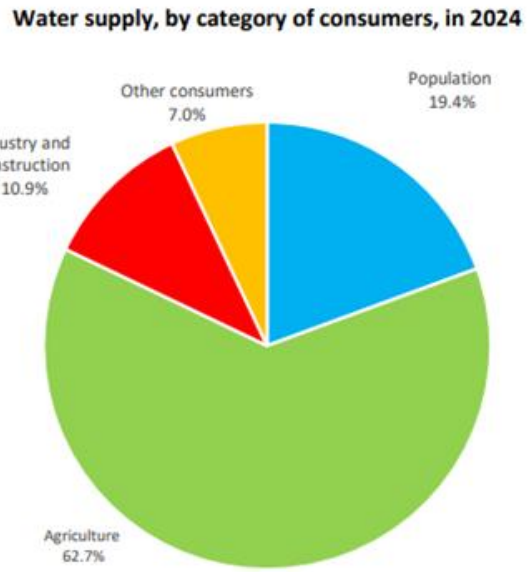

Figure 3: Water supply by category of consumers, 2024 data, source: link

Agriculture is Romania's largest water consumer and plays a central role in discussions of water circularity. The agricultural use is expected to increase as a result of investments in irrigation infrastructure, part of Romanian Strategy for Sustainable Development 2030. Agricultural zones, often located near WWTPs, range from intensive vegetable production to extensive cereal farming. Although farmers are generally organized into associations, social resistance to sludge use remains strong, even when safety criteria are met. Updated regulations and pilot projects could help demonstrate the feasibility and benefits of water reuse in agriculture.

Romania's policies for agricultural wastewater treatment focus on compliance with EU directives like the Nitrates Directive and Water Framework Directive, supported by EU funding programs and the National Recovery and Resilience Plan. Romania implements the EU Nitrates Directive (91/676/EEC) through HG 964/2000, which is the cornerstone regulation for protecting surface water and groundwater against pollution caused by nitrates from agricultural sources.

4.3.5 Industrial Waste Water Treatment policies and practice

Industrial wastewater treatment in Romania is governed by a combination of national laws and EU Directives, including the Environmental Protection Law, the Water Law, the Urban Waste Water Treatment Directive (UWWTD), and the Industrial Emissions Directive (IED).
Any industrial activity with a potential environmental impact must obtain specific permits, such as an Environmental Agreement, Environmental Authorisation, or an Integrated Environmental Authorisation. Operating without the correct permits can lead to significant fines and business suspension.

Industrial wastewater often contains heavy metals and other specific pollutants that require advanced or tertiary treatment beyond the standard primary/secondary methods. The required level of treatment (primary, secondary, tertiary, or advanced) depends on the wastewater's composition and the quality standards of the receiving environment. Common industrial methods include filtration, reverse osmosis, ion exchange, and biological processes. There is growing interest in promoting industrial wastewater reuse as a sustainable practice

In practice, industrial units are responsible for ensuring their wastewater is handled in accordance with regulations, which includes implementing on-site treatment systems or ensuring appropriate pre-treatment before discharge into urban collecting systems.

Furthermore, the implementation of Best Available Techniques (BAT) under the IED and BAT Reference Documents (BREFs) is uneven across sectors, leading to significant variations in industrial discharge quality and limiting predictable reuse potential.

Currently, no dedicated regulatory pathway exists for industrial reuse loops (e.g., water reuse for cooling, process water recycling).

4.3.6 Tourism waste water treatment policies and practice

Although specific water reuse projects in tourism are not yet developed, the sector could benefit from cleaner urban environments and sustainable water use practices that enhance destination appeal. The government aims to strengthen collaboration between industry and agriculture to promote integrated water resource management and cross-sectoral efficiency. National sustainability strategies ((Sustainable Development Strategy, Circular Economy Strategy) encourage cross-sectoral efficiency., Romania's policies on tourism wastewater are integrated within its general environmental and water management legislation, which is aligned with EU directives such as the Urban Waste Water Treatment Directive. However, Romania faces significant challenges in practice, with implementation lagging due to insufficient infrastructure, particularly in rural tourist areas.

Tourism units are required to obtain several specific permits and authorizations from national and local authorities:

- Environmental Permit/Authorisation
- Water Management Permit
- Sanitary Authorisation

The National Strategy for Tourism Development 2023-2035[67] emphasizes the optimal use of environmental resources, the preservation of natural heritage, and sustainable development principles.

Some initiatives and good practices are emerging:

[67] https://turism.gov.ro/web/wp-content/uploads/2022/11/SNRDT-actualizat-var-pt-HG-2023-2035.pdf

- Eco-friendly Treatment Systems: Projects have introduced green wastewater management systems, such as reed-bed filters, in some agritourism businesses to demonstrate efficient and innovative methods.
- Sustainable Practices in Agritourism: Some small tourism enterprises have started implementing water-saving activities, waste recycling programs, and encouraging customers to be environmentally friendly.
- Integration of Strategies: There is a recognized need to integrate tourism development strategies with policies for water/wastewater infrastructure development to achieve sustainable economic growth.

Despite these examples, there is no dedicated national framework for water reuse in tourism. Hotels and pensions can only discharge wastewater into sewerage systems or operate authorised on-site systems; reuse of treated wastewater is not currently regulated.
The lack of standardized tourism-sector monitoring and the absence of incentives (e.g. eco-certification schemes linked to water reuse) limits the adoption.

4.3.7 Water reuse policies and practice

In the Romanian Strategy of Water Management 2023-2035[68] starting in 2022, the WEI+ index was evaluated at the level of river basins and at the national level for surface water sources (excluding the Danube River) and groundwater. In this study, in order to identify the regions/river basins affected by water shortages, the volumes of water of the year 2021 were compared to a reference period defined as the previous five years, namely 2016–2020.

Thus, at the national level, the WEI+ values classify Romania, both annually (for the year 2021) and multi-annually (2016–2020), as being in the category without pressure on water resources (below the 20% threshold), for both surface and groundwater sources.

Following the summation of the water volumes corresponding to the three main categories of use (population, industry, agriculture) from surface water sources in 2021, the western part of the country can be considered a zone without pressure on the water resource, whereas the eastern part of the country (the river basins managed by Prut–Bârlad Water Administration and Dobrogea Water Administration) faces a severe water shortage. The southern part of the country (Jiu, Olt, Argeș–Vedea, and Ialomița–Buzău river basins) falls, according to the WEI+ values, into the alert class, and compared to the other basins, it can also be said that there is pressure on the surface water resource in years with more severe drought. Taking into consideration the above presented facts there is a need for wastewater reuse at national level.

The policy on the reuse of wastewater and sewage sludge is regulated at the European Union level and transposed into Romanian legislation, aiming to protect the environment and valorize resources. The main objectives are to reduce pollution and promote a circular economy through the safe reuse of water and nutrients contained in sludge.

[68] https://climate-laws.org/document/national-strategy-for-water-management-2023-2035_4513

National framework for wastewater reuse:

- Romania transposes European legislation through various normative acts, including specific regulations for public water supply and sanitation services, such as Law 241/2006.
- The National Administration Apele Române promotes the reuse of treated wastewater as a strategic measure in water resources management.
- Infrastructure projects for wastewater treatment, often financed by European funds, aim at aligning with EU standards and modernizing treatment plants.

National framework sludge reuse:

- Order 344/2004 and the Technical Norm of 2004 (transposed by Ord. 344/2004) regulate the use of sewage sludge in agriculture, with the aim of capitalizing on its agrochemical potential and protecting the environment.
- Sludge producers have strict obligations, including analyzing the composition of the sludge, informing environmental authorities and users, and obtaining permits for application on agricultural land.

Direct water reuse faces regulatory and technical barriers, including the absence of national quality standards beyond those required by Regulation (EU) 2020/741.

Indirect reuse occurs through treated effluent discharged into the environment and later used for irrigation. However, standards for irrigation water are outdated and require revision to align with the EU Water Framework Directive and related regulations. Most water reuse initiatives in Romania focus on agriculture. Nonetheless, there is a shortage of pilot projects and demonstrative case studies to build social acceptance and confidence in reuse and sludge valorisation. Romanian legislation (Order 344/2004) prohibits the use of sewage sludge on vegetable crops, crops consumed raw, crops with edible parts in direct contact with soil, vineyards, fruit-tree plantations and pastures during vegetation periods.

GEO 52/2023 has transposed the Water Reuse Regulation (EU) 2020/741 only partially; secondary methodological norms, operator accreditation criteria, and monitoring protocols have not yet been finalised, which means that no authorised direct reuse schemes currently operate in Romania.

4.3.8 Digitalisation of the water sector

Romania is progressively integrating digital solutions into water management. Smart metering and real-time digital monitoring are being introduced nationwide, particularly in large urban WWTPs. Funding programs have been established to support digital and sustainable infrastructure development.

In the private sector, water metering is already mandatory for wells and agricultural users. Farmers and agricultural companies are adopting digital tools for irrigation management, signalling gradual progress toward efficiency and data-driven water use. Digitalization is expected to expand naturally as monitoring and reporting requirements evolve under EU directives, providing a foundation for circular water systems.

State of water sector digitalization in Romania:

- Smart metering: There are pilot projects and strategies for the implementation of smart meters by regional operators.
- Sensors and real-time monitoring: A sensor network for monitoring water quality and pressure is still under development, and the use of IoT (Internet of Things) technology is limited.
- Management and analysis systems: The use of software platforms for managing water networks, analysing data and optimizing operations is more common in large regional operators and private operators.
- Digital customer services: Some operators already offer online services for viewing invoices, paying and submitting the water meter index.
- European funding: There are numerous digitalization projects financed through the Large Infrastructure Operational Program (POIM) and the new Sustainable Development Program (PDD).

However, digitalisation is fragmented between operators, and there is no national interoperability framework ensuring integration of SCADA, GIS, laboratory data, and reporting obligations such as WFD, UWWTD and DWD. Rural and small operators are much less digitalised, which makes it difficult to implement remotely operated, decentralised treatment systems.

4.3.9 Hindering and enabling policies, challenges and obstacles

Romanian policies in general are helping water circularity projects and initiatives:

- The UWWTP regulations are promoting wastewater collection and treatment plants
- The CAP is promoting agricultural wastewater treatment
- Romania’s National Strategy for Sustainable Development 2030 and the Circular Economy Action Plan encourage the adoption of the circular model in the water sector
- The Environmental Impact Assessment, the IED and Environmental Permitting is promoting the de-centralised treatment of rural, tourism and industrial wastewater
- The Digital Transition is favouring more efficient water treatment facilities and enables the remote operation of decentralised treatment units.

However, some policy frameworks are incomplete or outdated, particularly irrigation water quality standards and end-of-waste criteria for sludge, which limits the implementation of circular water practices. In Table 10 the enabling and hindering dimensions of policies are presented while in Table 6 the same link policy instruments with their target domains are presented (as Greece).

Table 9 *Policies and specific aspects of their implementation that are hindering and enabling the implementation of Circular Water Economy*

Relevant Policy and specific aspect of implementation	**Enabling (✓) Hindering (X)**
UWWTP Implementation	✓
CAP Implementation	✓
The Environmental Impact Assessment, the IED and Environmental Permitting is promoting the decentralised treatment of rural, tourism and industrial wastewater	✓
Inspection and monitoring of private WW facilities (existing but not efficient)	X
Digital Transition	✓
Water Reuse Regulation Implementation	✓
High cost of Water Reuse Regulation (high treatment cost in relation with the quality of existing WWTP effluents)	X
Funding Mechanism for Implementation of Water Reuse	X
Sustainable tourism	✓
Circular Economy – Green Public Procurement (yet no measures taken to create a market for reclaimed water, sludge and nutrients from WW)	X

Additionally, the absence of clear financial incentives, such as reduced tariffs for reclaimed water, or subsidies for water reuse infrastructure, makes reuse difficult to implement in all sectors.

4.3.10 Current situation and policy navigation recommendations

Romania has a low compliance level with the Urban Waste Water Treatment Directive (UWWTD), with 15% of sewage treated in line with UWWTD legislation[69].

Public collective systems are well established, and many are in the process of retrofitting and expansion in order to reach higher levels of treatment. Private individual or corporate decentralized treatment systems are also in expansion because of stricter permitting procedures and new economic activities.

Promotion and funding of the digital transition in the water sector will also make economically feasible the construction of more decentralized systems operated remotely.

However, the water reuse policies and practices in Romania are in an incipient phase characterized by a big potential but very low implementation. Romania's efforts mainly focused on compliance with UWWTD experiencing delays and even being referred to the EU Court of Justice for non-compliance in some cases, reuse has not been a top priority. The potential for

[69] Country profiles on urban wastewater treatment, EEA, link

water reuse is considered huge, especially in the context of climate change, which brings periods of intense and prolonged droughts with negative impact on water resources.

Romania recognizes the need and potential of water reuse, but is at the beginning of the journey, with concrete legislative transposition measures and infrastructure investments needed to move from the stage of incipient to real practices.

On the other hand, Romania's largest circular water opportunity is to transform municipal wastewater treatment plants into resource recovery hubs. Many large plants already have assets such as anaerobic digesters and advanced sludge treatment thanks to EU Cohesion Fund investments. Instead of simply treating wastewater and discharging it, these facilities recover energy from biogas, generate heat for their own operations, and could convert treated sludge into fertiliser or soil improver. This shift can dramatically reduce operating costs for utilities, make plants close to energy-neutral, and create new revenue streams from materials that are currently treated as waste. At the same time, treated effluent could be reused for industrial processes, irrigation, or urban green spaces, reducing pressure on groundwater and drinking water systems—especially important in regions already affected by drought and agricultural water demand. Because the infrastructure base already exists, circularity here is a high-impact, low-friction opportunity: one upgrade benefits water, energy, and nutrient cycles simultaneously.

There are also in place national strategies related to water sector that will enable water circularity in the next future such as:

National Strategy for water management 2023-2035[70]. Presents a vision to achieve the European objectives assumed by Romania: zero pollution and energy independence by 2050, strengthening adaptive capacity and minimizing vulnerabilities to climate change in terms of water resource security.

- Strategic objective 1: Integrated water resources management to ensure sustainable use of water resources
- Strategic objective 2: Manage and protect water resources to achieve and maintain good status of surface and groundwater and prevent its deterioration
- Strategic objective 3: Reduce water related risks in the context of climate change on population, economic activity, environment and cultural heritage
- Strategic objective 4: Develop the legislative, organizational and scientific framework for water management

National Strategy on Education for the Environment and Climate Change 2023-2025[71]. Is the first time that Romania adopts a national strategy dedicated to education for environment and climate change.

[70] https://mmediu.ro/domenii/mediu/evaluare-impact/evaluare-de-mediu-pentru-strategii-planuri-programe/strategia-nationala-pentru-gospodarirea-apelor-2023-2035/

[71] *https://mmediu.ro/domenii/educatia-pentru-mediu/strategia-nationala-privind-educatia-pentru-mediu-si-schimbari-climatice-2023-2030/*

- Implementation of a National Educational Program for environment and climate
- Identify, promote and facilitate solutions for the creation and use of educational resources
- Create, develop and support rehabilitation of infrastructure for sustainable schools
- Training of human resources involved in education on environment and climate change in order to promote a culture of sustainability

Romania Country Strategy 2025-2030[72] (by European Bank for Reconstruction and Development). This document outlines investment priorities and reform directions for Romania over the period 2025-2030 and includes a section on water/wastewater infrastructure. Relevant points:

- Prioritising expansion and modernisation of water supply and wastewater treatment infrastructure — especially in underserved or rural areas.
- Enhancing resource efficiency and pollution prevention in the water & wastewater sector (highlighted in the "Resource Efficiency and Pollution Prevention and Control" part).
- Supporting reforms and investments to strengthen the regulatory and operational capacity of water utilities.

National Circular Economy Strategy. The strategy explicitly mentions "water and wastewater" as part of the resource/flow streams to be addressed under the circular economy model. The direction "reducing the impact of production and management of waste and wastewater" is spelled out. For circular water practices, the strategy provides leverage through these mechanisms:

- Reuse of treated water: By promoting resource efficiency and reducing consumption of virgin resources, reuse of water becomes a part of the resource lifecycle thinking.
- Energy recovery from water/wastewater: Via the principle of "keeping resources in use" and "valorising waste streams", wastewater utilities are implicitly encouraged to recover energy from digestion/heat-flows.
- Nutrient/sludge recovery: The strategy's emphasis on waste minimisation and valorisation (including "wastewater/sludge" flows) offers a policy foundation for nutrient recovery from sludge and biosolids reuse.
- Industrial symbiosis/utility integration: The industrial symbiosis direction supports integrating utilities (water, wastewater) into circular networks with reuse, byproduct exchange, heat recovery, etc.
- Romanian Circular Economy Action Plan (PAEC 2024–2032)
  - Water & wastewater has been explicitly included as one of the sectors with high circular-economy potential.
  - Among the transversal actions: digitalisation, green public procurement, education/training, R&D/innovation. These are enabling conditions for deploying circular-water practices (reuse, resource recovery) in utilities and municipalities.

[72] https://www.ebrd.com/content/dam/ebrd_dxp/assets/pdfs/country-strategies/romania/romania-country-strategy-2025-30.pdf

- For water/wastewater, this means:
  - infrastructure investment to support reuse of treated effluent (non-potable uses, industrial/irrigation)
  - supporting energy-recovery from wastewater/sludge lines (biogas/heat)
  - enhancing sludge and biosolids valorisation (nutrient recovery)
  - regulatory/institutional reform to allow water reuse and resource recovery business models
- Monitoring and evaluation are built into the PAEC so projects in water/wastewater will have performance metrics, thus helping utilities make the business case.

National Strategy on Adaptation to Climate Change for the period 2024-2030, with a perspective to 2050 has been approved by the Romanian government

- By targeting reduction of water resource deficits (SO 1.1) and improving resilience of water systems, the strategy opens up space for reuse of treated effluent and non-traditional sources of water as adaptation measures.
- The objective on increasing dam/dyke safety (SO 1.3) and flood risk reduction links to improved hydraulic infrastructure, which can integrate circular systems (e.g. integrating storage for reuse).
- While not always explicitly cited, the broader adaptation via “resource resilience” and “circular economy transition” means that water/wastewater systems recovering energy, nutrients or reusing water contribute to the strategy’s adaptation goals (by reducing dependency on vulnerable supply chains, lowering infrastructure burdens, enhancing system flexibility).
- Sectoral approach means that adaptation in water fits with agriculture (irrigation), municipalities (urban water systems), energy (heat recovery from wastewater), industry (water reuse) and ecosystem services (natural water retention, wetlands, green infrastructure). This integration is exactly what circular water practices need to flourish.
- For water utilities or municipalities looking to implement circular water projects (reuse networks, energy recovery at WWTPs, biosolids reuse), aligning with SNASC signals that their project contributes to national adaptation objectives, which can strengthen funding applications/investment cases.

Despite this extensive strategic framework, **Romania still lacks an integrated national roadmap** for water reuse that defines priority sectors, financial mechanisms, quality standards, monitoring systems, and institutional responsibilities.

4.4 Moldova

To ensure consistent evaluation across all seven countries, this analysis applies the Circular Water Domain Framework defined in Section 2.4. National policy landscapes are assessed against five core innovation areas essential for a Water Circular Economy. Policies are classified as either Generic (broad sustainability goals without specific targets) or Specific (clear provisions and binding requirements). Finally, the analysis identifies Enabling Conditions that facilitate uptake and Hindering Conditions (e.g., regulatory bottlenecks) that block progress. This structured approach highlights the specific Policy and Policy Implementation Gaps concerning Circular Water Economy the WaterWise Hub must address. Table 11 presents policy conditions in Moldova.

Table 10: Policy conditions per water-CE innovation domain in Moldova

Circular water innovation domain	Specific, Generic or no policy	Enabling conditions	Hindering conditions
Basic water management, provision and sanitation	Specific	Establishes legal and regulatory framework for water supply, sewage, drinking water, wastewater collection & treatment; ensures accessibility, reliability, and compliance with quality and environmental standards.	Technological and financial constraints; infrastructure challenges; legal framework gaps; stakeholder resistance; compliance and enforcement issues.
Water saving	Generic	Promotes rational use of water resources through reporting requirements; encourages efficient management and monitoring of water withdrawals.	Limited enforcement and compliance; lack of infrastructure for monitoring; institutional and governance gaps.
Water reuse	Generic	Establishes clear requirements for wastewater treatment plants; regulates discharges into water bodies; promotes safe reuse of treated water in line with environmental standards.	Technological and infrastructure limitations in wastewater treatment; financial constraints for upgrading facilities; compliance issues.
Nutrient and energy recovery	Specific	Promotes circular economy principles, waste reduction, and resource recovery (including potential for nutrient/energy recovery from wastewater and sludge).	Institutional and legal framework barriers; insufficient technical capacity; lack of financial incentives and investment.

4.4.1 General Information

Moldova currently has general waste management legislation but lacks specific laws governing wastewater management or the Water Circular Economy (WCE). New legislation is expected to be introduced next year to address this gap. The country's water management relies primarily on two major rivers and rainfall, with no significant issues related to water scarcity. However, challenges persist in wastewater treatment, infrastructure modernization, and the development of circular water systems.

The country operates a mix of large and small water utilities—approximately five to twenty-five public companies serving urban areas, supported by smaller local providers in villages. Water pricing and distribution are monitored, and utilities maintain data systems that inform management decisions. Water remains relatively expensive, particularly outside the capital, which reinforces interest in more efficient and sustainable water use.

4.4.2 EU Policy Alignment

Moldova is not an EU Member State but is moving toward closer alignment with European environmental standards through its Association Agreement with the EU. Planned legislative reforms in wastewater management and WCE are expected to reflect EU principles of sustainability, resource efficiency, and pollution prevention.

While Moldova does not yet have national directives promoting water conservation or reuse, the forthcoming legal updates are anticipated to create the enabling conditions for adopting circular water practices, particularly in line with EU approaches to sludge management, energy recovery, and treated water reuse.

4.4.3 Urban and Rural Wastewater Treatment

One of Moldova's major challenges is the condition of its wastewater treatment plants (WWTPs). Many facilities are outdated, providing only primary treatment, and often operate inefficiently. As a result, several municipalities still discharge partially treated or untreated wastewater directly into rivers.

Currently, 36 of the larger cities have both primary and secondary treatment systems that function adequately, but smaller towns and rural communities often lack effective wastewater infrastructure. This gap hinders environmental protection and limits opportunities for resource recovery and reuse. Upgrading treatment technology and extending services to rural areas are therefore essential steps for advancing WCE implementation.

4.4.4 Water Reuse

At present, treated wastewater is not used in agriculture or industry, as no legal provisions permit its reuse. Although Moldova's water licensing system regulates the abstraction of river and rainwater for agricultural use, it excludes treated wastewater. New legislative reforms are expected to address this barrier.

Agriculture—including wineries and juice-processing factories—is heavily dependent on surface water. There is growing interest in reusing treated water and improving rainwater harvesting, especially given the high cost of freshwater. Farmers are not permitted to use drinking water for irrigation, which further strengthens the case for alternative sources, such as treated or reclaimed water, once legally authorized.

4.4.5 Resource and Energy Recovery

Sludge management represents both a challenge and an opportunity for Moldova's water sector. Many WWTPs lack advanced sludge treatment systems, and there is limited capacity for reuse or energy recovery. However, Moldova's legal framework does not classify sludge as waste, allowing for its potential use in biogas production or agricultural applications.

Energy recovery from wastewater—particularly through biogas generation to power treatment plants—is seen as a promising area for future development. This opportunity is especially relevant as Moldova continues to diversify its energy sources away from historical dependence on Russian imports toward European energy networks and domestic thermal and electric generation. Renewable energy development remains in its early stages, further highlighting the value of energy recovery from wastewater.

4.4.6 Sectoral Context

Agriculture: Agriculture is a key water consumer in Moldova, relying primarily on river and rainwater sources under a licensing regime. Farmers are organized into cooperatives or associations, though some operate independently. While interest in using treated or reclaimed water for irrigation is increasing, legal and safety concerns—especially regarding food production—remain unresolved. Updated standards and pilot projects will be critical for building trust and demonstrating feasibility.

Industry: Industrial activity, including wineries and fruit-processing plants, depends largely on river water. The lack of reuse infrastructure and outdated treatment technologies limit industrial opportunities for circular practices, though reforms in sludge management and energy recovery could benefit industrial users in the future.

Tourism: Tourism (particularly wine and camping tourism) peaks in summer and autumn, adding seasonal pressure on local water resources. The national "wine holiday" in October draws significant visitors, highlighting the need for water-efficient systems in hospitality and recreation sectors.

4.4.7 Digitalization

Moldova is gradually advancing in the digitalization of its water sector. Many operators have introduced digital customer management platforms and monitoring systems comparable to smart metering technologies. These systems enhance transparency, improve billing accuracy, and enable data-driven water management decisions.

Digital infrastructure development provides a foundation for future innovation in circular water management, including real-time monitoring of treatment processes, leak detection, and performance optimization across utilities.

4.5 Ukraine

To ensure consistent evaluation across all seven countries, this analysis applies the Circular Water Domain Framework defined in Section 2.4. National policy landscapes are assessed against five core innovation areas essential for a Water Circular Economy. Policies are classified as either Generic (broad sustainability goals without specific targets) or Specific (clear provisions and binding requirements). Finally, the analysis identifies Enabling Conditions that facilitate uptake and Hindering Conditions (e.g., regulatory bottlenecks) that block progress. This structured approach highlights the specific Policy and Policy Implementation Gaps concerning Circular Water Economy the WaterWise Hub must address. Table 12 presents policy conditions in Ukraine.

Table 11: Policy conditions per water-CE innovation domain in Ukraine

Circular water innovation domain	Specific, Generic or no policy	Enabling conditions	Hindering conditions
Basic water management, provision and sanitation	Specific	There is a specific legal and regulatory framework governing centralized water supply and sanitation, encompassing the provision of drinking water services, quality requirements, wastewater collection and treatment, as well as rules for the design, operation, maintenance, and monitoring of water supply and wastewater infrastructure and facilities. Requirements for basic supply and centralized wastewater treatment. Regulations for the development, maintenance, and monitoring of wastewater technologies and infrastructure, including those related to energy efficiency and leakage prevention.	Aging and damaged infrastructure, high water losses and incomplete metering; fragmented sector governance and limited implementation capacity; chronic underfunding and low cost recovery; tariff restrictions that reduce the ability of utilities to finance operation and maintenance, as well as modernization.
Water saving	Generic	Water efficiency is addressed indirectly through broader water-sector strategies and utility performance agendas (e.g., universal metering, leakage control and reduction of non-revenue water, and operational efficiency). Special water use permits in Ukraine promote water conservation by	There is no standalone, enforceable national water-saving policy with clear sector-specific targets and instruments Demand-management incentives are weak, data and metering coverage remain incomplete, and high network losses, along with chronic underinvestment, limit the

Circular water innovation domain	Specific, Generic or no policy	Enabling conditions	Hindering conditions
		setting mandatory withdrawal (use) limits and requiring sound calculations of water demand and monitoring of compliance. They also create financial incentives for efficiency, as fees are tied to actual withdrawal, with significantly higher rates for over-the-limit use and for unmetered use. There is regulatory logic in this regard, but the outcome depends heavily on practical implementation.	achievable savings.
Water reuse	Specific	Requirements and accounting regulations are in place for water reuse in agriculture and industry, including permitted uses, quality and disinfection provisions, and accounting obligations for utilities and users.	Reuse is allowed only under strict compliance with pollutant limit values and irrigation standards, with mandatory disinfection and monitoring. It is prohibited for irrigating berries and vegetables that are consumed raw and medicinal plants. Additionally, the land is subject to post-irrigation restrictions. The framework is largely permissive (enabling) rather than mandatory and does not create binding uptake obligations or strong economic incentives for reuse.
Nutrient and energy recovery	Specific	Regulations allow and define the conditions for the management and limited beneficial use of sewage sludge, including requirements for treated (dewatered) sludge and its controlled use as organic fertilizer and soil improver. Also, industry technical standards and the general framework for renewable energy recognize resource recovery options, such as heat recovery from wastewater and energy production from biogas from wastewater treatment plants.	There is no effective national system with targets, incentives, and market rules for scaling up nutrient recovery or energy recovery from municipal wastewater/sludge. Sludge utilization is minimal. Funding gaps hinder the transition to advanced treatment and recovery technologies.

4.5.1 General Information

Ukraine's transition to circular water practices is hindered by long-standing structural bottlenecks in the water supply and sanitation (WSS) sector, as well as the impacts of the full-scale war. The industry relies on largely Soviet-era assets, with a substantial share of networks and treatment facilities in critical condition and high levels of non-revenue water (national average losses estimated at 36%), reflecting chronic underinvestment and deferred maintenance.

Wastewater infrastructure challenges are compounded by the legacy design of most WWTPs (predominantly built in the late 1970s–early 1980s), which focused on conventional BOD and suspended solids removal, with limited provision for nutrient removal; sludge valorisation remains minimal, with sludge predominantly stored on drying beds without further processing.

The war has further damaged and disrupted WSS systems and service delivery. The Fourth Rapid Damage and Needs Assessment (RDNA4) indicates that millions of people require essential WSS services and estimates total sector needs of approximately US$11.25 billion for the period 2025-2035.

While awareness of modernization needs is increasing, the enabling environment for scaling circular solutions (e.g., water reuse, energy recovery, resource recovery) remains in its early stages, with implementation capacity and financing constraints at both the utility and municipal levels.

Circular economy approaches are not yet a national policy priority. The lack of infrastructure, funding, and technical expertise, combined with pressing socio-economic challenges, severely limits progress. Nevertheless, there is an increasing recognition among local authorities, researchers, and water utilities that reform and modernization are urgently needed, particularly to improve water security and resilience.

4.5.2 EU Policy Alignment

Ukraine is gradually aligning its environmental and water management system with EU legislation in the context of the Association Agreement and the EU accession process. Progress has been made in water management at the river basin level, including the adoption of River Basin Management Plans aligned with the EU Water Framework Directive. However, gaps in legislative harmonisation and implementation remain significant in key areas, such as water quality (particularly in drinking water, urban wastewater, and nitrates).

While a national strategy for the circular economy is still under development and expected by 2026, existing environmental and sectoral strategies (covering water resources, agriculture, and climate adaptation) acknowledge the importance of efficiency and circularity. However, they do not yet include specific incentives or targets for water reuse, sludge valorization, or nutrient recovery. Current references to circularity in sectoral strategies remain largely ad hoc or declarative, rather than results oriented.

4.5.3 Urban and Rural Wastewater Treatment

Wastewater infrastructure in Ukraine is centralized in large cities, with smaller systems present in a few larger villages. Many WWTPs provide only primary treatment, some are non-functional. In rural areas, wastewater is often discharged directly into surface waters. Centralized wastewater collection and treatment services are concentrated in urban areas, while rural coverage remains very low. Only about half of Ukraine's population is connected to centralized wastewater collection and treatment systems, and over 20 million people lack access to these services. The urban-rural gap is significant (rural sewerage connection is about 8% compared to almost 75% in urban areas). Aging assets and chronic underinvestment limit the efficiency of wastewater treatment. Many facilities operate below required standards due to deferred maintenance and insufficient capital investment.

The regulatory framework focuses mainly on centralized wastewater management, with provisions for volume tracking and quality assessment of effluents and sludge. Still, modernization of infrastructure requires major financial investment. War-related destruction of hydropower facilities and water infrastructure has further strained system capacity and reduced water availability in affected regions. Damage assessments show significant impacts on wastewater treatment plants and collection networks, while attacks on the energy system have repeatedly compromised pumping, treatment, and sanitation services in the affected areas.

4.5.4 Water Reuse

Ukraine has some regulatory framework for the reuse of treated urban wastewater and sewage sludge, including a specific procedure that sets quality requirements, monitoring and accounting provisions, and mandatory disinfection for irrigation. Reuse is allowed mainly for industrial purposes and for the irrigation of certain categories of agricultural crops, while use for drinking is prohibited, and additional restrictions apply to certain food crops (e.g. berries, mushrooms, and vegetables consumed raw).

Despite this legal framework, implementation remains limited and is not yet supported by a robust national tracking system (e.g. a registry of reuse schemes) or widespread circular economy practices across the sector.

Hence, water reuse is not yet practiced on any significant scale. Public and stakeholder awareness remains low. Nonetheless, water scarcity in central and eastern Ukraine creates potential regional demand for future reuse initiatives, particularly in agriculture and industry.

4.5.5 Resource and Energy Recovery

Regulations permit the use of treated sewage sludge and composted biosolids for agricultural applications, mainly for cereals, grasses, and non-food crops, subject to strict limits on heavy metals and microbiological contaminants, documentation and monitoring, and positive sanitary and epidemiological assessment. The framework also sets clear restrictions on where and when sludge can be applied (e.g. restrictions on pastures and certain categories of crops, as well as pre-harvest periods) and requires disinfection and drying as mandatory treatment steps.

However, technological capacity for sludge treatment is inadequate, and the country lacks facilities capable of handling large sludge volumes with high contamination levels. Hence, sludge management is still dominated by storage rather than valorization practices.

Interest in biogas production from wastewater and sludge has increased is and supported by the broader legal context of renewable (alternative) energy, particularly as Ukraine seeks alternatives to imported gas amid wartime energy shortages. While biogas and nutrient recovery are recognized as promising areas, current activity remains at the research or pilot stage, with limited operational examples.

4.5.6 Sectoral Context

Agriculture: Ukraine's agriculture is predominantly rain-fed; irrigation is geographically concentrated (mostly in the south, with some systems in the central regions) and relies mainly on surface water transported through irrigation infrastructure, with groundwater being used in some places. Although reuse of treated urban wastewater is legally permitted under a specific national procedure, wastewater irrigation is not implemented on a large scale in practice and is reportedly not being implemented due to quality and risk concerns. Future opportunities may exist in peri-urban areas where agricultural users are located close to treatment facilities, subject to feasibility, monitoring capabilities, and contractual arrangements, which depend on economic feasibility and demonstrated safety.

Industry: The demand for industrial water in Ukraine is significant, especially in water-intensive sectors such as energy and metallurgy, where cooling processes provide a starting point for solutions for the circular use of water (e.g. recirculating cooling systems and improved reuse of return cooling water).

At the same time, the effectiveness of industrial wastewater management is uneven. While national legislation regulates wastewater discharges and requires compliance with pollution limits (including the need for on-site treatment of certain industrial wastewater before discharge to municipal sewers), the capacity to ensure compliance and implementation varies, and upgrading industrial pre-treatment and monitoring remains a key investment need.

4.5.7 Digitalization

Digitalization in Ukraine's water sector is progressing but remains uneven and fragmented across institutions and utilities. At the national level, Ukraine has expanded digital public services and environmental platforms (e.g., EcoSystem, including the e-Water service package for permitting and reporting), and state surface-water monitoring data are published through the national open-data portal; however, parts of water-information functionality may be temporarily constrained under martial-law conditions.

Data on water quality, volumes, and treatment performance are often incomplete, limiting transparency and evidence-based decision-making. Despite these advances, water-related datasets and operational performance information are not yet consistently standardized, integrated and interoperable across registers and sector actors, which limits transparency and evidence-based planning. In the WSS sector, incomplete metering coverage (reported around

60%) further constrains the reliability of volume and efficiency metrics (e.g., losses and energy performance).

Modernization of monitoring and control systems is therefore a strategic priority for improving operational efficiency and resilience, enabling remote operation where feasible, and meeting EU-aligned basin planning and reporting needs. Current rehabilitation programmes increasingly include SCADA and telemetry requirements, while EU-supported initiatives continue to strengthen monitoring capacity.

4.6 Serbia

To ensure consistent evaluation across all seven countries, this analysis applies the Circular Water Domain Framework defined in Section 2.4. National policy landscapes are assessed against five core innovation areas essential for a Water Circular Economy. Policies are classified as either Generic (broad sustainability goals without specific targets) or Specific (clear provisions and binding requirements). Finally, the analysis identifies Enabling Conditions that facilitate uptake and Hindering Conditions (e.g., regulatory bottlenecks) that block progress. This structured approach highlights the specific Policy and Policy Implementation Gaps concerning Circular Water Economy the WaterWise Hub must address. Table 12 presents policy conditions in Serbia.

Table 12: Policy conditions per water-CE innovation domain in Serbia

Circular water innovation domain	Specific, Generic or no policy	Enabling conditions	Hindering conditions
Basic water management, provision and sanitation	Specific	The institutional framework for integrated water and waste management is well defined and supports investment in wastewater treatment.	Basic infrastructure for wastewater collection and treatment is lacking.
Water saving	Generic	Water saving is identified as important, especially with regards to losses in distribution systems. Water saving potential in sectors is identified.	No specific requirements or incentives for sectors to save water
Water reuse	Generic	Water reuse is mentioned in the national CE innovation strategy.	No specific parameters or guidelines have been defined to regulate (waste)water reuse.
Nutrient and energy recovery	Specific	Legislation sets goals for the development of renewable energy. National innovation strategy includes CE goals and the valorization of agricultural waste, as well as utilization of sludge from wastewater treatment for industrial, agricultural, and energy	Limited emphasis on water as a key element in the CE. Limited ability to move beyond end-of-waste.

		purposes.	

4.6.1 General Information

Serbia's circular water economy is in the early stages of development. The concept is mainly present within broader frameworks on environmental protection, waste management, and sustainable development, but practical implementation remains limited. The Water Law establishes the basis for integrated water resources management (IWRM) across surface, groundwater, and thermal waters, while ongoing reforms aim to align the country's policies with EU environmental and water directives.

Despite policy advances, less than 20% of wastewater is treated, and circular applications such as water reuse, sludge valorisation, and energy recovery are still rare. Infrastructure limitations, insufficient financing, and fragmented institutional responsibilities are major barriers.

4.6.2 EU Policy Alignment

Serbia's water and environmental policies are progressively aligned with EU directives. However, these are currently used more as guiding frameworks than as enforceable laws. Full transposition and implementation are expected in the next decades, though the timeline remains uncertain.

National strategies on the circular economy, energy transition, and innovation also reference water efficiency, sludge management, and resource recovery, but regulatory mechanisms are underdeveloped. Waste management legislation promotes valorisation and decarbonisation, yet treated wastewater reuse and sludge processing are not fully addressed. Serbia's progress toward EU accession continues to be a key driver for improving its environmental governance.

4.6.3 Urban and Rural Wastewater Treatment

Wastewater treatment in Serbia is underdeveloped and below EU standards. The percentage of treated wastewater remains below 20%, and most treatment plants provide only primary treatment. Infrastructure for both collection and treatment is limited, especially in smaller municipalities and rural areas.

Recent adoption of the Wastewater Treatment Directive provides a legal foundation but lacks enforcement mechanisms. The government acknowledges the need for massive investment in infrastructure, as current systems lag far behind those for drinking water. Some pilot initiatives for sludge drying have been launched, but a coordinated national roadmap for wastewater infrastructure development is still missing.

4.6.4 Water Reuse

There are currently no specific regulations or standards for water reuse in Serbia. The concept is generically mentioned in national innovation strategies. Given Serbia's relatively abundant water resources and limited water stress (except in parts of southern Serbia), there is low political and public urgency to pursue water reuse projects. Demonstration projects and awareness-building will be critical to establish trust and highlight the benefits of reuse for non-potable applications such as irrigation or industrial use.

4.6.5 Resource and Energy Recovery

Resource and energy recovery from wastewater and sludge is still at an early stage. Sludge is generally classified and managed as regular waste, with no clear "end-of-waste" criteria or legal pathways for reuse in agriculture or energy production.

Energy recovery, such as biogas generation from sludge, remains limited to a few pilot projects—less than 20% of wastewater treatment plants are involved in such activities. While the technology exists, uptake is constrained by financial barriers, regulatory uncertainty, and lack of technical expertise. Nonetheless, the government has begun to promote sludge valorisation and energy generation as part of its broader circular and energy transition agendas.

4.6.6 Sectoral Context

Agriculture: Agriculture is an important sector in Serbia, but treated wastewater and sludge are not currently reused for irrigation or soil enrichment. Legal and social constraints limit progress, and water reuse is not seen as a viable near-term option for farmers.

Industry: Industrial actors—particularly in the beverage, textile, and agri-processing sectors—are required to treat their wastewater but compliance may be limited. Standards for industrial discharge are being negotiated, and collective treatment systems are rare. Greater cooperation between industry and research institutions could help translate circular principles into practice.

Energy and Tourism: The energy sector is transitioning away from thermal power toward renewable sources, including hydropower (currently about 27% of total production). However, declining hydropower output due to changing rainfall patterns has led to renewed debate over diversification, including nuclear energy, which remains politically sensitive.

Tourism is not yet a key driver of circular water practices, though improving water quality and bathing conditions could become priorities as the sector expands.

4.6.7 Digitalization in the Water Sector

Digitalization in Serbia's water sector is nascent. While national strategies acknowledge its importance for improving efficiency, transparency, and data management, digital tools are rarely applied in practice. The sector suffers from limited data collection and insufficient technical capacity.

Upskilling improved inter-agency coordination, and investment in digital systems—such as smart metering and monitoring platforms—are needed to enable progress. Integrating digitalization into future circular water planning could significantly enhance resource efficiency and regulatory compliance.

4.7 Albania

To ensure consistent evaluation across all seven countries, this analysis applies the Circular Water Domain Framework defined in Section 2.4. National policy landscapes are assessed against five core innovation areas essential for a Water Circular Economy. Policies are classified as either Generic (broad sustainability goals without specific targets) or Specific (clear provisions and binding requirements). Finally, the analysis identifies Enabling Conditions that facilitate uptake and Hindering Conditions (e.g., regulatory bottlenecks) that block progress. This structured approach highlights the specific Policy and Policy Implementation Gaps concerning Circular Water Economy the WaterWise Hub must address. Table 14 presents policy conditions in Albania.

Table 13: Policy conditions per water-CE innovation domain in Albania

Circular water innovation domain	Specific, Generic or no policy	Enabling conditions	Hindering conditions
Basic water management, provision and sanitation	Specific	Establishes national and basin-level frameworks for IWRM; river basin governance; reforms in water utilities; sector strategies up to 2030; national safety plans; clear standards for water/sewerage utilities; integration with EU directives.	Institutional overlap; weak enforcement; outdated provisions; operational resistance to reform; coordination issues across agencies; financial shortages; rural implementation gaps.
Water saving	Generic	Promotes efficient irrigation and drainage systems; encourages sustainable agricultural water use; pricing reforms incentivise efficiency; technical codes set standards to reduce losses.	Limited infrastructure; financial constraints; need for tariff reform; weak monitoring and adoption in rural areas.
Water reuse	Generic	Regulates wastewater collection, treatment, and discharge; supports aquaculture with sustainable water reuse provisions; basin management plans integrate reuse and ecosystem protection.	Aging wastewater infrastructure; enforcement limitations; high investment needs; institutional and monitoring gaps.
Nutrient and energy recovery	Generic	Framework for resource recovery through wastewater treatment; potential to link with agriculture (sludge use, nutrient reuse); opportunities in aquaculture and irrigation systems.	Limited technical capacity for advanced recovery; weak financial incentives; institutional overlap; insufficient investment in infrastructure.

4.7.1 General Information

Albania has made notable progress in developing a policy framework for integrated and sustainable water management, with strong ambitions to align with EU standards. Its national strategies for water management aim to modernize the sector through infrastructure upgrades, improved governance, and sustainable resource use.

Despite this progress, implementation lags significantly. Only 3 WWTPs operate effectively across the country, and most rural areas discharge untreated wastewater directly into rivers and coastal waters. Infrastructure gaps are severe, especially in rural areas where water distribution networks and sewer systems are underdeveloped or absent. Governance challenges—such as overlapping institutional responsibilities and weak enforcement—further limit innovation.

4.7.2 EU Policy Alignment

Albania is in the process of aligning its legal and strategic frameworks with EU directives. National policies emphasize integrated water resources management (IWRM), river basin governance, pollution prevention, and the protection of public health and ecosystems. However, explicit provisions for water reuse, sludge valorization, and nutrient recovery are still lacking. Clear regulatory standards for reuse quality and monitoring have yet to be defined, limiting investment and innovation in circular water solutions.

4.7.3 Urban and Rural Wastewater Treatment

Wastewater treatment coverage remains limited—only around 17% of wastewater is treated, mostly in urban areas. In rural regions, wastewater is often discharged untreated into rivers or the sea. Hotels and private businesses are required by law to install storage and collection systems, but this is poorly enforced. Municipalities face major financial and technical barriers to expanding treatment infrastructure. Smaller towns cannot afford collective WWTPs, and decentralized treatment is being explored as a more cost-effective option. The collection of wastewater remains a major logistical issue.

4.7.4 Water Reuse

Albania lacks a formal regulatory framework for water reuse. Reuse is currently limited to informal or pilot-scale activities in agriculture and industry. Social acceptance for reuse may be low and is related to public distrust of water quality—drinking water is often viewed as unsafe, leading to heavy reliance on bottled water. Reuse for agricultural irrigation or industrial cooling is considered acceptable in principle but not yet practiced systematically. The absence of clear reuse standards and economic incentives prevents scaling up of circular practices.

4.7.5 Resource and Energy Recovery

Resource and energy recovery from wastewater is at an early stage in Albania. Only a few case studies or pilot initiatives exist. Larger WWTPs with energy recovery capacity are a long-term goal, but these require heavy investment. The country's low energy costs and abundant water resources have reduced the financial incentive for recovery. However, there is growing interest in biogas generation and sludge valorization, supported by evolving regulations. Nature-Based Solutions (NBS) are considered promising—particularly for rural areas—but remain financially prohibitive for most municipalities.

4.7.6 Sectoral Context

Agriculture: Agriculture consumes the largest share of water but suffers from low irrigation efficiency and limited infrastructure. Farmers show cautious interest in reuse and sludge applications, but public and regulatory barriers persist. Circular water approaches could be integrated into agricultural modernization programs.

Industry: Industries such as textiles and agri-processing (e.g., olive oil production) conduct sustainability assessments, including wastewater management, but lack collective treatment systems. There is limited awareness of cost-effective alternatives.

Tourism: Tourism is expanding rapidly and is becoming a key driver for water quality improvements, particularly along the coast. EU bathing water standards are applied, but monitoring occurs only once per year and bathing water quality remains poor in several locations. Improvements are expected within the next 10–15 years, driven by EU integration efforts. Demonstrating cost-effective decentralized wastewater treatment for tourism facilities could accelerate circular water adoption in this sector.

4.7.7 Digitalization

Digitalization is in its early stages. Most utilities lack real-time data systems for monitoring water quality, consumption, or wastewater flows. Data scarcity and outdated infrastructure hinder digital integration. Efforts are underway to introduce smart metering and data management platforms, but progress is slow and uneven across municipalities. In the longer term, digital monitoring and transparent data reporting will be crucial to improving efficiency, supporting water reuse standards, and aligning with EU digital transition goals.

4.8 North Macedonia

To ensure consistent evaluation across all seven countries, this analysis applies the Circular Water Domain Framework defined in Section 2.4. National policy landscapes are assessed against five core innovation areas essential for a Water Circular Economy. Policies are classified as either Generic (broad sustainability goals without specific targets) or Specific (clear provisions and binding requirements). Finally, the analysis identifies Enabling Conditions that facilitate uptake and Hindering Conditions (e.g., regulatory bottlenecks) that block progress. This structured approach highlights the specific Policy and Policy Implementation Gaps concerning Circular Water Economy the WaterWise Hub must address. Table 15 presents policy conditions in North Macedonia.

Table 14: Policy conditions per water-CE innovation domain in Macedonia

Circular water innovation domain	Specific, Generic or no policy	Enabling conditions	Hindering conditions
Basic water management, provision and sanitation	Specific	Establishes overarching legal and regulatory framework for water management; integrated water permits; pricing mechanisms encourage efficiency; ensures sustainable water supply and wastewater collection.	Financial and institutional barriers; infrastructure gaps; strict compliance requirements hinder innovation.
Water saving	Generic	Pricing structures (variable tariffs) encourage efficient use and create financial incentives for reduced water consumption, especially for industry.	Institutional and technical gaps; slow adaptation of new technologies; limited incentives for households; compliance and enforcement difficulties.
Water reuse	Specific	Legal framework supports reuse of treated wastewater; clear emission standards; recognition of zones where reuse is more favourable.	High technological and financial requirements; infrastructure gaps; governance and stakeholder resistance; strict quality standards can be difficult to achieve.
Nutrient and energy recovery	Generic	Opens space for innovation in sludge treatment and recovery of materials/energy; potential for downscaling technologies to distributed systems; recognition of circular resource use.	Technical and financial barriers; lack of infrastructure for advanced recovery technologies

4.8.1 General Information

North Macedonia (MK) is not a member of the European Union; however, the country's environmental and water management policies are closely aligned with EU water directives. The country's main water sources are groundwater reserves, which generally require little or no treatment before use. Groundwater is widely used in mining, agriculture, and the machinery sector, and all users must obtain abstraction licences. Once used, water must be treated before being discharged back into the environment, and non-compliance can lead to severe penalties. Surface water provides the main supply for urban areas, supported by reservoirs and dams that ensure regional distribution. Water scarcity is not currently a significant issue, although some transboundary lakes shared with Greece have experienced shortages, likely due to tectonic or agricultural influences. North Macedonia is also attentive to transboundary water management, particularly along its border with Albania.

Public utilities oversee the national water supply in collaboration with irrigation authorities. The country's energy mix is dominated by coal and hydropower, though hydropower plants remain underutilized due to public opposition. Natural gas is imported from Bulgaria.

4.8.2 EU Policy Alignment

Although not a member of the EU, North Macedonia follows EU environmental standards and water directives closely. The country's water management framework is designed to be flexible yet stringent, allowing innovation while ensuring compliance with environmental objectives. Regulatory bodies oversee licensing and tariff structures for water services, ensuring consistency with EU-aligned principles of efficiency, transparency, and sustainability.

Regarding water quality management, a new Law on water is expected to be adopted soon, to further align with the Water Framework and Groundwater Directives. River basin management plans and the upgraded water monitoring strategy have been adopted for most basins. There is no progress on aligning with the EU acquis on flood and water reuse. In 2025, a water management programme was adopted.

4.8.3 Urban and Rural Wastewater Treatment

National legislation mandates that used water must be treated before discharge, with strict environmental standards prohibiting release until legal quality thresholds are met. Treated water can only be released into natural or communal systems with a valid operating licence. Interestingly, water used for cooling processes can be legally discharged because heat is not considered a pollutant.

However, the untreated sewage and discharge from the bigger cities remain the primary sources of water pollution, particularly for rivers. Lack of designation of sensitive areas and the lack of a sludge management strategy hinder wastewater treatment in line with the relevant EU acquis. In line with EU legislation and best practices, the infrastructure sustainability requires reforms in the public communal enterprises and the use of a funding model, applying the polluter-pays and full-cost-recovery principles. The inspection and sanctions system needs to be further strengthened.

Urban areas primarily rely on surface water sources, while rural and agricultural regions depend on groundwater and irrigation systems. Over the last decade, the agricultural sector has received loans to build large-scale irrigation systems, though wastewater reuse remains underdeveloped. Urban wastewater treatment plants (WWTPs) have potential for reuse applications, such as cleaning streets or public spaces, where ultra-clean standards are unnecessary.

4.8.4 Water Reuse

While North Macedonia's national policy technically allows for water reuse, no licences have yet been issued for such activities. Authorities recognize that public acceptance of water reuse is a key precondition for future implementation. Concepts for a Water Circular Economy (WCE) include reusing treated water for non-potable purposes such as pavement washing or firefighting.

A tariff model for reusable water already exists, and regulatory bodies are responsible for setting service prices. For any future WCE framework to succeed, it must integrate these tariff structures and ensure that decision-makers understand the environmental and economic benefits of reuse.

4.8.5 Resource and Energy Recovery

Climate change is one of the main drivers behind the push for developing WCE initiatives in North Macedonia. The government is exploring business models that can demonstrate both environmental and economic gains, including the sale or energy conversion of sludge.

The country enforces high environmental standards, which restrict discharges until treated water reaches legally defined quality levels. However, these same standards present opportunities for energy-efficient and resource-recovery solutions. Innovative treatment and recovery technologies could contribute to the shift toward sustainable water management.

Tariffing of services of water supply and wastewater collection and treatment can be further improved to stimulate use of reclaimed water across communal and economy sectors. The national strategies for waste management and sludge management still need to be fully put into force.

Similarly to the material component (e.g. sludge), the clean energy component (methane, biofuel, hydrogen production,) of products of wastewater treatment, should be given more attention in the regulations related to wastewater, as it can provide additional financial justification of the circular water paradigm.

4.8.6 Sectoral Context

Agriculture: The agricultural sector is expanding its irrigation infrastructure, supported by loans and investments. While water reuse is not yet implemented, artificial aquifer recharge and gravity-fed systems are being considered to enhance water efficiency and reduce the need for new infrastructure.

Industry: Industries such as mining and machinery heavily depend on groundwater. Other industries use services provided by communal water supply and wastewater collection and treatment systems. Strict abstraction and discharge licensing, as well as regular monitoring and field inspections, encourage compliance and efficiency, providing a supportive regulatory environment for future circular economy initiatives. Currently, financial benefits of reuse of water for own technological purposes have been recognized in some industries. It can be expected that other industries will follow good examples, taking advantage of regulatory framework enabling reuse of water.

Tourism: Although specific water reuse projects in tourism are not yet developed (except on a small scale, pilot or promotional basis), the sector could benefit from cleaner urban and rural environments and sustainable water use practices that enhance destination appeal. Additionally, financial benefit can be found in reuse of part of the discharged water for maintenance purposes.

The government recognizes the benefits of strengthening collaboration between industry and agriculture, as the main water consumers, to promote integrated water resource management and cross-sectoral efficiency.

4.8.7 Digitalization

Digitalization presents a key opportunity for improving water sector efficiency and supporting a future WCE framework. North Macedonia's Smart Specialisation Strategy integrates smart materials in building design and promotes smart agricultural practices. Within this national R&I strategy, there is growing interest in launching research, innovation pilot projects or feasibility studies related to circular water technologies, innovation and integrated water resources management.

Smart technologies could help detect leaks, collect operational data, and optimize system performance. They also provide valuable support for research, innovation, and decision-making. In urban settings, digital monitoring could complement Nature-Based Solutions (NBS) to manage stormwater and runoff from pavements—where primary treatment may be sufficient for reuse.

5 Cross-country results

5.1 Common challenges

A summary of the assessment of policies in the WaterWise Hub partners countries is displayed in Table 16.

Table 15: Summary of policy specificity per circular water innovation domain, per country.

Country	Basic water management, provision and sanitation	Water saving	Water reuse	Nutrient and energy recovery
AL	Specific	Generic	Generic	Generic
EL	Specific	Specific	Specific	Specific
MD	Specific	Generic	Generic	Specific
MK	Specific	Generic	Specific	Generic
RO	Specific	Generic	Generic	Generic
RS	Specific	Generic	Generic	Specific
UA	Specific	Generic	Specific	Specific

Table 17 outlines the levels of (and thereby gaps between) circular water (CW) policy development, alignment with EU directives, and practical implementation per country. Across the board, this shows that implementation is lagging behind the policy development. This suggests that while some policy adjustments may be required, broader governance barriers (e.g. barriers related to institutional alignment, resources, and prioritization) may need to be addressed with highest priority.

Table 16: Levels of Circular Water (CW) policy development, alignment with EU Aquis, and practical implementation.

Country	CW Policy	EU alignment	Implementation
AL	In process	In process	Initiating
EL	Advanced	Advanced	In process
MD	In process	In process	Initiating
MK	In process	Advanced	In process
RO	In process	Advanced	In process
RS	Initiating	In process	Initiating
UA	Advanced	In process	Initiating

These summaries show that there are significant differences among these countries. In countries where there already is a strong legal and strategic foundation for a circular water economy, such as Greece, Romania and Ukraine, stakeholders must now translate this legal framework into action plans that are clear, financially supported, and practically accessible to end users. By strengthening coordination, incentivizing innovation, and enhancing regulatory guidance, these countries are on the brink of unlocking the full potential of circular water solutions for sustainability, resilience, and compliance with EU goals.

To successfully implement circular water economy solutions in countries where circular economy policies have not yet been implemented or are under development, it is essential to bridge the current policy gaps with targeted regulation, cross-sector coordination, and capacity development. Especially the development of detailed specifications for circular water practices, such as wastewater reuse and sludge valorization, requires attention. Leveraging EU integration processes and existing sector reform strategies can catalyze the uptake of water reuse and resource recovery practices. Despite regional and national differences, several general conclusions can be drawn:

An legal provision supporting circular water economy is the existence of quality standards for reclaimed water, dry sludge and recovered nutrients. These quality standards set the threshold between waste that must be appropriately disposed and alternative resource that can be used/sold/exploited. The existence of quality standards facilitates the private sector to invest, get the necessary administrative approvals/permits and subsidies and act as criteria for public and private projects to get public and private funding targeted to the promotion of Circular Water Economy.

Water saving incentives are *not* a policy priority across all the WaterWise Hub partner countries except Greece. In several countries this is related to relative water abundance, while in countries that experience water scarcity this may be due to the sensitivity of water pricing mechanisms. Yet, the need to save water is known to be a strong external driver to push sectors to adopt circular solutions.

In all WaterWise Hub partner countries, **there is significant disparity between urban and rural settings.** Hence, policies for CWE need to acknowledge this gap and pay attention to opportunities in both rural and urban systems. Manoeuvring ability is required to enable both centralized and decentralized systems for reuse and recovery, as well as nature-based solutions. It is imperative to develop a narrative and **strategy for circularity in rural areas**. A lack of basic water provision and sanitation infrastructure in rural areas, combined with technological and financial barriers of scale (small-scale solutions are often not viable), currently impede the adoption of CW.

Policies supporting circular water development should cater to the current and expected demographic and sectoral developments in each country. Most WaterWise Hub partner countries have seen **deindustrialisation** combined with **urbanisation** and rural depopulation in the past decades. New industrial development has generally been shifting away from primary production to distribution and digital infrastructure (data centres). Agriculture remains an important economic sector in the region. These are important factors in the procurement of viable CW implementation and supportive governance structures.

Where **basic infrastructure** (water distribution, wastewater collection and treatment) is lacking or requires rehabilitation, countries have an opportunity to develop their water infrastructure with **circularity principles in the design phase**. New investments for infrastructure development should be aligned to achieve CWE goals.

Regional differences about water availability and scarcity require attention from policy makers since **different incentives** may be required to stimulate adoption of circular systems.

Public acceptance may be an obstacle to implementation, but this hypothesis is not yet supported by regionally relevant research. It is important not to assume that public acceptance will be low, as this may provoke unjustified decisions *not* to take initiatives towards circularity. Instead, **engagement of key stakeholders** from different sectors in the initial phases of development, transparency of decision-making process and open access to monitoring data are widely considered as key elements towards acceptance. More important still is the design and consistent delivery of positive narratives which explain the benefits of the CE.

5.2 Establishing an extensive circular economy in water sector

Establishing a Water Circular Economy requires the implementation of a range of coordinated and complementary measures:

1. Appropriate treatment of wastewater and sludge.
2. Recovery of nutrients and energy during the treatment process.
3. Development of clear policies and quality standards for all potential water reuse applications, such as irrigation, industrial processes, urban use, and groundwater replenishment, along with robust risk management for these practices. Comprehensive quality standards can encourage private sector investment in key economic sectors, including industry and tourism.
4. Utilisation of digital tools to enhance monitoring of collection and treatment infrastructure and effluent quality. These technologies also enable remote management of smaller, decentralised treatment facilities.

The establishment of a market requires the implementation of additional measures:

1. Include water circularity objectives into the planning/permitting procedures of new projects (eg. housing, commercial activities, industrial sites, mining, irrigation systems etc.)
2. Setting appropriate water tariffs to position reclaimed water as an economically viable option and promote water savings.
3. Financing essential infrastructure, similar to past investments in wastewater treatment facilities, for large-scale projects such as aqueducts and irrigation systems.
4. Providing subsidies for private water reuse systems.

5. Making water, sludge, and nutrient reuse a prerequisite for funding future irrigation projects.
6. Advancing water, sludge, and nutrient reuse through Green Public Procurement initiatives.

6 Future perspectives and Recommendations

6.1 Policy Recommendations

The Policy Recommendations outlined in this report are intentionally broad, having been discussed with all stakeholders to facilitate consensus and establish a unified vision and innovation strategy among WaterWise Hub partner countries. Each recommendation may be interpreted differently by each country, depending on their existing national policies and institutional frameworks. While all proposed recommendations have relevance across WaterWise Hub partner nations, this report endeavours to prioritize and present those most applicable and effective for each country, considering the maturity of existing legal frameworks, current infrastructure status, and the relative significance of economic activities. Based on the preceding country analyses, we have identified 13 key policy recommendations, as detailed in Table 18. To translate the analysis into an actionable roadmap, each policy recommendation has been codified based on the specific policy instruments required for its successful implementation. Drawing on the governance framework established in Section 2.2, we utilize four primary policy instrument codes as follows:

- **L – Legal & Regulatory**: Measures requiring legislative change, new standards, or stricter enforcement (e.g., binding water reuse targets).
- **F – Financial:** Measures requiring economic incentives, subsidies, tariffs, or penalties (e.g., funding for irrigation networks).
- **C – Capacity Building:** Measures requiring training, institutional strengthening, or technical upskilling (e.g., training operators on digital twins).
- **P – Public Awareness:** Measures requiring stakeholder engagement and social acceptance campaigns (e.g., educating farmers on the safety of reclaimed water).

Each of these codes is associated with the corresponding policy recommendations, and they may be integrated when combined actions are suggested *(e.g. when a recommendation covers both legal and financial instruments is coded as LF).* These recommendations were also presented during the 1st WaterWise Hub Think Tank meeting, held on-line on the 11th of December 2025, and were prioritised by the participants who represented the WaterWise Hub partner countries and all parts of the Quadruple Helix. Selected results are presented in Annex I. The validation results from the Think Tank meeting were very positive, showing that all proposed recommendations touched an acceptable voting score. Voting scores varied from 14 to 4 votes. Therefore, no Policy Recommendation was rejected as not relevant.

Furthermore, we see from the global ranking that infrastructure, public awareness and funding are the main issues put forward by the Think Tank (total score from 10 to 14). Specific issues of implementation of the water circular economy have a medium importance (total score from 5 to 9), but this result can be also due to the specificity of these recommendations.

The proposal for real-time remote inspection and monitoring of private wastewater facilities received the lowest score, indicating both concerns about imposing additional financial burdens and regulatory oversight on the private sector, as well as limited trust in the credibility of private WW operations (Figures 4 and 5). Validation results demonstrate that each segment of the Quadruple Helix model (Figure 6) holds distinct perspectives regarding the necessary policy recommendations for advancing a Circular Water Economy. Therefore, it is essential to involve all Quadruple Helix stakeholders in establishing a shared strategic innovation vision.

Table 17: Policy Recommendations and their codification

ID	Policy Recommendation	Code
1	Speed up the implementation of the UWWTD/ Funding mechanism	LF-1
2	Promote effective decentralised WWT systems so as to cover the gap till the construction of collective WWT	LF-2
3	Promote the Digitalisation of the Water Sector	LFCP - 1
4	Promote real-time remote inspection and monitoring of private WW facilities	LFCP - 2
5	Adopt/Update quality standards and technological requirements for all possible water and sludge reuse activities	L – 1
6	Funding mechanism for industrial WWT and reuse	F -1
7	Education/specialisation of stakeholders on water-scarcity and available water-reuse technologies	C – 1
8	Public Awareness on water scarcity and available water-reuse technologies	P – 1
9	Create a market for Water Circular Economy through Green Public Procurement	LFC – 1
10	Create a market for Water Circular Economy through Environmental Impacts Assessment	LFC – 2
11	Adopt the EU Water Reuse Regulation for agricultural reuse	LFCP – 3
12	Give financial incentives so as to make water and sludge reuse economically viable	F – 2
13	Promote water reuse in new irrigation infrastructure/ Funding mechanism	F – 3

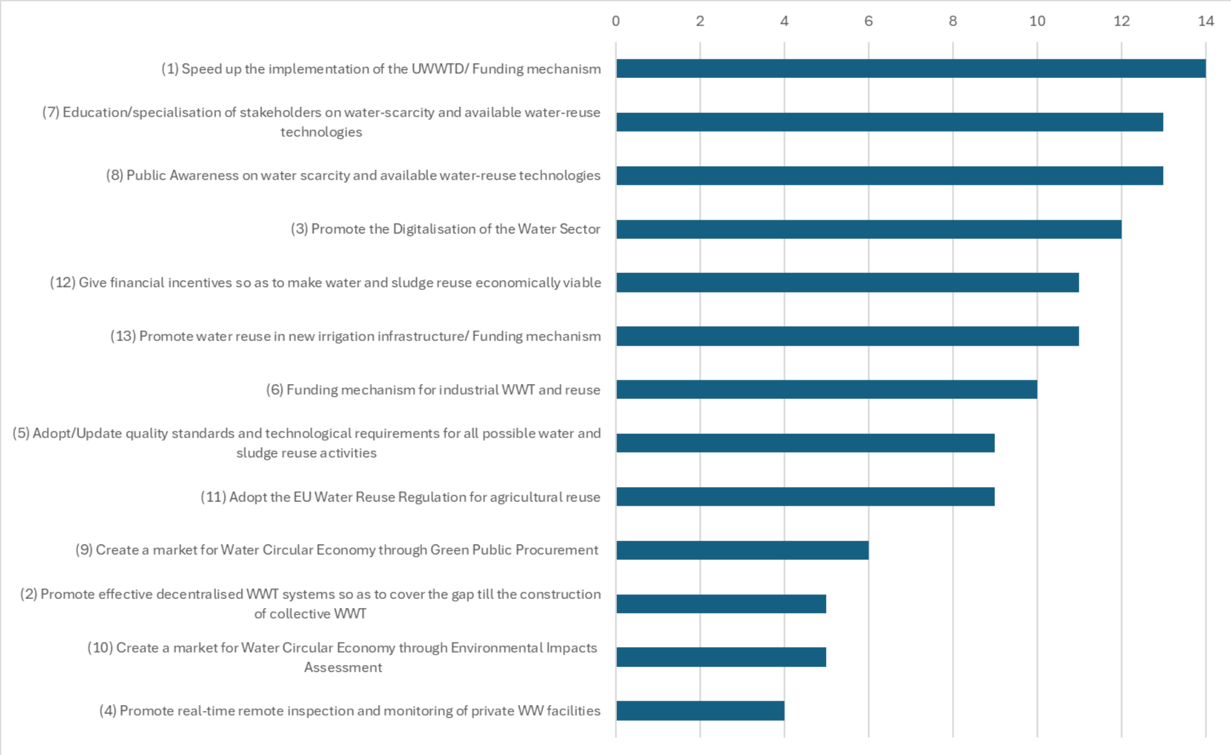

Figure 4: Validation of policy recommendations total votes

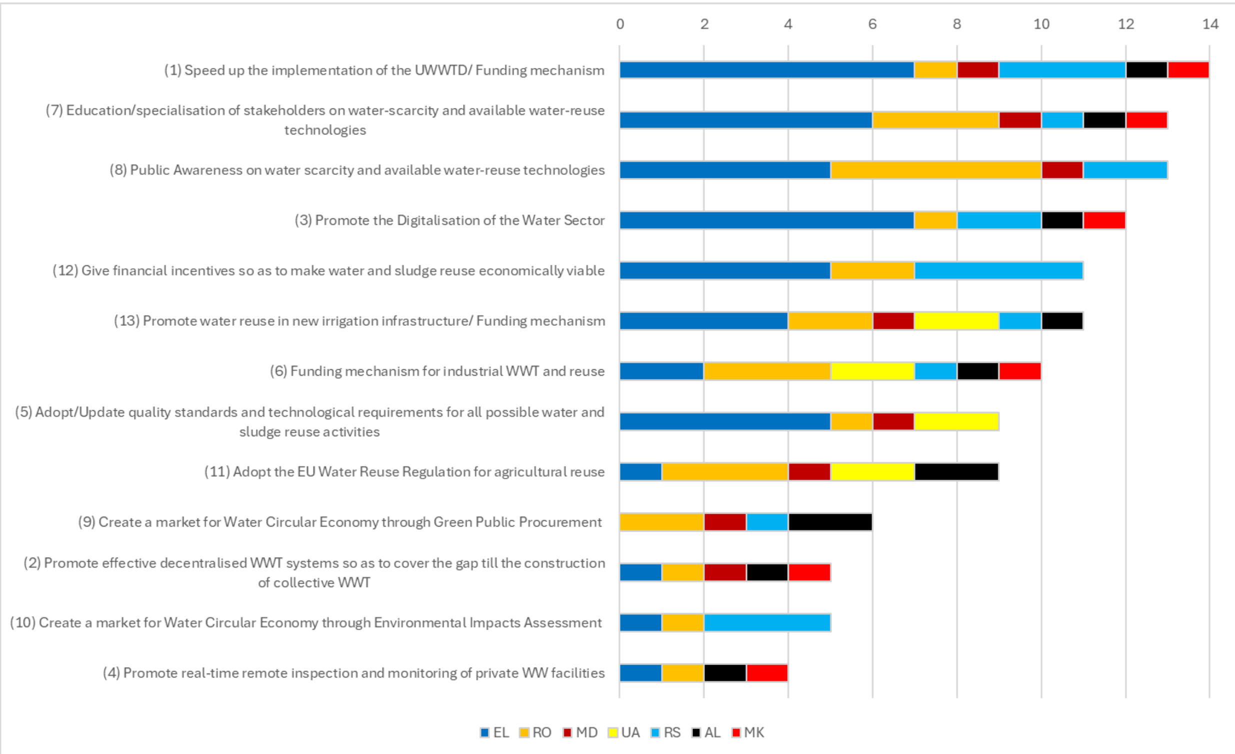

Figure 5: Validation of policy recommendations total votes per partner country of the WaterWise Hub

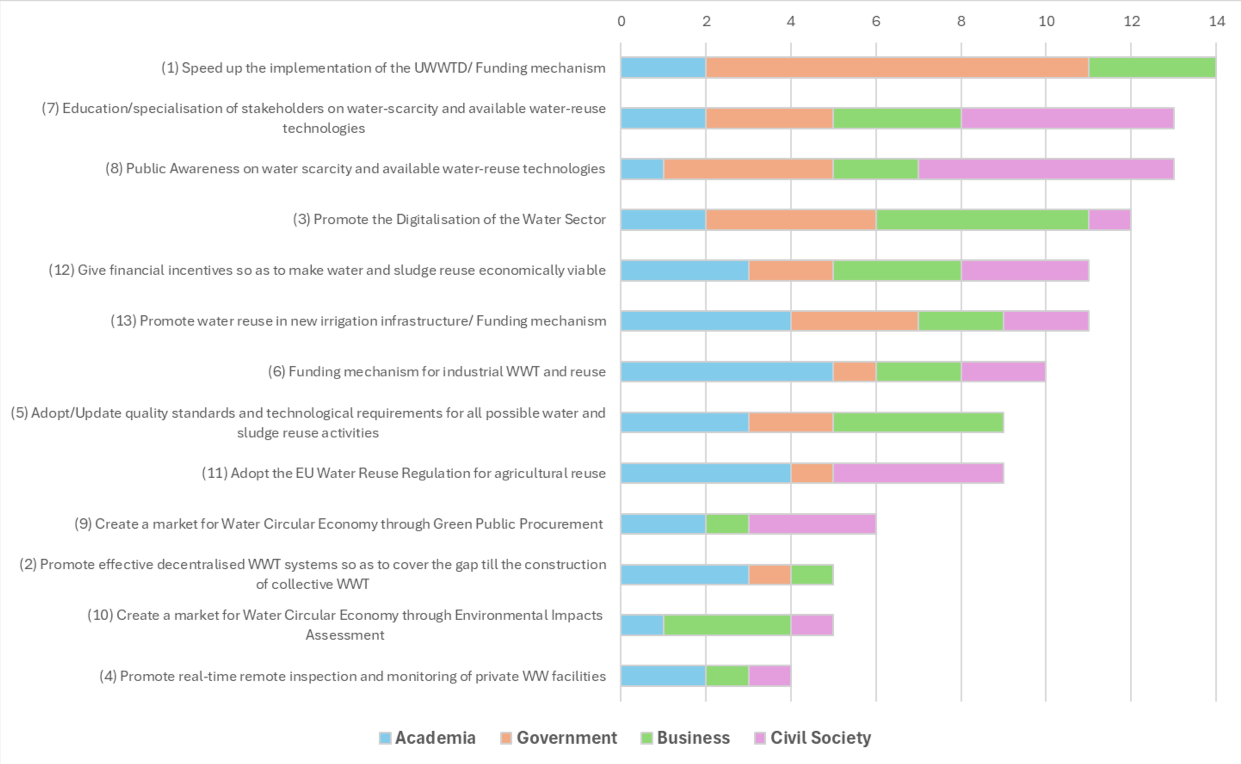

Figure 6: Validation of policy recommendations total votes per Quadruple helix orientation

Annex I: Think Tank Validation session

The Policy Recommendations presented in chapter 6 were presented during the first WaterWise Excellence Hub Think Tank meeting held online on the 11/12/2025. Stakeholders from the seven participating countries representing all the Quadruple Helix participated in the 1st Think Tank Meeting which aimed to validate the Policy Recommendations via an online exercise in MIRO platform. The online exercise was to select a sticker based on the positioning in the Q-helix and choose the top five (5) policy recommendations applicable to the country of their origins as shown in Figure 7.

Figure 7 – Online exercise validating the proposed list of policy recommendations.

Annex II: Countries Interviews

Country	Interviews' dates
Albania	28/10/2025
Greece	29/10/2025
Moldova	30/10/2025
North Macedonia	03/11/2025
Romania	28/10/2025
Serbia	29/10/2025
Ukraine	30/10/2025

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