

D2.4. Policy briefs

Cetaqua-Water Technology Centre

D2.4. Policy briefs

Summary

This deliverable presents a consolidated set of three policy briefs developed under WP2 of LIFE WARRIOR. In line with the Grant Agreement, this public deliverable aims to translate relevant project results into policy-oriented recommendations and best practices for reclaimed water reuse in agriculture.

Methodologically, the policy briefs were prepared through the review and consolidation of project results and practical experience generated in LIFE WARRIOR, complemented by the analysis of the relevant EU and national policy and regulatory framework, and by the collection of stakeholder views and field-based evidence. The three policy briefs address complementary dimensions for the wider uptake of reclaimed water in Europe: the development of an EU certification framework for agricultural products and activities using reclaimed water; the strengthening of risk-based governance and digitalised Risk Management Plans under Regulation (EU) 2020/741 and Royal Decree 1085/2024; and sustainable design guidance for R&D pilot plants, including modularity, resource efficiency, reuse of materials and alignment with BREF/BAT references.

D2.4 aims to support a more enabling framework for safe, circular and climate-resilient water reuse in agriculture and serves as a synthetic and accessible take-away document for policy officers, stakeholders and the wider public. Its recommendations are intended to contribute to ongoing policy reflection at EU level on water resilience, circular economy and sustainable agricultural innovation.

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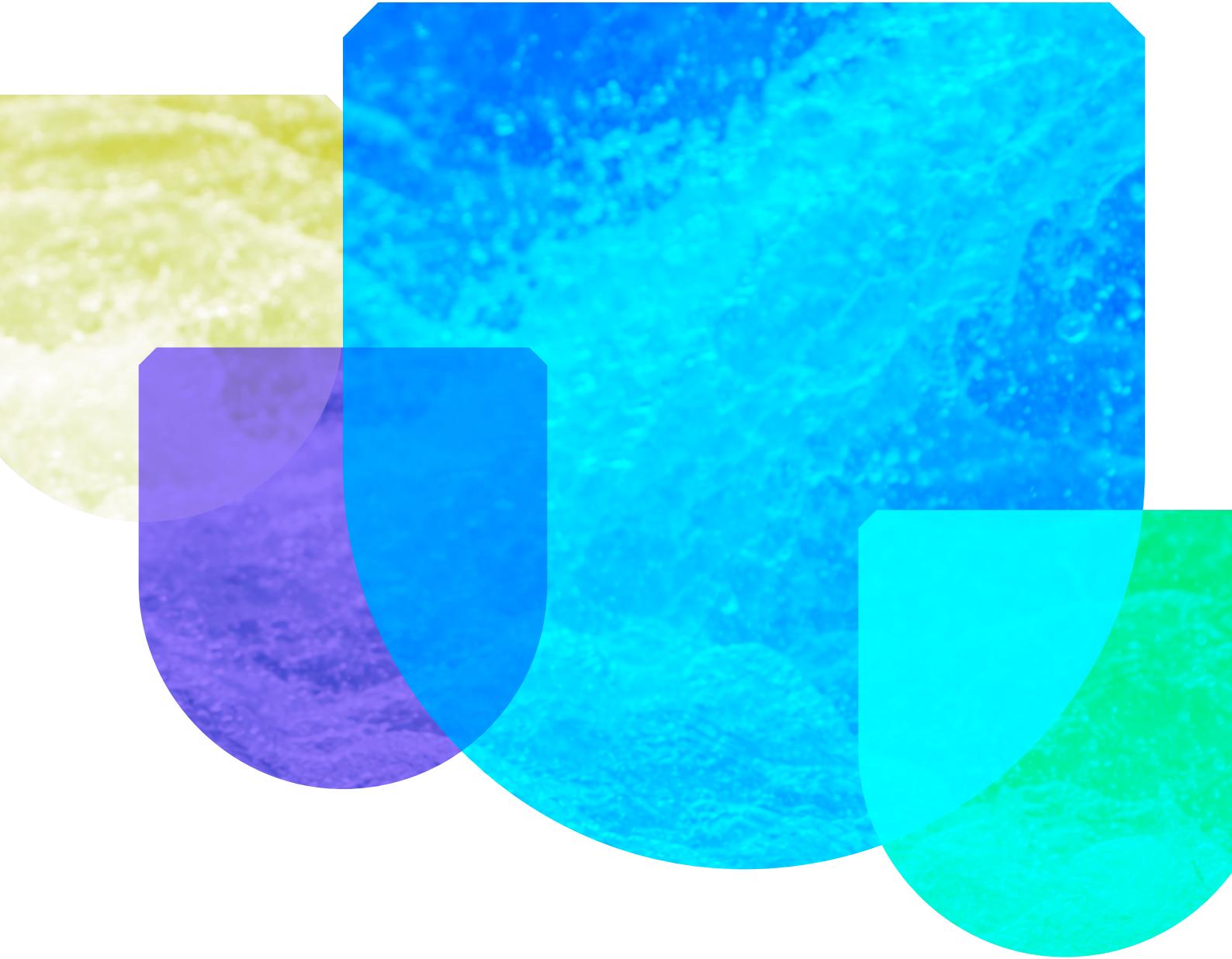
Executive summary

D2.4 Policy Briefs is a public deliverable of LIFE WARRIOR under WP2. It consolidates three policy briefs prepared under Task 2.4 with the purpose of translating relevant project results into recommendations for policy adaptation and best practices at EU level. As defined in the Grant Agreement, Task 2.4 builds on existing policy gap analyses and on the expertise and experience of project partners and stakeholders, and foresees the drafting and dissemination of three policy briefs through wider outreach channels and direct communication with policy actors.

The deliverable is grounded in LIFE WARRIOR's overall objective to demonstrate an innovative and cost-effective water reclamation train for safe agricultural irrigation in line with Regulation (EU) 2020/741. The project combines reused ultrafiltration membranes, low-energy UV-LED disinfection and digital tools for risk management and process optimisation, thereby supporting a circular, low-emissions and climate-resilient approach to water reuse.

The three policy briefs address complementary enabling conditions for the wider uptake of reclaimed water in Europe. The first brief promotes the development of a voluntary EU certification framework for agricultural products and activities using reclaimed water, with the aim of improving safety, traceability, transparency and public confidence. The second brief focuses on strengthening risk-based governance and the implementation of Risk Management Plans under Regulation (EU) 2020/741 and Royal Decree 1085/2024, while highlighting the contribution of the WARRIOR SSP Tool. The third brief provides practical guidance for more sustainable R&D pilot plant design, including modular and demountable approaches, efficient use of energy and chemicals, reuse of materials, and reference to BREF/BAT frameworks for future scale-up.

The recommendations presented in D2.4 are informed by project results, partner expertise, policy analysis, stakeholder consultations and field-based evidence. Overall, D2.4 provides concise and accessible take-away material for policy officers, stakeholders and the wider public, contributing to a more enabling framework for safe, circular and resilient water reuse in European agriculture.



POLICY BRIEF

Assessment of the certification of
reclaimed water for agriculture in Europe

Guillermo Ortiz Seco

LIFE WARRIOR is a European project co-funded by the LIFE Programme (LIFE21-ENV-ES-WARRIOR 101074367), the European Union's funding instrument for the environment and climate action. The general objective of LIFE is to contribute to the implementation, updating, and development of EU policy and legislation on environment and climate through the co-financing of projects with European added value. The opinions and views expressed are solely those of the author(s) and do not necessarily reflect those of the European Commission or CINEA. Neither the European Commission nor the granting authority can be held responsible for them.

POLICY BRIEF

Assessment of the certification of reclaimed water for agriculture in Europe



EXECUTIVE SUMMARY

Although the European countries most vulnerable to water scarcity are taking advantage of EU incentives to produce agricultural products with reclaimed water and thus combat the environmental challenge, many regions ignore or reject this alternative water source, partly due to a lack of visibility, knowledge, transparency and trust.

In line with the LIFE Warrior project, this document encourages the European Union to develop the first reclaimed water certification for agricultural products and activities in Europe guaranteeing safety, traceability, and transparency of these products, eliminating social barriers and promoting the use of reclaimed water, as well as agricultural and environmental sustainability.



Agricultural irrigation (stock image)

CONTEXT

Water scarcity due to climate change, coupled with the relentless growth of the global population, is leading countries that rely heavily on agriculture (such as Spain and other Mediterranean regions) to implement water reclamation techniques to meet their increasingly fragile water needs.

The leading countries in reclaimed water in the UE are: Cyprus, with a 90% reuse of their wastewater; Malta, with a 60% (OCDE, 2024); and Spain, which reuses approximately 400 hm³ (12%) of its wastewater annually (MITECO, 2024), with regions more affected by water scarcity (such as Murcia) with plants that regenerate up to 90% of the wastewater generated (Esamur, 2023).

However, while these countries are more aware of the importance of managing water sustainably, there are still many other EU regions (mainly northern and central countries) where water is not regenerated due to a lack of sense of need, experience or investment, and existing social barriers to acceptance due to a lack of knowledge, which generates distrust among the population. (Radini et al, 2023; Malinauskaite et al, 2024).

A potentially useful tool for promoting the production of reclaimed water and improving its visibility, awareness, and impact on the EU countries sustainability, can be the creation of the first public reclaimed water certification for agricultural products and activities.

The aim of this policy brief is to promote the creation of this official EU certification motivated by the LIFE Warrior project experience, where a sustainably designed pilot plant for reclaimed water was built in Murcia, Spain, providing local farmers with new and sustainable water resources.

PUBLIC AND PRIVATE PRODUCT CERTIFICATIONS FRAMEWORK

There exist multiple certifications for food products, both public (EU Protected Designation of Origin or EU Traditional Speciality Guaranteed) and private (Fair Trade International, Animal Welfare Approved, or Carbon Trust) which have proven to be very useful in informing, raising awareness, educating consumers on a relevant topic.

Furthermore, certifications related to water use and quality also exist even though they are much more limited and mainly managed by private organisations (Global GAP, Rainforest Alliance or Water Footprint Certification). Nevertheless, these certifications do not recognise the use of reclaimed water as a sufficient measure to grant certification to a product or activity.

On the other hand, in 2010 the EU, with the aim of unifying the different organic labels of each country and boosting the European organic and sustainable market, created the EU Organic Certification, currently governed by the Regulation (EU) 2018/848. However, even though this certification takes into account the origin of the products and their cultivation methods, it does not consider the alternative origins or efficient management of water as a sufficient measure of sustainability for a product to be recognised as organic or ecological.

SPANISH DRAFT ORDER IN 2025

In the case of Spain, in October 2025 a draft order was created for the establishment of a national seal for transparent water management: "Draft Order TED/XX/2025, which regulates the procedure for granting the transparent water management seal".



Official EU eco-logo for organic certification

This seal, managed jointly by the Ministry for Ecological Transition and the Demographic Challenge and the autonomous communities, would be awarded to water use rights holders who meet the objectives of transparency of information and good water management within their respective areas of competence. There would be two types of seals: one less stringent (Transparent Water Management Seal) and another more stringent (Transparent and Sustainable Water Management Seal).

Among the criteria for obtaining the second seal is "having water regeneration facilities such that, at least, the regeneration water effectively used represents 1% of annual consumption, with a gradual increase in the percentage of regeneration water proposed".

Therefore, while this seal represents a good initiative, it is not considered comparable to the certificate proposed in this policy brief, nor is it sufficiently comprehensive, as it is not exclusive to the consumption of reclaimed water in agricultural activities, nor does it have the international character sought by being promoted by the EU.

Therefore, nowadays there is no private or public certification for the use of reclaimed water neither for food nor industrial products or practices in the EU.

BASES OF A RECLAIMED WATER CERTIFICATION

The support and bases necessary for the creation of a European Union certification recognising the use of reclaimed water in the irrigation of agricultural products are explained below.



Proposed seals for transparent water management in Spain

SUPPORT FROM OFFICIAL BODIES

Some of the official bodies whose principles would support the creation of this certificate are:

- The European Environment Agency (EEA)

EEA states in many official documents such as “Europe’s state of water 2024: the need for improved water resilience” or “Water for people, nature and the economy 2025” that reclaimed water should become a resource for agriculture and replace freshwater intakes (rivers or aquifers), which helps to reduce pressure on natural water resources and address one of the major consequences of climate change that mainly affects southern Europe.

- United Nations and SDG

The certification would be aligned with the Sustainable Development Goals (SDG) established by the United Nations’ 2030 Agenda:

SDG 6 – Clean Water and Sanitation (which promotes the safe treatment and reuse of water).

SDG 12 – Responsible Consumption and Production (which encourages sustainable and responsible agricultural practices).

SDG 13 – Climate Action (which helps mitigate water scarcity linked to climate change).

- European and national regulations

Regulation (EU) 2020/741 is the main European regulatory framework governing the minimum requirements for the reuse of water for agricultural irrigation. In Spain, the guidelines of this regulation were incorporated through Royal Decree 1085/2024, which includes other uses for reclaimed water besides crop irrigation.

- Food and Agriculture Organization of the United Nations (FAO)

For more than a decade, the FAO has declared that the use of reclaimed water in agricultural crops is the path that all countries suffering from water scarcity should follow to combat population growth and the effects of climate change. Among the several articles, guidelines and official reports stand out: “The wealth of waste: The economics of wastewater use in agriculture” (FAO 2010) and “Unconventional

Water Resources” (United Nations and FAO, 2022). However, none of these organisations have promoted the creation of a reclaimed water certificate so far. Therefore, the basis and scope of such a certificate are not yet defined.



Reclaimed water distribution system (stock image)



Sustainable Development Goals 6, 12 and 13

PROPOSED STRUCTURE OF THE EU RECLAIMED WATER CERTIFICATION

The certification scheme requires a harmonised EU framework for credibility and effective implementation, using existing national bodies for verification and monitoring. This ensures consistency across Member States without new administrative structures.

ELIGIBILITY CRITERIA

Certification should apply to agricultural producers who demonstrably use reclaimed water in compliance with existing European legislation, particularly Regulation (EU) 2020/741 on minimum requirements for water reuse. Producers should be able to demonstrate traceability of reclaimed water use, compliance with quality standards, and the implementation of appropriate risk management and monitoring practices.

SCOPE OF CERTIFICATION

The certification scheme should allow for flexibility in the extent to which reclaimed water is used. Certification could apply to specific plots or production units, or even entire farms, provided traceability within the production system is ensured. This flexibility would encourage the gradual adoption of reclaimed water while maintaining transparency in the supply chain.

DUAL STRUCTURE: B2B AND B2C

The certification should operate through a dual structure addressing both supply chains (technical module) and consumers (market module):

The **B2B** component would focus on the technical verification and traceability of agricultural supply chains. It would provide distributors, retailers and regulatory authorities with verified information on the use of reclaimed water in agricultural production. This would be achieved through documented audits, traceability systems, and compatibility with existing agricultural compliance schemes.

The **B2C** component would translate verified water reuse practices into a clear, recognisable communication tool for consumers. A standardised EU label could be placed on certified products to show that they were produced using reclaimed water under verified conditions. Digital tools such as QR codes could enhance transparency and trust by providing consumers with additional information about water reuse practices, safety standards, and environmental benefits.

BENEFITS OF A RECLAIMED WATER CERTIFICATION

The need to use reclaimed water in agriculture seems quite evident and approved by the official EU bodies. However, given the question of what benefits a specific certification for these products would bring, the following points are outlined.

BENEFITS FOR FARMERS

- Recognition of sustainable practices and commitment to the environment.
- Improving the agricultural company's image in terms of environmental sustainability.
- Potential access to incentives and new markets.

BENEFITS FOR CONSUMERS

- Instilling confidence in consumers regarding the safety and health of this water source by providing an official EU certification.
- Possibility of implementing more sustainable practices and contributing to environmental protection by purchasing products with the reclaimed water certificate.

BENEFITS FOR REGIONS AFFECTED BY WATER SCARCITY

- Raising public awareness of the environmental challenges they face and the current need to manage water resources more efficiently due to the effects of climate change.

BENEFITS FOR UE AND ADMINISTRATIONS

- Promote the construction of reclaimed water plants and increase the percentage of reuse.
- Support sustainable development goals and circular economy policies.
- Serve as a monitoring and governance tool for water.

CONCLUSION

Reclaimed water has proven to be a safe, sustainable, and strategic resource for European agriculture, however, despite existing EU regulations and support, the level of acceptance and implementation of reclaimed water in Europe is not high enough.

Furthermore, the lack of public and private certifications for the use of reclaimed water in products and activities under-values the importance of using this sustainable resource.

Therefore, the EU is being asked to promote the creation of this first public and voluntary certification for both agricultural products and farms that use reclaimed water in Europe.

In this way, projects like LIFE WARRIOR would have greater visibility and impact on society.

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POLICY BRIEF

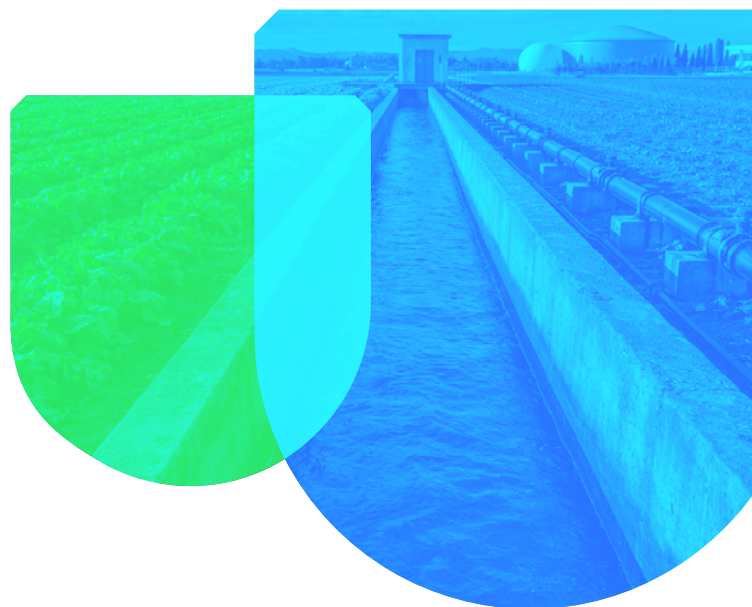
Enhancing water resilience –
Strengthening risk management in
regenerated water for agricultural use

Blanca Perdigones Guerrero

LIFE WARRIOR is a European project co-funded by the LIFE Programme (LIFE21-ENV-ES-WARRIOR 101074367), the European Union's funding instrument for the environment and climate action. The general objective of LIFE is to contribute to the implementation, updating, and development of EU policy and legislation on environment and climate through the co-financing of projects with European added value. The opinions and views expressed are solely those of the author(s) and do not necessarily reflect those of the European Commission or CINEA. Neither the European Commission nor the granting authority can be held responsible for them.

POLICY BRIEF

Enhancing water resilience – Strengthening risk management in regenerated water for agricultural use



EXECUTIVE SUMMARY

The increasing challenges of water scarcity and climate change demand innovative water management strategies. Regenerated water, derived from treated wastewater, is a critical resource for agriculture, supporting the circular economy and enhancing water resilience. Spain's Royal Decree 1085/2024 represents a significant regulatory advancement, integrating Regulation (UE) 2020/741, to promote safe reuse of regenerated water, particularly in agriculture (European Parliament and the Council of the European Union, 2020; Spain, 2024). A cornerstone of this legislation is the mandatory implementation of Risk Management Plans (RMPs), including Sanitation Safety Plans (SSPs) and comprehensive environmental risk assessment, marking a shift towards preventive, risk-based water governance.

Despite this strong regulatory framework, the practical implementation of Risk Management Plans across the water reuse chain remains uneven, revealing coordination, capacity, and digital integration gaps that may limit the effectiveness of the regulation in practice.

To assess the practical implementation of this regulatory goal, the LIFE WARRIOR project hosted a multi-stakeholder workshop in Cartagena (Murcia) on 22 January 2026. This event brought together key players in the reclaimed water risk management chain, including operators, irrigation communities, farmers, public authorities, and technology providers. The discussions aimed to identify administrative and operational gaps in the development and implementation of RMPs and to formulate practical recommendations to strengthen coordination and digital integration. This policy brief builds on those findings, translating field-based evidence into policy-relevant recommendations to support coherent, effective, and scalable implementation of RD 1085/2024.

This brief also introduces the WARRIOR project's SSP Tool, a digital solution designed to streamline SSP implementation and dynamic updates. By embracing digitalisation, capacity building, and harmonised frameworks, the EU can solidify a resilient approach to safe and sustainable water reuse.

LIFE WARRIOR PROJECT

The LIFE WARRIOR project, co-funded by the EU through the LIFE Programme (Grant Agreement No. 101074367), aims to develop and validate a low-emissions, circular water reclamation scheme for agricultural irrigation in line with Regulation (EU) 2020/741. The project is being implemented in Cartagena (Murcia, Spain), a semi-arid region where water reuse plays a strategic role in agricultural resilience. The project combines reused ultrafiltration (UF) membranes recovered from drinking water treatment plants with UV-LED disinfection technology, delivering a sustainable and cost-effective treatment solution that reduces energy consumption and avoids chemical use while ensuring compliance with stringent reclaimed water quality standards.

LIFE WARRIOR also integrates a digital decision-support tool to optimise the operation of the treatment train, extending membrane lifespan. Furthermore, it incorporates digitalised Sanitation Safety Plans to streamline the management and monitoring of health risks. To further promote circularity, the project has launched the Re-UF Market Place, a platform connecting suppliers of used UF membranes with end users, thereby fostering resource efficiency and accelerating safe water reuse uptake across the EU.

THE ROLE OF REGENERATED WATER IN EUROPEAN AGRICULTURE

Water scarcity is a pressing concern across Europe, exacerbated by climate change and increasing demand. Regenerated water offers a vital, climate-resilient resource, particularly for agriculture, which accounts for significant water consumption. The EU's commitment to a circular economy and climate adaptation underscores the importance of safe water reuse (European Commission, 2023).

Spain's Royal Decree 1085/2024 serves as a progressive response, transposing and expanding upon EU Regulation 2020/741. In a country characterised by marked hydrological asymmetry (where south-eastern regions face structural water deficits) the need for a robust reuse framework is particularly relevant. This reality becomes especially visible in the Region of Murcia, one of the most water-stressed territories in Europe, where reclaimed water has long been integrated into irrigation systems and now represents a consolidated, strategic pillar of the agri-food sector rather than a complementary resource.

RD1085/2024: A LANDMARK IN WATER REUSE LEGISLATION

Royal Decree 1085/2024 of 22 October establishes the national regulatory framework for water reuse in Spain, approving the Regulation on water reuse and aligning domestic law with Regulation (EU) 2020/741. It introduces binding risk management requirements, technical validation procedures and differentiated water quality classes to ensure that regenerated water is fit for its intended use, safeguarding public health, animal health, and environmental integrity.

Within this strengthened regulatory architecture, the following key advancements stand out:

- **Alignment with EU Regulation 2020/741:** The decree mirrors the European Regulation, incorporating new obligations for agricultural reuse and ensuring harmonisation with EU objectives for water quality and safety.
- **Expanded scope:** Extends beyond agricultural irrigation to urban, industrial, recreational, and environmental uses, promoting integrated water management.

- **Mandatory Risk Management Plans:** In the aftermath of RD1085/2024, authorisation for reclaimed water requires the submission and approval of a thorough risk assessment. This ensures proactive identification, evaluation, and mitigation of potential risks to human health, animal health, and the environment. Risk Management Plans (RMPs) include Sanitation Safety Plans (SSPs), which must have the mandatory and binding report from the competent health authority. These plans apply a risk-based methodology to manage health hazards across the entire water reuse cycle, following the risk management approach promoted in Sanitation Safety Planning guidance (World Health Organization, 2016) and the technical specifications for risk management elements established at EU level (European Commission, 2024). The reclaimed water concession is contingent upon both the preparation of the RMP and a demonstrable commitment to adhering to its provisions.
- **Robust technical validation and quality assurance framework:** The decree mandates the validation of water reclamation facilities to ensure that treatment processes consistently achieve the required performance levels. It establishes detailed water quality classes, operational parameters, and monitoring protocols, including routine and validation controls, to guarantee that regenerated water meets stringent safety standards for its intended use.
- **Transparency and accountability:** RD 1085/2024 strengthens transparency and accountability mechanisms in water reuse, moving beyond basic reporting obligations towards a structured governance framework aligned with EU principles of traceability, public information, and risk communication. A key innovation of RD 1085/2024 is the integration of reclaimed water information into national digital water governance systems. In particular, the creation of the Water Management Observatory as an information platform on water management in Spain and its consumption cycle represents a qualitative leap in transparency.

IMPLEMENTATION GAPS BETWEEN LEGISLATION AND OPERATIONAL PRACTICE - LIFE WARRIOR EVIDENCE

Within the framework of LIFE WARRIOR project, a dedicated multi-stakeholder workshop, “*Developing a risk management plan*”, was held in Cartagena (Murcia) on 22 January 2026 during the event “*LIFE WARRIOR – Safe Agricultural Irrigation: Reclaimed Water for a Greener Future*”. This practical workshop aimed to analyse the practical implementation of RMPs, with focus on SSPs, across the water regeneration chain: Wastewater Treatment Plant (WWTP) - Water Reclamation Plant (WRP) - Irrigation Communities - Farmers. The session was specifically designed to identify administrative and operational gaps in the preparation and execution of the reclaimed water risk management plans, and to collect actionable recommendations to strengthen coordination among actors. The workshop was attended by a total of 36 participants, including WWTP and WRP managers and operators, irrigation communities, farmers, public

health and water authorities, and technology providers—bringing together all stakeholders directly involved in the development and application of risk management plans.

Stakeholder and end-user consultations revealed that the main challenges in implementing reclaimed water RMPs under Royal Decree 1085/2024 do not stem from the normative design itself, but from their operational deployment across the entire regeneration chain.

The implementation gap identified through stakeholder consultations appears systemic rather than technical. In particular, the consultation highlighted issues related to governance fragmentation across the reuse chain, financial and capacity disparities among actors, operational and monitoring vulnerabilities, uneven levels of risk culture and technical expertise, and regulatory ambiguities affecting the coordination between actors.

1. GOVERNANCE FRAGMENTATION AND COMMUNICATION FAILURES

Stakeholders consistently identified structural weaknesses in communication across the reuse chain, particularly in emergency scenarios such as disinfection failures, electrical outages, or deviations in microbiological parameters. Although formal responsibilities are defined, communication pathways are often formalistic and compliance-driven rather than adaptive and responsive, and early warning mechanisms remain insufficiently harmonised.

In practice, the absence of interoperable digital platforms limits real-time information exchange and traceability. This reduces the capacity for coordinated response and shifts risk management towards reactive rather than preventive approaches. Moreover, accountability boundaries between WWTP operators, reclamation facilities, and irrigation communities remain unclear in certain operational contexts, especially where mixed water streams are involved.

On-site monitoring and data-driven management of reclaimed water systems (Stock image)



2. FINANCIAL AND ORGANISATIONAL CAPACITY DISPARITIES

While RD1085/2024 establishes stringent quality and validation standards primarily applicable to WWTPs and water reclamation facilities, stakeholders emphasised that smaller irrigation communities and operation plants often lack the financial and technical capacity to develop and implement risk management plans in a truly preventive and systematic manner. Although the Decree does not mandate the deployment of advanced technologies, the preparation of a robust RMP—incorporating enhanced monitoring systems, digital data integration, or predictive tools—requires investments that go beyond formal compliance. Current funding mechanisms do not systematically cover these structural improvements, potentially creating disparities in risk management maturity and resilience across territories and organisational scales.

3. OPERATIONAL AND MONITORING VULNERABILITIES

The simulation of different risk scenarios during the workshop revealed vulnerabilities in disinfection systems, insufficient continuous monitoring, and lack of clarity regarding water quality at mixing points prior to distribution.

Although corrective measures such as alternative disinfection, recirculation, or by-pass exist, they often depend on manual decision-making processes rather than automated predictive systems. Furthermore, ambiguity persists regarding the precise regulatory control point within the chain—whether responsibility is concentrated at the WWTP outlet, the irrigation community inlet, or distributed across actors—creating operational uncertainty.

The absence of interoperable data systems prevents seamless integration of laboratory results, operational parameters, and RMP updates, thereby limiting traceability and dynamic risk reassessment.

4. RISK CULTURE AND CAPACITY GAPS

Stakeholder discussions revealed that risk perception and response responsibilities are not uniformly internalised across the reuse chain. Farmers and irrigation community managers may not always be fully aware

of the specific health risk profile associated with re-generated water. Similarly, operators may lack specialised expertise in preventive risk assessment methodologies aligned with ISO-based SSP principles.

Beyond these organisational capacity gaps, risk culture and the acceptance of reclaimed water are significantly influenced by regional experience. In areas with a long history of water reuse, such as the Mediterranean, where it has been an essential necessity, farmers generally view it as a reliable resource and are primarily concerned with availability rather than safety. Conversely, in regions where water reuse has not historically been part of water management strategies, like northern Europe or non-Mediterranean areas of Spain, reclaimed water may still be associated with greater uncertainty or perceived health risk. To bridge this perception gap, public awareness and communication initiatives, such as the LIFE WARRIOR Info Day “*Aigua regenerada, ciutats resilientes: Una gota, moltes vides*” are vital for fostering informed acceptance and building societal trust in safe water reuse.

5. ADMINISTRATIVE COMPLEXITY AND REGULATORY AMBIGUITIES

Stakeholders highlighted perceived overregulation, procedural burdens, incompatibilities in concession frameworks, and insufficiently detailed guidance on indirect reuse and mixed water streams. Although RD1085/2024 aligns with European requirements, implementation across diverse hydrological and socio-economic contexts requires clearer operational guidance and greater regulatory coherence.

A key operational ambiguity arises in systems where water streams are mixed prior to irrigation. While WWTPs and WRP are subject to strict discharge and quality controls, storage reservoirs or irrigation ponds may receive additional inflows—such as surface runoff, groundwater contributions or other uncontrolled sources—that are not systematically monitored under the same framework. This situation can affect the final quality of irrigation water and generate uncertainty regarding the effective control point and the distribution of responsibilities within the reuse chain.

Stakeholders also pointed to a broader structural inconsistency between wastewater discharge and water reuse frameworks. Wastewater discharges are



Precision irrigation using reclaimed water to optimise resource efficiency and crop growth (Stock image)

regulated primarily to protect receiving water bodies under the European framework governing urban wastewater treatment established by Directive (EU) 2024/3019 (European Parliament and the Council of the European Union, 2024), while reclaimed water intended for irrigation must comply with specific quality classes and risk management obligations. In practice, treated effluent discharged into a river may later be abstracted downstream for irrigation without being subject to the reuse-specific risk management framework. This difference in regulatory approach can create perceived inconsistencies in risk governance.

Otherwise, public authorities participating in the workshop highlighted the growing administrative burden associated with the documentation required under the current regulatory framework, a concern also shared by other stakeholders across the reuse chain. The volume and complexity of reports, monitoring records and risk management documentation can strain both administrative and operational capacities, making the management and effective oversight of information increasingly challenging.

PROPOSALS FOR IMPROVEMENT: TOWARDS A ROBUST AND SUSTAINABLE FRAMEWORK

The workshop results indicate that effective risk management depends less on isolated technical performance and more on systemic factors, including coordinated governance across the reuse chain, adequate financial and organisational capacity, digital integration of monitoring systems, and clearly defined responsibilities among stakeholders.

The LIFE WARRIOR project proposes the following measures to improve the implementation of RD1085/2024, specifically addressing identified gaps in the development and execution of RMPs. These proposals are based on the input gathered from stakeholders and end-users during the workshop.

Gap	Implementation risk	LIFE WARRIOR proposals
Fragmented communication and weak early warning mechanisms.	Reactive emergency management and unclear accountability across the reuse chain.	Development of interoperable communication systems across the reuse chain, supported by harmonised EU-level early warning standards.
Financial asymmetry among operators and irrigation communities.	Uneven compliance and territorial disparities in safety levels.	Dedicated EU funding instruments for digitalisation, monitoring infrastructure, and resilience upgrades, particularly to support smaller-scale WWTP–WRP systems and irrigation communities, ensuring equitable compliance and risk management capacity across Member States and regions.
Limited digital integration of operational and laboratory data.	Static RMPs/SSPs and reduced traceability.	Integration of real-time monitoring, laboratory validation, and automated hazard registration, enhancing traceability and enabling continuous plan updates.
Technical vulnerabilities in disinfection and redundancy.	Increased probability of non-compliant water reaching irrigators/end users.	Incentivised redundancy systems in critical treatment processes complemented by predictive monitoring technologies capable of detecting performance deviations at an early stage, enabling preventive intervention and reducing the risk of non-compliant water reaching end users.
Uneven risk culture and training deficits.	Inconsistent risk assessment quality and coordination failures.	Structured capacity-building programmes and institutionalised multi-stakeholder platforms to consolidate a shared culture of preventive risk management.
Administrative complexity, regulatory ambiguity and administrative burden.	Delays in permitting, inconsistent enforcement, potential unmanaged risks and reduced stakeholder confidence.	<ul style="list-style-type: none"> - Harmonised technical guidance and digitalised permitting and reporting systems to reduce administrative burden while increasing transparency and supervisory effectiveness. - A more integrated, system-based perspective linking wastewater treatment and water reuse to improve regulatory clarity, proportionality and overall risk consistency across the water cycle.

Table 1. Stakeholder-identified systemic gaps and strategic responses for strengthening water reuse governance

THE WARRIOR PROJECT: A DIGITAL SOLUTION FOR SSP IMPLEMENTATION

The WARRIOR project addresses several of these implementation gaps through its innovative SSP Tool, which streamlines compliance processes while strengthening risk management across the reuse chain. By enabling real-time data integration, enhanced traceability, and dynamic risk monitoring, the tool directly responds to governance and operational challenges identified during the stakeholder consultation.

OBJECTIVE

The SSP Tool provides a digital platform for controlling, monitoring, and managing health risks, aligned with SSP principles. It facilitates real-time detection of hazardous events, historical monitoring, and informed decision-making.

FUNCTIONALITIES

- Real-time monitoring: Continuous tracking of physico-chemical parameters ensures treatment processes meet established criteria.
- Laboratory integration: Validates the quality of the recovered water by integrating data on E. coli, BOD₅, suspended solids, turbidity, etc., showing whether it meets the required quality standards for the defined use (e.g., Class A).

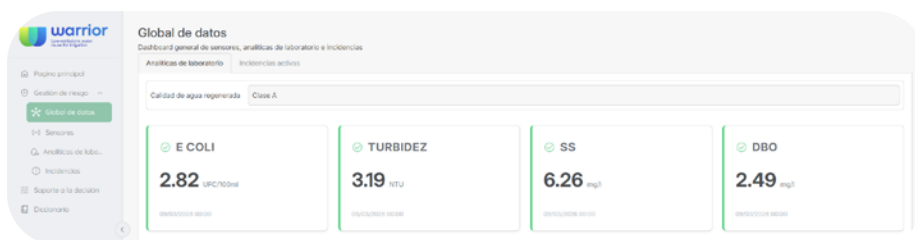
- Early warning system: Automated alarms identify hazardous events, suggest corrective measures according to the defined RMP, and record unforeseen events, making the tool dynamic.

HEALTH RISK ANALYSIS

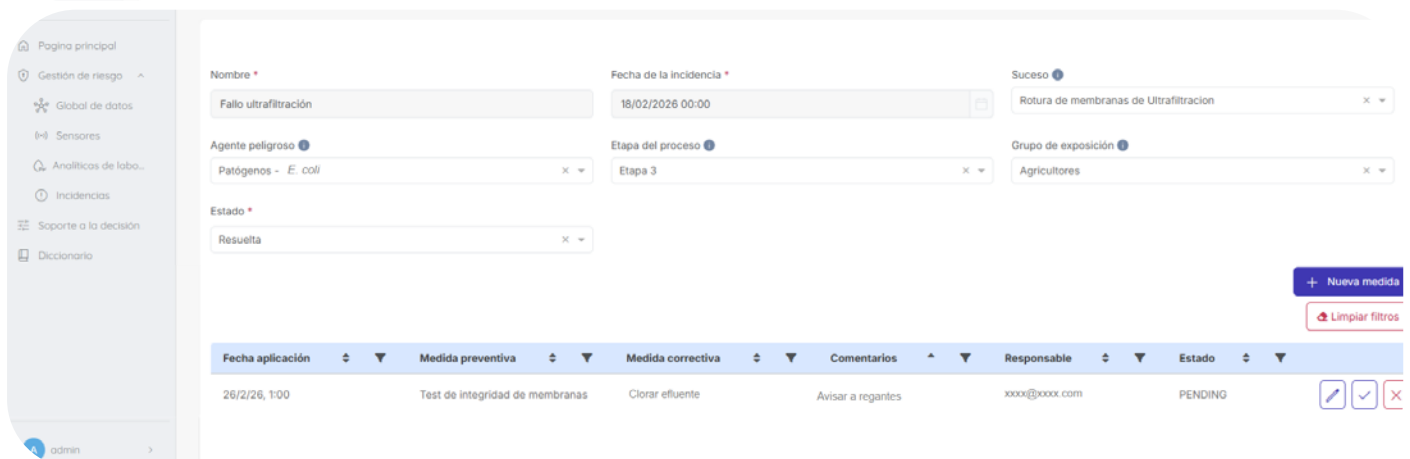
The tool involves the digitalisation of Sanitation Safety plans following the guidance developed by CEDEX (Spanish Centre for Studies and Experimentation of Public Works) for health risk management in water reuse systems (CEDEX, n.d.). It incorporates a structured health risk analysis, identifying hazardous agents, exposure groups, and events throughout the water reuse system. The risks associated with these events are prioritised using a probability-severity matrix.

DYNAMIC UPDATES TO THE RISK MANAGEMENT PLAN

The SSP tool facilitates the detection and recording of new hazardous events that can be incorporated into the updated Sanitation Safety Plan. Furthermore, this tool generates historical data that allows not only the addition of new events to the SSP but also the updating of the risk level associated with previously identified events based on their actual probability and severity, as well as the addition of new preventive and corrective measures.



Functionalities of the SSP Tool



A SUSTAINABLE FUTURE FOR EUROPEAN AGRICULTURE

The adoption of Regulation (EU) 2020/741, complemented in Spain by Royal Decree 1085/2024, represents a significant step towards strengthening Europe's water resilience and advancing a circular water economy. Reclaimed water is increasingly becoming a strategic resource for agriculture, particularly in water-stressed regions where climate change is intensifying pressure on conventional supplies.

However, the effectiveness of this regulatory framework will ultimately depend on its practical implementation across the entire reuse chain. Addressing operational challenges (such as fragmented governance, uneven financial capacity, limited digital integration, and regulatory complexity) requires coordinated action at both national and European levels.

The recommendations outlined in this policy brief underline the pivotal role of digitalisation in strengthening risk governance across water reuse systems.

Integrated digital monitoring, interoperable data platforms and harmonised guidance for risk management plans can enhance traceability, coordination and early risk detection, while simultaneously simplifying reporting processes and reducing administrative burdens for both operators and public authorities.

The LIFE WARRIOR project demonstrates the potential of digital tools to make risk management plans more dynamic, traceable, and operationally effective. Supporting the digitalisation of risk management systems and facilitating coordinated implementation across the reuse chain should therefore become key priorities in future EU water resilience and circular economy policies.

Moving from regulatory compliance to integrated risk governance will be essential for ensuring that regenerated water becomes a reliable, trusted and widely adopted resource for climate-resilient European agriculture.

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POLICY BRIEF

Sustainable design guides for R&D pilot plants
based on LIFE Warrior project experience

Guillermo Ortiz Seco

LIFE WARRIOR is a European project co-funded by the LIFE Programme (LIFE21-ENV-ES-WARRIOR 101074367), the European Union's funding instrument for the environment and climate action. The general objective of LIFE is to contribute to the implementation, updating, and development of EU policy and legislation on environment and climate through the co-financing of projects with European added value. The opinions and views expressed are solely those of the author(s) and do not necessarily reflect those of the European Commission or CINEA. Neither the European Commission nor the granting authority can be held responsible for them.

POLICY BRIEF

Sustainable design guides for R&D pilot plants based on LIFE Warrior project experience



EXECUTIVE SUMMARY

Nowadays sustainability is key to all projects under the 2030 Agenda and the Sustainable Development Goals principles. This document presents sustainable design recommendations for Research and Development (R&D) pilot plants manufacturers based on some strategies implemented in the LIFE WARRIOR project, such as: modular and demountable design, efficient use of energy and chemicals, recycled or reused materials, and digital tools to optimise operations. It is also recommended to consult the Best Available Techniques Reference Documents (BREFs) to minimise environmental impacts and facilitate future scalability to a full-scale plant.

CONTEXT

Sustainability is the mandatory vehicle that all projects must adopt in the coming years, regardless of their scope, according to the 2030 Agenda for Sustainable Development and the Sustainable Development Goals (SDG), approved by the UN in 2015, to which all project members have committed to fulfilling.

For a project to be considered sustainable, it must meet certain requirements based on three pillars: environmental, social and economical.

This policy brief aims to serve as a simple guide to making R&D pilot plants more sustainable based on some of the techniques used in the LIFE Warrior project, in which an innovative tertiary treatment system for wastewater reuse was installed including: recycled ultrafiltration membranes, a UVC-LED lamp for disinfection, and a digital tool for optimising the process.

PUBLIC PERCEPTION AND ACCEPTANCE BARRIERS

According to Deloitte's Sustainable Supply Chain Survey (2023), 71% of companies in Central Europe are already implementing sustainable practices, and an additional 20% plan to do so. Furthermore, 77% have observed growing customer demand for sustainable products and services. However, 57% of companies find it challenging to align business interests with sustainable supply chain practices.

On the other hand, the Flash Eurobarometer 549 (2024) survey reveals that 93% of EU SMEs have implemented at least one resource efficiency measure; 66% have increased their energy-saving efforts; and 24% predominantly use renewable energy sources.

Therefore, this document aims to help those companies that find it difficult to implement sustainable techniques in their R&D pilot plants or do not see it as necessary so far.

PILOT DESIGN

Regarding the sustainable design of a pilot plant, several recommendations are presented below:

- **Modules and containerisation:** Placing heavy elements (such as pumps, lamps, membranes) on a metal skid or inside an adapted or recycled ISO container facilitates the transport and installation of the equipment, saving space, money, and construction materials.

- **Assembly and disassembly:** The ease with which a pilot plant is assembled will determine how easy it is to dismantle it at the end of its life, allowing for the recovery and recycling of its still-usable parts.
- **Connections and fasteners:** In line with the previous recommendation, avoiding welding and permanent connections facilitates the reuse of pilot plant elements.

ENERGY AND CHEMICALS

The efficient use of energy and chemicals in pilots can lead to significant economic savings and a smaller ecological footprint. Some suggestions include:

- Avoid the use of hazardous chemicals as much as they can be **replaced** with other techniques or environmentally friendly chemicals (e.g. EDDS instead of EDTA).
 - Use more **efficient equipment** with lower energy consumption, the ability to modulate them and with a lower environmental impact after their end of life, such as UV-LED lamps instead of low-pressure mercury UV lamps (as implemented in Life Warrior project).
 - Use **renewable energy** such as solar panels attached to the lights to reduce non-renewable energy consumption.
- If using chemicals, **correctly dose** the required amount at the right time, using **sensors**.
 - Use **ERDs (Energy Recovery Devices)** and heat exchangers to consume less energy and/or make better use of excess energy.

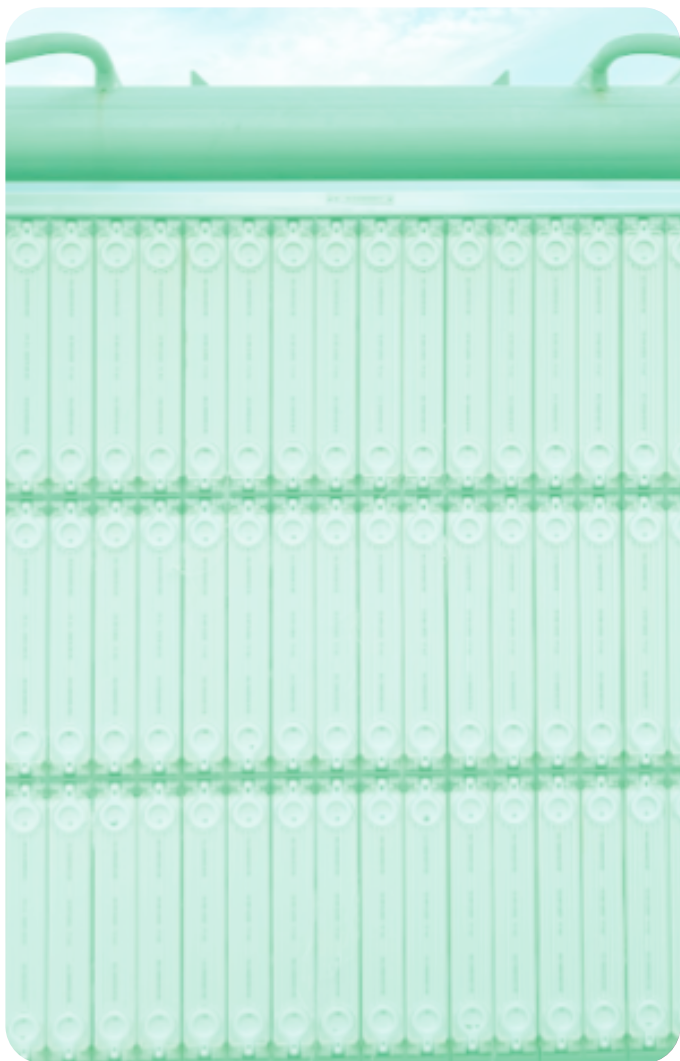
MATERIALS AND COMPONENTS

The selection of sustainable construction materials and components for a pilot plant can draw on a variety of sources and become both more economical and/or efficient:

- **Recycled materials**, such as plastic, paper, glass, wood, or iron. Depending on the component, this can be a very good option to consider.
- **Reused materials** and components from other projects or processes that are no longer in use but still maintain these components' full or partial functionality (such as the UF membranes from the LIFE Warrior project).
- **Locally sourced materials and suppliers**, avoiding emissions associated with long-distance transport (typically from Asia) in addition to promoting local businesses and products, and contributing to SDGs 8, 11, and 12.



UVC-LED lamp from the LIFE WARRIOR project



Reused modules of ultrafiltration from the LIFE WARRIOR project

DIGITAL TOOLS

Nowadays, digital tools have become a great sustainability ally, making pilot plants more efficient thanks to user tools such as:

- **DSS (Decision Support System):** These tools integrate data (energy, water quality, flow, climate, etc.) to help decide optimal operating or maintenance strategies. For example, adjusting chemical dosages or pumping strategies based on demand and energy (such as in the LIFE Warrior project).
- **Digital Twin:** A Digital Twin virtually replicates the behavior of the physical system to simulate scenarios or optimise operations. For example, simulating how energy efficiency changes depending on process conditions.

- **SCADA systems:** These systems monitor and control pumps, valves, flow meters, and sensors in real time, providing a visual overview of the plant's status and enabling automation of operations.

ENVIRONMENTAL IMPACTS

If your pilot plant generates noise, odors, or emissions into the air, water, or soil, generates waste, or consumes excessive resources, it will consequently have various impacts on the environment and society. To avoid this, you can consult the EU's **BREF (Best Available Techniques Reference Documents)** to identify solutions that can make your process more environmentally sustainable. BREF documents are part of the Industrial Emissions Directive (IED, 2010/75/EU) and include the **Best Available Techniques (BAT)** for different industrial activities.

While BREFs and BATs are not directly aimed at pilot plants, if the goal of your pilot is eventual scaling to a full-scale facility, consulting these documents is strongly recommended. Some of the benefits you can find using BATs are:

- Demonstrating alignment with international standards.
- Providing technical credibility to authorities, funders, or reviewers.
- Enable comparing your innovation against recognised BATs.
- Facilitating future scaling if the pilot plant is converted into a full-scale installation.

KEY QUESTIONS FOR SUSTAINABILITY DESIGN

Question	Recommendation
How to know if a process is sustainable or not	Check how many SDGs the process meets.
How can a system have fewer environmental emissions?	Following the BRIEF documents and the Best Available Techniques (BAT) for a specific process.
Where can a pilot be built to ease mobility?	Place it in a skid or inside an adapted or recycled ISO container.
Where can raw materials or components be obtained from?	Select local providers and recycled/reused materials as much as possible.
How to save energy in a pilot plant	Install energy recovery devices, solar panels or choose LED lights.

CONCLUSION

Applying some of the LIFE WARRIOR project's sustainable strategies allows R&D plants to be more sustainable, efficient, circular, and aligned with international standards, laying the groundwork for their future industrial scalability.

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