



SYMSITES

ECOSITES implementation for industrial-urban symbiosis through social and technological solutions

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Abstract

This report explores industrial-urban symbiosis (I-US) as a catalyst for sustainability in European cities, emphasizing circular economy principles and resource efficiency. It addresses non-technological barriers—regulatory, administrative, economic, and social—that hinder the scaling of systems like wastewater reuse and waste valorisation by showcasing action plans that have been developed by the four EcoSites in Denmark, Spain, Austria and Greece.

Key initiatives reported on include recommendations on I-S standardization through CEN/TC 465, advancing CWA 17354:2018, a pre-standard on I-S developed in 2018, by emphasizing specifically local governments' roles as enablers, regulators, and facilitators. The report underscores the importance of governance models, public-private collaboration, and innovative policy alignment to overcome barriers and foster scalable, sustainable practices in urban-industrial ecosystems.



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1. Introduction

Cities are at the heart of the European economy and thus at the heart of the transformation to sustainability. Cities depend heavily on outside resources and the demand for materials is a key driver of energy use, greenhouse gas emissions, and waste production worldwide: the transition to sustainability requires better management of those resources in circulation within the cities, with a systemic view to valorising waste flows and keeping in them in productive use for longer. Addressing Scope 3 emissions requires taking a holistic approach to responsibility for carbon emissions along the valorisation chain, to manage the embodied energy in resource and material flows as part of a circular economy. Industrial symbiosis (IS) plays a critical role in advancing the circular economy by facilitating the collaborative use of resources, energy, water, and materials among different industries. The core idea is that the waste or by-products of one company become valuable inputs for another, thus closing material loops and minimizing waste. These often consist of urban wastes including solid waste, heat and wastewater - often managed by cities - which can also be integrated into symbioses. This urban inclusion is sometimes referred to as Industrial-urban symbiosis (I-US), for example in many recent EC funded European projects, such as the SYMSITES, H4C ECoP, ASHCYCLE and other projects.

Standardization has a key role to play in providing the necessary framework conditions for new value chains and business models to interact and thrive, because closed-loop economies require an increased level of cooperation and communication among the actors along the entire value chain. Standards and specifications define interfaces and ensure clear communication between the different stages in the materials and products' lifecycle, thus enabling a more circular economy.

As a city network, ICLEI can provide a specific outlook on the urban aspect and its importance for inclusion in such a standard. Particularly when considering the potential for co-treatment of urban waste and wastewater for use in other industries, as is the focus of the SYMSITES project. Furthermore, through its involvement in the standardisation on European and international level, ICLEI is in a good position to bring the topic to the attention of urban and other stakeholders by a) presiding as chair to the CEN/TC 465; and b) presiding as chair to the related German mirror committee.

The CEN workshop agreement CWA 17354:2018 - Industrial Symbiosis: Core Elements and Implementation Approaches is currently the sole pre-standard on the topic of IS, therefore it is the starting point for the development of a full CEN standard, and the recommendations provided in this report are directed towards developing this workshop agreement into a European, and possibly an ISO standard, highlighting specifically the role that local governments can play within I-US.

2. Engagement and influence on I-US Standardisation during the course of the project

Successful HSBooster Application

In order to increase the impact of SYMSITES results within and among the standardization community, ICLEI has applied to become part of the HS Booster. One of the objectives aimed for in this context, was to contribute to the work on the Proposed Work Item (PWI) on Industrial Symbiosis within CEN/TC 465, building the existing CWA 17354:2018, especially with regard to adding an urban perspective to IS. The application to the HS Booster has been accepted, and at least two virtual meetings took place between ICLEI and standardization experts from HS Booster to consult



ICLEI experts more generally on the gaps within I(-U)S as well as specifically on how to establish a liaison relationship with CEN/TC 465. ICLEI has initiated the application process for the CEN TC liaison for SYMSITES, which was followed by numerous Emails between the TC Secretariat and ICLEI, as well as a presentation of the SYMISTES project in a TC plenary meeting in September 2024. The liaison has formally been accepted in April 2025. ICLEI will act as lead focal point for the liaison throughout the remainder of the project, aiming to contribute as sensible to the PWI development using this document its contained recommendations as background.

Successful Establishment of Liaison Position with CEN TC 465

The acceptance of the liaison role for the SYMSITES followed a presentation held in at the June 2024 meeting of TC 465 *Sustainably Cities and Communities*, to convey ICLEI's perspective on IS and I-US, via SMYSITES and other I-US projects ICLEI works on including the CCRI, Redol, SYMBA and H4C ECoP. The purpose of the presentation was to request establishment of a liaison position to the proposed development of an ISO standard on Industrial Symbiosis, building on the CEN workshop agreement *CWA 17354 Industrial Symbiosis: Core Elements and Implementation Approaches*. ICLEI provided information on what expertise the SYMSITES consortium can provide and an initial vision of what such a standard should include. Following a voting process which occurred at a subsequent TC meeting, in March 2025 SYMSITES was confirmed to have successfully established a liaison position. ICLEI awaits to hear when meetings on the development of the standard will begin.

As liaison, SYMSITES's role will be to provide feedback on drafts of the standard and attend each of the 6-8 meetings, across 2 years, to shape its development. Any member of SYMSITES can attend a meeting to bring their expertise to the table. While non-exhaustive, the recommendations in this deliverable will form a basis for the project's input into the standard development within CEN TC 465.

RISERS Contribution

Further contributing to I(-U)S standardisation, ICLEI was approached in March 2025 to participate in an interview with the RISERS consortium as an expert from the industrial-urban symbiosis perspective, to provide input on the roadmap for standardisation of Industrial Symbiosis, which they are developing. The importance of considering the "urban" aspect of urban wastes/residues and public actors in enabling I(-U)S was highlighted during the interview, and examples of public waste and wastewater authorities engaging in I(-U)S provided. ICLEI was subsequently invited to participate in their working groups further supporting the development of the roadmap.

3. Standards Considered and Reviewed

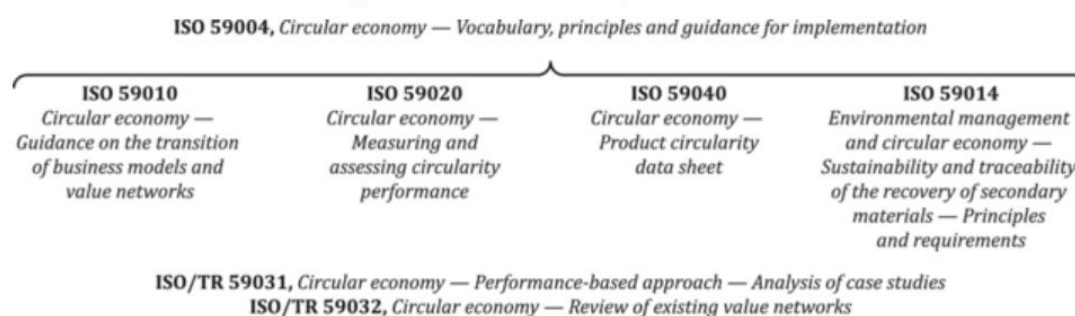


Figure 1: The new ISO 59000 series on circular economy. Source: ISO 59010:2024(en)

A broad selection of standards were first identified for potential relevance to I(-U)S (Annex 1(a)). This was reduced to a more concise list relevant to the development of a first defining I(-U)S standard, aligned with standardisation to date on the circular economy and sustainable development (Annex 1(b)), including with focus on sustainable urban development. This is not an exhaustive review of all technical aspects of I(-U)S. This list naturally began with the existing [CEN workshop agreement CWA 17354](#). This report focuses on the new ISO 59000 series on circular economy (see figure below) and specifically on ISO 59010, ISO 59020 and ISO 59040 as they are interconnected and specifically aim to support organizations in implementation.

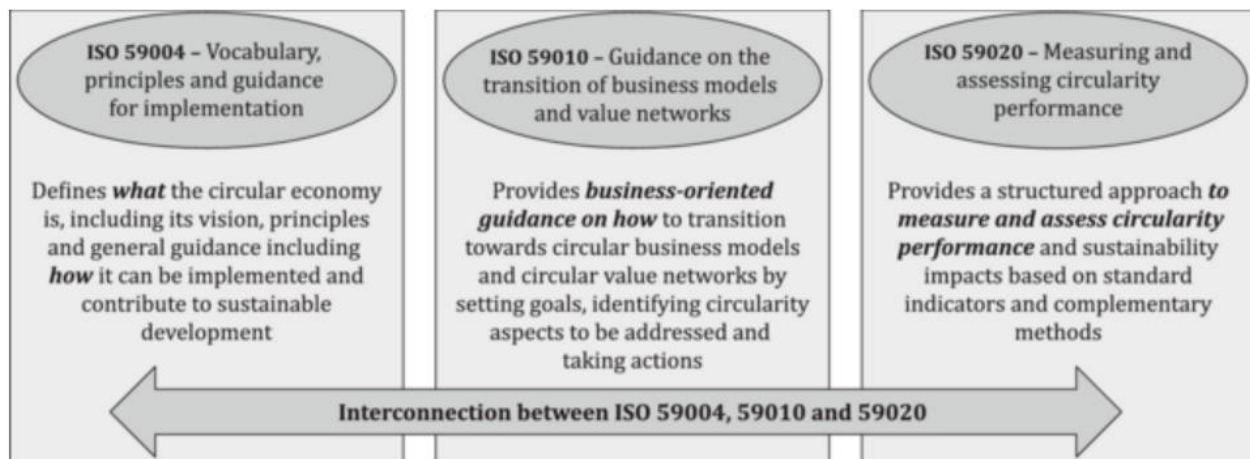


Figure 2: schematic overview on the connections between standards in the new ISO 59000 series. Source: ISO 59010:2024(en)

A comprehensive meta-analysis of existing standards and other technical documents published on I-S, has found that most documents have been published globally (57%), with 28% being national standards and documents and only 15% exist with a dedicated European focus (Beltrani et al., 2024). 65% of the examined documents have been published by standardization bodies and 35% by other entities.

Notably, most of the documents examined by Beltrani and colleagues (67%), are organizational standards, i.e. with focus on the organization and management of I-S itself; consequently, reference is made to organizational systems that concern industrial symbiosis "as a whole", from the management of energy and raw materials raw materials up to by-products, through the management of services and human resources. Furthermore, eight key topics can be identified in the examined body of literature – material or material resources, water resources, reduce/reuse /recycle/recover, energy resources, value added products, organizational, logistics, education and capacity building (ibid).

The analysis confirms yet again, that I-S standards and technical reports are currently not addressing local authorities as key actors, managing key resources, regulating, enforcing, facilitating or financing around the topic of I-S – a gap the WI currently developed in CEN TC 465 should seek to close.

4. Recommendations for the Development of I(-U)S Standardization

Towards a Vision of first Standard for Industrial(-urban) Symbiosis

If progressed through CEN TC 465 Sustainably Cities and Communities, the initial standard developed should consider cities/regions at its centre. Cities are central to Europe's economy and its transition to sustainability. They heavily rely on external resources, making them key drivers of energy consumption, greenhouse gas emissions, and waste production. To achieve sustainability, cities need to adopt systemic resource management, focusing on reusing waste and reducing Scope 3 emissions (indirect emissions from resource and material flows).

Industrial symbiosis offers a solution by treating waste as a resource. This approach promotes collaboration between industries and urban systems to reuse underutilized resources (e.g., waste, energy, water). A specific form, **industrial-urban symbiosis**, integrates city-managed wastes (solid waste, heat, wastewater) into industrial processes, aligning with the EU Green Deal and climate mitigation policies. This strategy improves resource efficiency, reduces carbon emissions, and advances circular economy practices.

As highlighted before, the CEN Workshop Agreement (CWA) 17354, established in 2018, outlines the principles of industrial symbiosis to promote best practices. It encourages collaboration between public and private actors to standardize approaches and guide industries in applying these concepts effectively. Transitioning this agreement into a European standard and adding specifically some considerations around the role of local governments, could further unify practices and terminology, fostering stronger collaboration and policy integration.

Industrial symbiosis is a methodology to deliver the resource efficiency needed for carbon-neutrality (particularly Scope 3 carbon reductions) and green growth. The WI should explore how cities can incorporate industrial symbiosis into circular economy action plans and strategies across departments including waste management, infrastructure, highways, planning, economic development, social housing and education to achieve their sustainability ambitions. The role of the local government in advancing this agenda may be as **enabler, regulator, funder, facilitator, or as owner** of resources suitable for industrial symbiosis.

The local government can facilitate links between companies that can use one another's waste as a resource, working within the current legislative constraints to capture, valorise and recirculate resources while supporting the local supply chains needed to support the circular economy. The efficient management of resources will protect industry from shortage and security threats, drive competitiveness and economic resilience, and also protect the environment and reduce the impacts of climate change. As part of the economic development strategy, research and innovation can align the links between industry and industrial symbiosis solutions.

Local government can play a leadership role and use their mandate (including e.g. urban planning) in their direct control. They can also raise expectations, communicate, develop partnerships, work with other local organisations and groups, and provide support for local businesses and communities. They can develop carbon neutrality policies, sustainability policies and net-zero action plans, incl. Climate City Contracts and Local Green Deals that apply industrial symbiosis as core action field to drive urban sustainability. Areas of particular relevance to local governments include:

- **Planning** - Spatial planning can make a major contribution by delivering the right development in the right place that integrates the principles of sustainable design and construction. Effective local and strategic plans can help to deliver a range of key solutions as well as meeting the aspirations of local residents and protecting them from the negative impacts of climate change. The city governance can ensure that the planning system sets developments and land use standards aimed at reducing carbon emissions and building



sustainable communities. It also can ensure that the infrastructure is put into place to drive brownfield development to anchor investment that uses existing material flows.

- **Economic development** - Taking a 'circular' approach to the economy assists by designing out waste and pollution, keeping products and materials in use as long as is possible. Reduction, re-use, and recycling of waste can provide economic opportunities. The development of industrial policy can target sectors with critical materials and high industrial symbiosis potential and support demand-led innovation to find reuse potential and strategically look at material security and scarcity.
- **Infrastructure** - The construction industry has an important role to play in delivering sustainable development. Sustainable design and construction take account of the resources used in construction, the environmental, social and economic impacts of the construction process itself and the design and future use of buildings. The co-benefits include the responsible and prudent use of resources, lower fuel bills, improved health and economic benefit.
- **Procurement** - The procurement of goods and services contributes to carbon emissions. Consideration of the embedded carbon costs of the products, services, and refurbishment and construction projects procured reflects best practice. Environmental issues can be incorporated across the procurement process at all levels to identify the key policy updates required. Local government has a key role in promoting reuse opportunities, alternative materials, capacity and setting expectations of data transparency along supply chains.
- **Waste** – Government and business must reassess waste as a resource in the wrong place and develop a coherent strategy. Relevant, accessible and up-to-date data helps to identify and address intervention and where infrastructure or reuse centres and reuse hubs might be appropriate.
- **Research and innovation** - align investment to industry needs for IS solutions (demand-led innovation). A key challenge in realising industrial symbiosis opportunities is the availability of waste and resource data concerning resources that could be kept in productive use. Cities can play a role in gathering and making transparent information on the types, location and availability of waste streams, not at least by building interfaces to local data platforms and the Local Digital Twin.

What is the current CEN workshop agreement CWA 17354 missing? Some overarching considerations

Currently the workshop agreement defines Industrial Symbiosis (IS). The potential to include the “(-urban)” parenthesis in the **definition** of “Industrial Symbiosis” is something that should be duly discussed by the TC. However, it is not proposed to be necessary if seen to create a divide in communities already using the term IS, as long as the concept of symbiosis involving urban resources and wastes such as wastewater and waste/residues, is explicitly included, as well as the role public actors can play in enabling and supporting symbiosis is referenced, and not only in the capacity of hiring external facilitators, as is the case in the current CEN workshop agreement. The inclusion of the urban dimension is a necessity if the standard is progressed for development in TC 465 given its primary focus on Sustainable Cities and Community.

The current standard does not specify that **regions** along with cities, are key levels of government to drive and support I(-U)S, given their ability to access larger municipal funding and better lobby national government. For example, the West Midlands, UK which once established as a regional authority, could leverage its size to lobby for sufficient funds from national level government to fund its [new Industrial Symbiosis facilitated programme](#) (T2.2, H4C ECoP policy analysis). Another key



public entity with high potential for I(-U)S not currently highlighted in the workshop agreement are **ports (cf. Circular Ports)**, thanks to the natural agglomeration of industries and often already existing port authorities through which exchange can be negotiated. There are numerous projects and case studies, including also the ICLEI position paper on I-US, that can be used to establish standard success factors for establishing symbiosis in these hubs.

The **benefits** of I(-U)S outlined in the workshop agreement, should be updated and broadened in the standard to focus on more recent sustainable city goals and targets, as well as to reflect the **EU's new priorities of a strong, competitive industrial hub**. A focus on I-US as a means to achieving resource sufficiency should be central to aligning it as a key lever city can implement under EU and national strategies.

The **wider range of levers** which public actors (including local and regional authorities and public utilities) can use to support I(-U)S can be found in ICLEI briefing note. This includes public waste and wastewater utilities as active participants in symbiosis exchanging urban residues. The breath of these levers should be considered, as opposed to exclusively viewing the public role as procuring external facilitators, which is the case as in the workshop agreement as it stands (ICLEI Europe).

It should be noted that the “Approaches to Industrial Symbiosis”, section 6 of the workshop agreement, are relevant only for businesses. This categorisation does not cover the breadth of governance approaches public actors can take to support I-US. A more suitable reference, of which public actors often invoke multiple governance approaches at once, is that found in the paper Södergren et al. (2021), distinguishing between **enabling or coordinating, self-governing or regulating and planning and controlling governance** principles and approaches for local governments. We recommend the use of this categorisation (or a similar approach) as it is more suitable be more suitable and applicable for local governments, with the business-focused approaches featuring as a subcategory.

The examples provided in the CWA should be expanded to cover a wide range of more recent European-based cases. Examples should focus specifically on showcasing the breath of levers public actors can use to support I(-U)S (cf. ICLEI Europe, 2024). These examples could include leading cities in the circular economy across Europe such as Malmö, smaller regions now investing in I(-U)S as part of EU initiatives like the CCRI e.g. [Møre og Romsdal](#), and cover geographical diversity. Good practices could be derived from these on the ground.

Building on existing relevant standards

Sector-specific standards should be developed post the initial groundwork standards, e.g. wastewater and organic waste or other material co-treatment, waste heat exchange, as is the case for the circular economy, where CEN standards are beginning to be developed specific value chains e.g. **CEN/TC248/WG39 Circular Textiles Chain** – Requirements and categories, textiles, **CEN TC207 Furniture** and CEN Construction Sector. Both energy use and waste treatment are European Commission priority material streams.

Transitioning from linear to circular business models is a key challenge for businesses, especially in larger, materials and energy intensive industries where the transition needs to be comprehensive. Although transitioning to circular models is challenging due to the required restructuring of value networks, organizations are increasingly adopting this approach. Therefore, consideration of circular business model requirements for successful operation of I(-U)S should be included in the WI where sensible. This can be based on and complement, **ISO 59010 Circular Economy — Guidance on the**



transition of business models and value networks (first edition 2024-05). The standard outlines guidance for transitioning from linear to circular models, organized into eight clauses. It aims to harmonize the understanding and implementation of the circular economy while supporting contributions to the UN Agenda 2030 for Sustainable Development.

Key basic principles in 59010 also apply to I-US initiatives and should be taken up in the current WI, or be subject to future I-US standardization and/or updates of existing standards, include:

- *Key enablers, such as shared infrastructure, circular suppliers, academic partnerships, and R&D, play a critical role in fostering circular and initiatives.* I-US initiatives need so focus on suppliers of wastewater and wastes (often managed by municipalities) and related waste utility operators; and on industries using the value-added materials or products (output end of the symbiosis).
- *A holistic approach to mapping considers resource flows, such as water usage and emissions, across the value chain, enhancing understanding of the operational context. This includes recognizing the characteristics of value chain partners, their value creation models, and other supporting elements.* This is especially applicable to I-US initiatives, in the sense of creating new value chains, rather than transforming existing ones.
- Defining the boundary of an organization's value chain or value network is critical for outlining the scope of actions needed to achieve circular goals.
- Understanding the current circularity performance by selecting circularity key performance indicators (using ISO 59020, which defines indicators on resource inflows, resource outflows, energy and water).
- *In the formulation of actions, the 9R-framework should be used where possible. While all strategies are relevant, refuse and rethink are most effective.* With I-US interventions pertaining more to the lower to recycling strategy, more specific examples should be included here.
- *Interventions should be set mainly during design, development and manufacturing stages. Circularity and net environ. Impacts materialize mainly during use and end of life phase, where less virgin materials are necessary.* I-US interventions can serve as complementary action field, where interventions are set at the end of life and facilitate impact through loop closing on the input side.
- Actions creating value include "industrial, regional or urban symbiosis". *In regional or urban symbiosis, multiple cities, regions and other subnational governmental organizations (as well as agencies) exchange or share resources, solutions, information and capabilities (infrastructure and knowledge).* While the notion focuses on an interesting concept here, namely the involvement of multiple cities and local governments in the exchange of resources, the concept should be specific further in the WI to provide a clear definition that will trickle into all relevant standards.
- *Actions on value recovery – recycling, cascadic use etc.* I-US can serve as specific examples here.
- Actions to support the circular economy transition – to improve conditions, relevant actors should participate to enable a systems change towards a circular economy. This also means that subsystems (e.g. education, research, political, legal, economic and financial systems)



should be reformed, and support should be provided for the evolution of cultural values and norms.

- Innovation. An important starting point for innovation processes are resource flows, focusing on strategies to slow, narrow and close (i.e. through I-US) them.

ISO 37111 Sustainable cities and communities — Urban settlements — Guidance for a flexible approach to phased implementation of ISO 37101, offers guidance for a more adaptable approach to implementing **ISO 37101**, making it suitable for smaller urban areas or those with a specialized focus. It caters to various contexts, such as settlements just beginning their sustainability journey from a low starting point or those aiming to adopt sustainable development gradually due to limited resources. Some may prioritize quick actions with immediate impact to showcase value and encourage broader support. The document includes practical resources, such as policies, economic incentives, technical tools, and self-assessment checklists, to facilitate implementation. It is applicable to urban settlements of any type or composition. The standard provides guidance for smaller urban settlements and their administrations to implement sustainable development.

The proposed classification role(s) of local governments, involving e.g. the above highlighted functions of **enabler, regulator, funder, facilitator, or as owner**, should be further detailed using (in part) the gradual process of sustainability management as outlined in ISO 37111 on the basis of ISO 37101. The WI should build on the organizations needed to engage that are outlined in ISO 37111 and ISO 37101 and specify them further for I-US.

The WI should consider the **tools and methods** highlighted in ISO 37111 for local authorities to rapidly initiate actions, address prioritized sustainability purposes and issues, and support and facilitate the implementation processes of ISO 37101 - review and adapt them, where necessary, to the purpose of facilitating the development of an I-US. These include:

- Building and promoting a shared vision
- Organizing workshops by engaging interested parties
- Checking readiness of the organization - getting prepared to initiate the process
 - Baseline review
 - Organizational structure and responsibilities
 - Training personnel
 - Identify preliminary parties for implementation
 - Risk assessment
 - Scheduling relevant KPIs
- Conducting capability review
- Developing or adjusting a roadmap with targets and interim objectives, pathways, priorities and milestones
- Risk mitigation strategies
- Specific plans, public policies and incentives (includes table with specific examples) - also participation stages - co-creation, co-design etc.



- Action plans with tasks for responsible actioners
- Using KPI frameworks to drive implementation - it can select ISO 37120, ISO 37122, and ISO 37123 or use its own.
- Monitoring, reporting and verification of progressing process

ISO 59020 Circular economy — Measuring and assessing circularity performance outlines requirements and offers guidance to organizations for evaluating and measuring the circularity performance of a defined economic system at a given time. The evaluation involves collecting and calculating data using a combination of mandatory and optional circularity indicators.

It provides a framework to assist organizations of all types and sizes in conducting this process, covering key aspects such as defining system boundaries, selecting indicators, and processing and interpreting data consistently and reproducibly to produce meaningful and verifiable results.

The framework can be applied at various levels of an economic system, including regional, interorganizational, organizational, and product levels. Additionally, it supports the measurement and evaluation of social, environmental, and economic impacts resulting from the organization's actions aimed at achieving circular goals and objectives.

The framework as outlined in ISO 59020 is largely applicable to I-US. Most of its outlined key principles, steps and key considerations are also applicable for I-US as sub-topic of the circular economy. For most principles, I-US represents a specific scale or impact mechanism, e.g. I-US requires a custom system boundary, determined by the number and position of actors involved in the symbiosis (e.g. waste suppliers, utility companies and industrial actors taking up the value-added or by products). This custom system boundary, focusing mostly on the organizational and product level (pp. 13, ISO 59020:2024(en)), transcends across administrative/territorial boundaries. Furthermore, the scale at which I-US operates is often referred to be in-between the micro (product) and macro (territorial) level – at meso level. Also, there is a specific set of circularity aspects and related strategies as well as specific social, environmental and economic impacts that are connected to I-US, depending also in part on the actors involved and their goals and targets.

Furthermore, core circularity indicators and associated data management appear largely applicable to I-US initiatives. A **possible weakness** or gap in measuring I-US performance may lie in the fact that in order to adequately capture the system dynamics in an I-US, one needs both material- and energy flows indicators (or substance flow indicators) for the organizational level (i.e. to describe the flows between participants of the symbiosis), and indicators derived with ecological footprints for the product level, in order to have an adequate account of the outcomes. Lastly, an understanding of the resources substituted with waste resources, or the virgin material substituted with a secondary material alternative, is crucial in order to understand the potential impact of an I-US in environmental terms (e.g. avoided emissions). **Reference on these issues should be made in the current WI on I-US and in related future standards.**

ISO 59004 Circular economy — Vocabulary, principles and guidance for implementation refers to industrial symbiosis as a system that fosters circular resource flows by bringing together traditionally independent organizations to collaborate in sharing inputs and outputs, thereby optimizing their value networks.



For instance, industrial symbiosis involves separate industries or value chains exchanging or sharing resources like energy, water, or by-products, leveraging synergies created by their geographic proximity.

In regional or urban symbiosis, multiple cities, regions, and subnational governmental bodies, including agencies, work together to share resources, solutions, information, and capabilities such as infrastructure and knowledge.

Additional opportunities for symbiosis also exist, including collaborations between governments and industries. This geospatial cooperation enables mutual value creation and resource efficiency, drives innovation, and minimizes the environmental, social, and economic impacts of their activities.

The **reference made to I-S in ISO 59004 is consistent with ISO 59010** *Circular economy — Guidance on the transition of business models and value networks*. But while ISO 59010 only mentions the possibility of additional symbiosis involving both government and industry, ISO 59004 provides a brief but more concrete description. While both standards list I-S under “actions to create value”, they fail to unveil the dynamic linkages between local authorities on the one hand side, both as owner of resources and as facilitator and regulator, and industries on the other. There is clearly a substantial gap in defining an urban component within the concept of I-S, both conceptually and operationally, by providing key terms and notions, approaches as well as guidance for implementation. The **WI currently discussed in CEN TC 465 provides an opportunity to close this gap**, building on existing standards, in particular some of the new circular economy standards examined in this report.

5. Conclusions

This report underscores the central role of industrial and urban symbiosis (I-US) in fostering sustainable resource management, advancing the circular economy, and addressing Scope 3 emissions. Through the analysis of a number of ISO standards (in particular ISO 59000 series) on circular economy, as well as citing secondary literature, the following conclusions emerge:

1. **Role of cities and regions currently not captured sufficiently in I-S**

Cities and regions are pivotal in transitioning to sustainability as they are significant drivers of resource consumption, waste production, and greenhouse gas emissions. Adopting systemic resource management, including waste valorisation, can significantly mitigate these impacts. Industrial symbiosis, particularly its urban counterpart, integrates waste streams like solid waste, wastewater, and energy from urban environments into industrial processes, aligning with EU Green Deal priorities.

2. **Standardization as an Enabler**

The development of standards, such as transitioning the CWA 17354 into a comprehensive European standard, is essential for unifying terminology and practice. It promotes public-private collaboration and enables local governments to act as enablers, regulators, and facilitators of I-US initiatives.

3. **Actionable pathways for local governments**

Local governments play a crucial role in I-US implementation through spatial planning, economic development strategies, infrastructure management, and innovative procurement practices. Their involvement ensures effective resource recirculation, enhances supply



chain resilience, and drives local economic competitiveness while reducing environmental impacts.

4. Challenges and opportunities

Major barriers to I-US adoption include regulatory inconsistencies, financial constraints, and insufficient data transparency regarding waste streams. Overcoming these challenges requires tailored action plans, stakeholder engagement, and targeted research and innovation efforts. Notably, examples from European cities like Malmö and regional initiatives illustrate scalable solutions.

5. Future directions

The report emphasizes the need to expand the scope of I-US to include comprehensive governance frameworks, stronger integration of urban dimensions, and detailed case studies to guide future standards. Innovative measures, such as adopting circular economy indicators (e.g., ISO 59020), are recommended for evaluating and enhancing the effectiveness of I-US initiatives.

In conclusion, industrial and urban symbiosis represents a transformative approach to sustainable development. By bridging gaps in policy, fostering collaboration, and leveraging innovative practices, cities and regions can lead the way toward a more resource-efficient and carbon-neutral future.



6. Summary of action plan development to overcome non-technological barriers for implementation in SYMSITES EcoSites

As part of Task 5.2, the four SYMSITES Eco-Sites implemented four workshops, one in each eco-site, in order to discuss relevant non-technological barriers related to the eco-site implementation with relevant stakeholders from local administrations to businesses. The aim of these workshops was to discuss related barriers and identify solutions to address them. Solutions formed part of an action plan, one for each Eco-Site, which are being used by Eco-Site leaders to further local discussions on upscaling pilot outcomes. All four action plans can be found in ANNEX 2 of this report.

The main goal of the Danish EcoSite action plan is to address and resolve non-technological challenges that impede the implementation and scaling of wastewater reuse practices on Bornholm. These challenges include regulatory, administrative, logistical, economic, and social issues that need to be addressed to enable the effective adoption of water reuse systems. By targeting these barriers, the plan seeks to foster a conducive environment for pilot projects and their eventual expansion, aligning with both regional and national sustainable water management strategies.

The report operates under the assumption that Denmark will adopt EU Regulation 741/2020, which establishes minimum standards for water reuse. Although the Danish Ministry of the Environment announced in September 2021 that the regulation would be adopted, implementation efforts have not yet begun at the time of writing. This regulation is designed to ensure the safe use of reclaimed water for agricultural irrigation and to promote water reuse across the EU. The action plan is informed by insights from a workshop conducted on March 20th in Bornholm, with detailed information provided in the appendix.

The action plan for the Greek Ecosite aims to tackle the diverse challenges of adopting sustainable practices and promoting collaborative relationships among stakeholders. This plan takes a holistic approach, striving to expand pilot initiatives to the regional scale while overcoming regulatory, financial, and social obstacles. By addressing these key issues, the plan intends to establish a strong foundation that enhances current strategies and facilitates continued progress beyond the project's duration.

The action plan for the Spanish EcoSite within the SYMSITES project outlines a strategy to advance industrial-urban symbiosis (I-US) and improve wastewater and organic solid waste treatment in Alcoy and Muro de Alcoy. The plan focuses on scaling up a pilot project regionally by addressing key barriers:

1. **Regulatory Compliance:** Collaborating with authorities to meet environmental regulations and secure permits.
2. **Financial Sustainability:** Securing diverse funding sources, including government grants, private investments, and public-private partnerships.
3. **Community Engagement:** Raising local awareness and support through outreach, workshops, and informational sessions.
4. **Standards for Symbiotic Exchange:** Establishing guidelines to manage stakeholder roles, pricing, and dispute resolution for efficient exchanges.

By overcoming these barriers, the plan aims to enhance the project's long-term viability and create a framework for future industrial-urban symbiotic initiatives.



Following the workshop held in Vienna in May 2025, the Austrian EcoSite Action Plan addresses non-technical barriers to EcoSite projects in Austria at regional and national levels by involving authorities, associations, and policymakers with the aim to explore upscaling – concretely to expand the Austrian pilot plant by securing funding and streamlining permits – and to apply lessons learned, promoting best practices, and support EU water reuse regulations.



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ANNEX 1(a) Standards Collected

CEN LEVEL:

CWA 17354:2018 - Industrial Symbiosis: Core Elements and Implementation Approaches

ISO LEVEL:

ISO/TC 207/SC 1 – Environmental management; Environmental management systems

ISO 14001:2015 - Environmental management systems — Requirements with guidance for use

ISO 14002-1:2019 - Environmental management systems — Guidelines for using ISO 14001 to address environmental aspects and conditions within an environmental topic area — Part 1: General

ISO 14002-2:2023 - Environmental management systems — Guidelines for using ISO 14001 to address environmental aspects and conditions within an environmental topic area — Part 2: Water

ISO/TC 207/SC 5 – Environmental management; Life cycle assessment

ISO 14046:2014 - Environmental management — Water footprint — Principles, requirements and guidelines

ISO/TC 282/SC 1 – Water reuse; Treated wastewater reuse for irrigation

ISO 20419:2018 - Treated wastewater reuse for irrigation — Guidelines for the adaptation of irrigation systems and practices to treated wastewater

ISO/TC 282/SC 2 – Water reuse; Water reuse in urban areas

ISO 20760-2: 2017 - [IS to be revised] Water reuse in urban areas — Guidelines for centralized water reuse system — Part 2: Management of a centralized water reuse system

ISO/TC 282/SC 4 – Water reuse; Industrial water reuse

ISO 22447:2019 - Industrial wastewater classification

ISO 4789:2023 - Guidelines for wastewater treatment and reuse in thermal power plants

ISO/TC 224 - Drinking water, wastewater and stormwater systems and services

ISO 46001:2019 - Water efficiency management systems — Requirements with guidance for use

ISO 24595:2024 - Drinking water, wastewater and stormwater systems and services — Guidelines for the provision of alternative water service for essential facilities during a crisis

ISO 24596:2024 - Drinking water, wastewater and stormwater systems and services — Guidelines for the planning and implementation of infrastructure hardening for water and wastewater systems

ISO 24566-1:2023 - Drinking water, wastewater and storm water systems and services — Adaptation of water services to climate change impacts. Part 1: Assessment principles

ISO 24566-2:2024 - Drinking water, wastewater and stormwater systems and services — Adaptation of water services to climate change impacts. Part 2: Stormwater services

ISO/TC 147 - Water quality



ISO 15839:2003 - Water quality — On-line sensors/analysing equipment for water — Specifications and performance tests

ISO 17381:2003 - Water quality — Selection and application of ready-to-use test kit methods in water analysis

ISO/TMBG – Technical Management Board - groups

ISO 31600:2022 - Water efficiency labelling programmes – Requirements with guidance for implementation

ISO 30500:2018 - Non-sewered sanitation systems — Prefabricated integrated treatment units — General safety and performance requirements for design and testing

ISO/TC 268 - Sustainable cities and communities

ISO 37101:2016 - Sustainable development in communities — Management system for sustainable development — Requirements with guidance for use

ISO 37101:2016/Amd 1:2024 - Sustainable development in communities — Management system for sustainable development — Requirements with guidance for use — Amendment 1: Climate action changes

ISO 37104:2019 - Sustainable cities and communities — Transforming our cities — Guidance for practical local implementation of ISO 37101

ISO 37106:2021 - Sustainable cities and communities — Guidance on establishing smart city operating models for sustainable communities

ISO 37111:2024 - Sustainable cities and communities — Urban settlements — Guidance for a flexible approach to phased implementation of ISO 37101

ISO/TC 323 - Circular economy

ISO 59004:2024 - Circular economy — Vocabulary, principles and guidance for implementation

ISO 59020:2024 - Circular economy — Measuring and assessing circularity performance



ANNEX 1(B) Sub-Set Of Standards Analysed

CEN Level:

CWA 17354:2018 - Industrial Symbiosis: Core Elements and Implementation Approaches

ISO LEVEL

ISO 59004:2024 - Circular economy — Vocabulary, principles and guidance for implementation

ISO 59020:2024 - Circular economy — Measuring and assessing circularity performance

ISO 59010: Circular economy – Guidance on the transition of business models and value networks

ISO 37111:2024: Sustainable cities and communities — Urban settlements — Guidance for a flexible approach to phased implementation of ISO 3710

14002-2 2023: Environmental management systems — Guidelines for using ISO 14001 to address environmental aspects and conditions within an environmental topic area — Part 2 Water





ANNEX 2: Action Plan – Greek EcoSite



GREEK ECOSITE

Action Plan to Overcome Non-Technological Barriers to Implement Industrial- Urban Symbiosis



Template for the Action Plan to Overcome Non-technological Barriers to implement Industrial-Urban Symbiosis

Task 5.2: Develop a list of actions to overcome non-technological barriers for exploitation of cross-company symbiosis

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1. The EcoSite in a nutshell



The Greek Ecosite represents a unique initiative aimed at fostering sustainable development through the integration of ecological practices and community engagement. Situated in a region rich in biodiversity and cultural heritage, the Ecosite serves as a living laboratory for testing innovative approaches to sustainability. It encompasses various sectors, including agriculture, tourism, and renewable energy, all of which are interconnected to promote a circular economy.

One of the key features of the Greek Ecosite is the implementation of symbiosis among different stakeholders, including local businesses, government entities, academic institutions, and community organizations. This collaborative approach is designed to optimize resource use, reduce waste, and enhance overall sustainability. By fostering partnerships, the Ecosite encourages the sharing of knowledge, resources, and best practices, creating a network of support that benefits all participants.

For instance, industrial liquid effluents may be co-treated with municipal wastewater and the liquid fraction of household food waste to generate biofuels (biomethane and biohydrogen) that may be used by the municipality or the industry, while also generating treated wastewater that may be used for irrigation. This may lead to significantly lower costs for waste management, while recycling significant resources. Another possibility involves agricultural producers in the Ecosite, who may collaborate

with a municipality to utilize compost generated from organic waste; thereby enriching the soil and reducing landfill disposal. Similarly, tourism operators may work with environmental organizations to promote eco-friendly practices, such as responsible waste management and conservation efforts, which enhance the visitor experience while protecting the local environment.

The symbiotic relationships established within the Greek Ecosite not only contribute to environmental sustainability but also bolster the local economy. By creating a circular economy model, where waste from one sector becomes a resource for another, the Ecosite enhances resilience and adaptability in the face of economic and environmental challenges.

In summary, the Greek Ecosite exemplifies a holistic approach to sustainability through the implementation of symbiosis among diverse stakeholders. This collaborative framework not only addresses ecological concerns but also fosters economic growth and community well-being, paving the way for a sustainable future in the region.

2. Objectives & scope

Scope of the Action Plan for the Greek Ecosite

The action plan for the Greek Ecosite is designed to address the multifaceted challenges associated with implementing sustainable practices and fostering symbiotic relationships among stakeholders. The scope of this plan is comprehensive, aiming to scale up pilot initiatives at the regional level while addressing regulatory, financial and social barriers that currently impede progress. By focusing on these critical areas, the plan seeks to create a robust framework that not only supports existing strategies but also lays the groundwork for future developments beyond the project's lifespan.

Building on Existing Strategies



This action plan builds upon a foundation of existing strategies and initiatives aimed at promoting sustainability within the region. It leverages insights gained from previous projects, stakeholder feedback, and best practices identified in other ecosystems, such as the Austrian Ecosite. By integrating these lessons learned, the plan aims to enhance the effectiveness of current efforts and ensure that new initiatives are aligned with regional and national sustainability goals.

The plan also recognizes the importance of collaboration with local authorities, businesses, and community organizations. By engaging these stakeholders in the planning process, the action plan ensures that it is responsive to local needs and priorities, thereby increasing the likelihood of successful implementation.

Future Development of the Plan

A key element of the action plan is ensuring its long-term sustainability after the project ends. Steps have been outlined to further develop and refine the plan, keeping it effective and relevant in addressing new challenges. This process will include regular engagement with stakeholders, progress reviews, and the integration of updated research and technology.

The plan will also implement monitoring and evaluation systems to allow for necessary adjustments. By promoting continuous improvement, the action plan aims to build a flexible and durable framework that can adapt to changing needs and evolving sustainability goals.

System Boundary

The system boundary of this action plan encompasses a regional scale, focusing on the Greek Ecosite (The Municipality of Western Achaia). Henceforth by the word Ecosite we imply this system. This regional approach allows for a comprehensive understanding of the interconnectedness of various sectors, including agriculture, tourism, industry, waste management and renewable energy. By considering the broader regional context, the action plan can effectively address the complex



interactions between different stakeholders and sectors, facilitating the development of symbiotic relationships that enhance sustainability.

The regional focus also enables the action plan to align with broader national and European sustainability targets, ensuring that local initiatives contribute to larger goals such as climate action, resource efficiency, and social equity.

Plan's main objectives

The action plan for the Greek Ecosite is guided by several overarching objectives, which include:

1. **Addressing Non-Technological Barriers:** The plan mainly focuses on identifying and reducing non-technological obstacles that make it hard to adopt better practices. This includes dealing with regulatory, financial, and social challenges faced by stakeholders.
2. **Scaling Up Pilot Initiatives:** The plan aims to scale up successful pilot initiatives at the regional level, ensuring that effective practices are adopted more widely. This involves creating a supportive environment for innovation and collaboration among stakeholders.
3. **Defining Standards for Symbiotic Exchanges:** A key objective is to establish clear methods and standards for symbiotic exchanges among stakeholders. This includes defining roles, responsibilities, and financial arrangements to facilitate cooperation and resource sharing.
4. **Enhancing Stakeholder Engagement:** The action plan emphasizes the importance of engaging stakeholders throughout the process. By fostering collaboration and communication, the plan aims to build trust and commitment among participants.



5. Promoting Awareness and Education: Raising awareness about the benefits of sustainability and symbiotic practices is crucial. The plan includes initiatives to educate stakeholders and the broader community about sustainable practices and their positive impacts.

6. Monitoring and Evaluation: Establishing a robust monitoring and evaluation framework is essential for assessing progress and making necessary adjustments. The plan aims to create mechanisms for tracking outcomes and sharing lessons learned.

Alignment with Broader Strategies and Targets

The action plan for the Greek Ecosite aligns with broader regional and national strategies aimed at promoting sustainability and addressing climate change. It supports key initiatives such as the European Green Deal, which seeks to make Europe the first climate-neutral continent by 2050. By focusing on non-technological barriers and fostering symbiotic relationships, the plan contributes to the overarching goals of resource efficiency, social equity, and environmental protection.

Additionally, the action plan aligns with national strategies for sustainable development, which emphasize the importance of integrating economic, social, and environmental considerations. By addressing the challenges faced by stakeholders in the Greek Ecosite, the plan supports the achievement of national targets related to climate action, biodiversity conservation, and sustainable resource management.

The action plan for the Greek Ecosite is a comprehensive framework designed to address non-technological barriers and promote sustainable practices through symbiotic relationships among stakeholders. By building on existing strategies, planning for future development, and focusing on a regional scale, the plan aims to create a resilient and adaptive approach to sustainability. Through its overarching objectives and alignment with broader strategies, the action plan seeks to contribute to a sustainable future for the Greek Ecosite and its surrounding communities.



3. Status quo & local context

Overview of the EcoSite's Industrial and Urban Sectors

The Greek EcoSite encompasses a diverse range of industrial and urban sectors that play a crucial role in the region's economy and resource management. This overview will provide insights into the key sectors, available economic and resource flow data, existing strategies, circular economy initiatives, local governance structures, and the roles of key stakeholders.

1. Industrial Sectors

The industrial landscape of the Greek EcoSite is characterized by several key sectors, including:

Agriculture: The agricultural sector within the EcoSite plays a pivotal role in the local economy, contributing significantly to employment, food security, and sustainable resource management. This sector encompasses a diverse range of activities, including crop production, livestock farming, and agroforestry, which are essential for both local consumption and export. Economic data indicates that agriculture accounts for approximately 10-15% of the region's GDP, with a substantial portion of the workforce engaged in farming-related activities. Resource flow data reveals that the sector relies heavily on water resources, with irrigation practices being a critical component for crop yield optimization.

In recent years, there has been a concerted effort to integrate circular economy principles into agricultural practices. Initiatives such as organic farming, permaculture, and agroecology are gaining traction, promoting sustainable land use and reducing waste through composting and recycling of agricultural by-products. Local governance structures, including agricultural cooperatives and regional development agencies, play a crucial role in supporting these initiatives by providing technical assistance, funding



opportunities, and market access for farmers. Key stakeholders in the agricultural sector include local farmers' associations, government agricultural departments, research institutions, and NGOs focused on sustainable agriculture. These entities collaborate to enhance agricultural productivity while ensuring environmental sustainability and resilience against climate change.

Food Processing: The food processing sector within the EcoSite is a vital component of the regional economy, transforming raw agricultural products into value-added goods that meet consumer demands. This sector encompasses a wide range of activities, including the processing of fruits, vegetables, dairy, and meat products. Economic data suggest that food processing contributes approximately 5-10% to the local GDP and employs a significant number of individuals, particularly in rural areas where agricultural production is concentrated. Resource flow data indicates that the sector is heavily reliant on local agricultural outputs, creating a symbiotic relationship that supports both industries.

Circular economy initiatives are increasingly being adopted within the food processing sector, focusing on waste reduction, energy efficiency, and sustainable sourcing of raw materials. Strategies such as zero-waste production, upcycling of food by-products, and the implementation of energy-efficient technologies are being promoted to enhance sustainability. Local governance structures, including food industry associations and municipal regulatory bodies, are instrumental in facilitating these initiatives by providing guidelines, incentives, and support for businesses aiming to adopt sustainable practices. Key stakeholders in the food processing sector include food manufacturers, local government agencies, health and safety regulators, and consumer advocacy groups. These stakeholders work collaboratively to ensure food safety, promote local products, and enhance the overall competitiveness of the food processing industry within the EcoSite.

Tourism and Hospitality: Given its rich cultural heritage and natural beauty, tourism is a major economic driver in the EcoSite. The hospitality sector, including hotels,



restaurants, and recreational facilities, supports local businesses and generates substantial revenue.

Renewable Energy: The EcoSite is increasingly focusing on renewable energy sources, particularly solar and wind power. Investments in renewable energy infrastructure are essential for reducing carbon emissions and promoting sustainable development.

Manufacturing: The manufacturing sector in the EcoSite includes various industries, such as textiles, construction materials, and machinery. This sector is crucial for job creation and economic diversification.

Waste Management and Recycling: As part of the circular economy initiatives, waste management and recycling industries are gaining prominence. These sectors focus on reducing waste generation and promoting resource recovery.

Economic and Resource Flow Data

While specific economic and resource flow data may vary, the following general trends can be observed:

Economic Contribution: The industrial sectors collectively contribute a significant percentage to the region's GDP. For instance, agriculture and food processing may account for approximately 10-15% of the GDP, while tourism can contribute around 20-25%.

Employment: The industrial sectors provide employment for a substantial portion of the local population. Agriculture and tourism are particularly labor-intensive, employing thousands of individuals.

Resource Flows: Resource flows within the EcoSite region include the movement of raw materials (e.g., agricultural products, construction materials), energy (e.g., electricity from renewable sources), and waste (e.g., recyclable materials). The



implementation of circular economy practices aims to optimize these flows, reducing waste and enhancing resource efficiency.

2. Urban Sectors

The urban sectors within the Greek EcoSite are integral to the region's development and sustainability. Key urban sectors include:

Residential Development: The urban landscape is characterized by a mix of residential areas, ranging from traditional homes to modern apartment complexes. Sustainable housing initiatives are being promoted to enhance energy efficiency and reduce environmental impact.

Transportation: The transportation sector is crucial for connecting urban and rural areas. Efforts are being made to promote sustainable transportation options, such as public transit, cycling, and electric vehicles.

Public Services: Local governments provide essential public services, including waste management, water supply, and sanitation. These services are vital for maintaining the quality of life in urban areas.

Green Spaces and Urban Planning: The integration of green spaces and sustainable urban planning practices is gaining attention. Initiatives to create parks, community gardens, and green roofs contribute to biodiversity and enhance urban resilience.

Economic and Resource Flow Data

Urban Economic Contribution: Urban sectors contribute significantly to the local economy, with services and commerce accounting for a large share of GDP. The service sector, including retail and hospitality, is particularly prominent.



Resource Flows: Urban resource flows include water supply, energy consumption, and waste generation. Efforts to implement circular economy practices aim to minimize waste and promote resource recovery in urban areas.

3. Existing Strategies and Circular Economy Initiatives

The Greek EcoSite is guided by several existing strategies and initiatives aimed at promoting sustainability and circular economy practices:

National Circular Economy Strategy: Greece has adopted a national circular economy strategy that emphasizes waste reduction, resource efficiency, and sustainable production and consumption. This strategy aligns with the European Union's Circular Economy Action Plan.

Regional Development Plans: Local governments have developed regional development plans that prioritize sustainable economic growth, environmental protection, and social equity. These plans often include specific targets for waste reduction, renewable energy adoption, and sustainable transportation.

EU Funding Programs: The EcoSite benefits from various EU funding programs aimed at supporting sustainable development initiatives. These programs provide financial resources for projects related to renewable energy, waste management, and sustainable urban development.

Local Circular Economy Initiatives: Several local initiatives focus on promoting circular economy practices, such as community recycling programs, composting initiatives, and sustainable business networks. These initiatives engage local stakeholders and foster collaboration.



4. Local Governance Structures

Local governance structures play a crucial role in implementing sustainability initiatives within the Greek EcoSite. Key components of the governance framework include:

Municipal Governments: Local municipalities are responsible for implementing policies and programs related to urban planning, waste management, and public services. They play a central role in engaging with stakeholders and promoting sustainable practices.

Regional Authorities: Regional authorities oversee broader development strategies and coordinate efforts among municipalities. They are responsible for implementing regional development plans and ensuring alignment with national and EU policies.

Public Entities and Agencies: Various public entities and agencies are involved in specific sectors, such as environmental protection, energy management, and transportation. These organizations provide expertise and resources to support local initiatives.

5. Key Stakeholders and Their Roles

The success of sustainability initiatives in the Greek EcoSite relies on the active participation of key stakeholders, including:

Industries: Local industries, including agriculture, tourism, and manufacturing, play a vital role in driving economic growth and implementing sustainable practices. They are responsible for adopting circular economy principles, reducing waste, and enhancing resource efficiency.

Local Governments: Municipal and regional governments are essential for creating supportive policies, providing public services, and engaging with communities. They



facilitate collaboration among stakeholders and ensure that sustainability initiatives align with local needs.

Public Entities: Public entities, such as environmental agencies and energy authorities, provide expertise and resources to support sustainability efforts. They play a critical role in monitoring progress and enforcing regulations.

Community Organizations: Local community organizations and NGOs are instrumental in raising awareness, promoting sustainable practices, and engaging residents in sustainability initiatives. They often serve as intermediaries between stakeholders and the community.

Academia and Research Institutions: Academic institutions contribute to sustainability efforts through research, education, and innovation. They provide valuable insights and data to inform decision-making and support the development of new technologies.

Citizens: The active participation of citizens is crucial for the success of sustainability initiatives. Engaging residents in decision-making processes and promoting sustainable behaviors can lead to more effective outcomes.

The Greek EcoSite presents a dynamic landscape of industrial and urban sectors that are interconnected and essential for the region's economic and environmental sustainability. By leveraging existing strategies, circular economy initiatives, and local governance structures, the EcoSite aims to foster collaboration among key stakeholders. Through their active participation, industries, local governments, public entities, community organizations, academia, and citizens can work together to create a more sustainable future for the region. The ongoing commitment to addressing economic and resource flow challenges will be critical in achieving the goals of the EcoSite and promoting a circular economy.



4. Identification of Non-Technological Barriers

Identification of Non-Technological Barriers

This section outlines the main non-technological barriers identified that hinder the implementation of Integrated Urban Systems (I-US) at the EcoSite. Each barrier is analyzed in terms of its nature, impact, desired outcomes, and relevant stakeholders.

Barrier #1: Organisation and Governance

What is the barrier? Is it a broader or specific barrier?

This barrier is a broader issue related to the overall governance structure and coordination among various stakeholders involved in the EcoSite. It encompasses challenges such as overlapping responsibilities, lack of clear leadership, and insufficient collaboration.

How is it hindering the implementation or upscaling of the symbiosis at the EcoSite?

Inefficient governance leads to fragmented efforts, where stakeholders may work in silos rather than collaboratively. This results in delays in decision-making, misallocation of resources, and ultimately, a lack of cohesive strategy for implementing I-US initiatives.

What is the best case / desired outcome to address this barrier?

The desired outcome is to establish a clear governance framework that delineates roles and responsibilities among stakeholders, promotes collaboration, and facilitates effective decision-making processes. This would enhance coordination and streamline efforts towards implementing I-US.

Which stakeholders does it concern and why should these stakeholders be involved to address this barrier?



Key stakeholders include local government officials, community leaders, and representatives from non-governmental organizations (NGOs). Their involvement is crucial as they can provide insights into governance challenges, facilitate stakeholder engagement, and help create a unified approach to governance that supports I-US implementation.

Barrier #2: Finance

What is the barrier? Is it a broader or specific barrier?

This barrier is a specific issue related to the financial constraints faced by stakeholders in the EcoSite. It includes limited access to funding, high investment risks, and a lack of financial incentives for adopting I-US practices.

How is it hindering the implementation or upscaling of the symbiosis at the EcoSite?

Financial limitations restrict the ability of stakeholders to invest in necessary infrastructure, technology, and training required for I-US. Without adequate funding, projects may be delayed or scaled down, preventing the realization of potential benefits from symbiotic relationships.

What is the best case / desired outcome to address this barrier?

The best-case scenario involves creating a diversified funding strategy that includes public and private investments, grants, and financial incentives for stakeholders to adopt I-US practices. This would ensure that adequate resources are available to support implementation and scaling efforts.

Which stakeholders does it concern and why should these stakeholders be involved to address this barrier?

Stakeholders include financial institutions, local businesses, and government funding agencies. Their involvement is essential to identify funding opportunities, develop financial models that mitigate risks, and create incentives that encourage investment in I-US initiatives.



Barrier #3: Policy and Regulation

What is the barrier? Is it a broader or specific barrier?

This barrier is a broader issue related to the existing policies and regulatory frameworks that govern urban development and resource management. It includes outdated regulations that do not accommodate innovative practices associated with Integrated Urban Systems (I-US).

How is it hindering the implementation or upscaling of the symbiosis at the EcoSite?

Rigid policies can significantly impede innovation by imposing stringent restrictions on the adoption of novel practices or technologies that have the potential to foster symbiotic relationships. Such inflexibility in policy frameworks can create barriers to the exploration and integration of innovative approaches, thereby limiting the capacity of organizations to adapt to emerging methodologies. Consequently, this rigidity may obstruct the effective implementation of Integrated Urban Systems (I-US), as stakeholders are unable to leverage new opportunities for collaboration and resource optimization. The inability to embrace adaptive strategies not only stifles creativity but also undermines the overall efficacy of initiatives aimed at enhancing urban sustainability and resilience. Therefore, it is imperative to advocate for more flexible policy environments that encourage experimentation and the adoption of innovative solutions within urban contexts.

What is the best case / desired outcome to address this barrier?

The desired outcome is to reform existing policies and regulations to create a more supportive environment for I-US. This includes developing adaptive regulatory frameworks that encourage experimentation and the adoption of innovative practices.

Which stakeholders does it concern and why should these stakeholders be involved to address this barrier?



Stakeholders include policymakers, regulatory bodies, and urban planners. Their involvement is crucial as they can advocate for policy changes, ensure that regulations are aligned with current needs, and facilitate the integration of I-US into urban planning processes.

Barrier #4: Skills and Capabilities

What is the barrier? Is it a broader or specific barrier?

This barrier is a specific issue related to the lack of skills and expertise among stakeholders necessary for implementing I-US. It encompasses gaps in knowledge about sustainable practices, technology use, and collaborative approaches.

How is it hindering the implementation or upscaling of the symbiosis at the EcoSite?

Insufficient skills and capabilities can lead to ineffective implementation of I-US initiatives, as stakeholders may lack the necessary training to utilize new technologies or engage in collaborative practices. This can result in suboptimal outcomes and missed opportunities for synergies.

What is the best case / desired outcome to address this barrier?

The best-case scenario involves developing comprehensive training programs and capacity-building initiatives that equip stakeholders with the necessary skills and knowledge to effectively implement I-US. This would enhance their ability to collaborate and innovate.

Which stakeholders does it concern and why should these stakeholders be involved to address this barrier?

Key stakeholders include educational institutions, training organizations, and industry experts. Their involvement is essential to design and deliver relevant training programs that address the specific needs of stakeholders in the EcoSite.



Barrier #5: Social Acceptance

What is the barrier? Is it a broader or specific barrier?

This barrier is a broader issue related to the social acceptance of I-US practices among community members and stakeholders. It includes resistance to change, lack of awareness, and misconceptions about the benefits of symbiotic relationships.

How is it hindering the implementation or upscaling of the symbiosis at the EcoSite?

Social resistance can serve as a significant barrier to the adoption of Integrated Urban Systems (I-US) initiatives, as stakeholders may exhibit reluctance to alter established practices or to invest in novel approaches. This resistance often stems from a variety of factors, including a fear of the unknown, perceived risks associated with change, and a strong attachment to traditional methods. Consequently, such reluctance can result in a diminished level of community support, which is essential for the success of collaborative efforts aimed at implementing I-US. Without active engagement and endorsement from the community, initiatives may struggle to gain traction, ultimately undermining their effectiveness and sustainability. Therefore, it is imperative to address social resistance through targeted engagement strategies that foster dialogue, build trust, and demonstrate the tangible benefits of adopting innovative practices within urban environments.

What is the best case / desired outcome to address this barrier?

The desired outcome is to foster a culture of acceptance and support for I-US through community engagement, awareness campaigns, and participatory decision-making processes. This would help build trust and encourage stakeholders to embrace innovative practices.

Which stakeholders does it concern and why should these stakeholders be involved to address this barrier?

Stakeholders include community organizations, local residents, and communication experts. Their involvement is crucial to facilitate dialogue, raise awareness about the



benefits of I-US, and ensure that community concerns are addressed in the planning process.

Barrier #6: Information Flows

What is the barrier? Is it a broader or specific barrier?

This barrier is a specific issue related to the lack of effective information sharing and communication among stakeholders involved in the EcoSite. It includes challenges in accessing relevant data, sharing best practices, and coordinating efforts.

How is it hindering the implementation or upscaling of the symbiosis at the EcoSite?

Poor information flows can lead to misunderstandings, duplication of efforts, and missed opportunities for collaboration. Without effective communication, stakeholders may not be aware of each other's initiatives or the resources available to support I-US implementation.

What is the best case / desired outcome to address this barrier?

The best-case scenario involves establishing robust communication channels and platforms for information sharing among stakeholders. This would facilitate collaboration, enhance transparency, and ensure that all parties are informed about ongoing efforts and opportunities.

Which stakeholders does it concern and why should these stakeholders be involved to address this barrier?

Key stakeholders include technology providers, communication specialists, and representatives from various sectors involved in the EcoSite. Their involvement is essential to develop and implement effective communication strategies that promote information sharing and collaboration.

The identification of these additional non-technological barriers highlights the multifaceted challenges faced in implementing Integrated Urban Systems at the EcoSite. By addressing these barriers through targeted strategies and stakeholder



engagement, it is possible to create a more conducive environment for innovation and sustainable development. Further barriers can be added in a similar format to provide a comprehensive overview of the challenges faced.

By understanding the nature of each barrier, its impact, desired outcomes, and the stakeholders involved, targeted strategies can be developed to facilitate progress and foster a collaborative environment conducive to innovation and sustainability. Further barriers can be added in a similar format to provide a comprehensive overview of the challenges faced.

5. Actions to Overcome Barriers

The following table outlines targeted actions designed to address the identified non-technological barriers within the EcoSite. These actions have been co-created through workshops and are intended to be practical, implementable, and aligned with local policies. Each action includes details on the barrier it addresses, the stakeholders involved, the time frame for implementation, and the expected outputs and outcomes

Description of activity	Barrier addressed	Stakeholders to be involved	Time for implementation	Expected outputs & outcome(s)
A1: Policy Reform virtual Workshop	Policy and Regulation	Local government officials, policymakers, urban planners	6 months	A set of policy recommendations that promote adaptive regulatory frameworks for Integrated Urban Systems (I-US). Increased flexibility in regulations to

				support innovative practices.
A2: Skills Development Program	Skills and Capabilities	Educational institutions, training organizations, industry experts	1 year	A Skills Development Program for Schools and Local Partners on Integrated Urban Systems
A3: Community Engagement Campaign	Social Acceptance	Community organizations, local residents, communication experts	3 months	A series of community workshops and outreach activities that raise awareness about I-US benefits. Increased community support and participation in I-US initiatives.
A4: Pilot Projects for I-US	Social Acceptance	Local government, community organizations, businesses	1 year	Implementation of pilot projects demonstrating the benefits of I-US. Increased visibility and understanding of I-US among community members and



				stakeholders.
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The actions outlined in this table provide a structured approach to overcoming the identified non-technological barriers within the EcoSite and their implementations are long-term and go well beyond the duration of the SYMSITES project. By engaging relevant stakeholders and aligning these actions with local policies, it is possible to create a supportive environment for the successful implementation of Integrated Urban Systems. The expected outputs and outcomes will contribute to the overall sustainability and resilience of the EcoSite, fostering collaboration and innovation among all participants.

This structured approach will facilitate discussions during the non-technological barriers workshops, ensuring that all participants can contribute effectively to the identification and resolution of barriers.

6. Activity Monitoring and Evaluation

Monitoring the Implementation of the Action Plan

Monitoring the implementation of the Action Plan is crucial for ensuring that the targeted actions effectively address the identified non-technological barriers within the EcoSite. A robust monitoring framework will help track progress, assess the impact of actions, and facilitate continuous learning and improvement. This section outlines the key methodologies, indicators, reporting timelines, and feedback mechanisms that will be employed to monitor the progress and impact of the actions outlined in the Action Plan.

1. Key Methodologies

To effectively monitor the implementation of the Action Plan, a combination of qualitative and quantitative methodologies will be employed:

Surveys and Questionnaires: Regular surveys will be conducted among stakeholders to gather feedback on the implementation of actions, perceived barriers, and overall satisfaction with the process. These surveys will be designed to capture both quantitative data (e.g., satisfaction ratings) and qualitative insights (e.g., open-ended feedback).



Interviews and Focus Groups: In-depth interviews and focus group discussions will be organized with key stakeholders to gain deeper insights into the challenges and successes experienced during the implementation of actions. This qualitative approach will provide context to the quantitative data collected through surveys.

Progress Tracking Tools: A project management tool will be utilized to track the progress of each action against predefined milestones and timelines. This tool will allow for real-time updates and facilitate communication among stakeholders.

Case Studies: Selected actions will be documented as case studies to illustrate best practices, challenges faced, and lessons learned. These case studies will serve as valuable resources for stakeholders and can be shared widely to promote knowledge exchange.

2. Indicators to be Used

To effectively measure the progress and impact of the actions, specific indicators will be established for each action. These indicators will be categorized into three main types: output indicators, outcome indicators, and impact indicators.

Output Indicators: These indicators will measure the immediate results of the actions taken. Examples include:

- Number of workshops conducted.
- Number of participants engaged in training programs.
- Number of policy recommendations developed.

Outcome Indicators: These indicators will assess the changes resulting from the actions in the short to medium term. Examples include:

- Percentage increase in stakeholder satisfaction with the implementation process.
- Number of new skills acquired by participants in training programs.



- Level of community engagement in I-US initiatives (e.g., attendance at community events).

Impact Indicators: These indicators will evaluate the long-term effects of the actions on the EcoSite and its stakeholders. Examples include:

- Improvement in the overall sustainability metrics of the EcoSite (e.g., reduction in carbon emissions, increased green spaces).
- Changes in local policies that support I-US initiatives.
- Enhanced collaboration among stakeholders leading to innovative solutions.

3. Reporting Timelines

Regular reporting will be essential to keep stakeholders informed about the progress of the Action Plan. The following reporting timelines will be established:

Monthly Progress Reports: A brief report will be generated each month to summarize the progress of each action, highlight any challenges encountered, and outline next steps. This report will be shared with all stakeholders involved in the implementation process.

Quarterly Review Meetings: Every three months, a review meeting will be held with key stakeholders to discuss the progress of the Action Plan, share insights from surveys and interviews, and make any necessary adjustments to the implementation strategy. These meetings will provide an opportunity for stakeholders to voice their concerns and contribute to the decision-making process.

Annual Impact Assessment: An in-depth impact assessment will be conducted annually to evaluate the overall effectiveness of the Action Plan. This assessment will involve a comprehensive analysis of the indicators established and will culminate in a detailed report outlining the findings, lessons learned, and recommendations for future actions.



4. Feedback and Learning Mechanisms

To foster a culture of continuous improvement, feedback and learning mechanisms will be integrated into the monitoring framework:

Feedback Loops: Stakeholders will be encouraged to provide ongoing feedback throughout the implementation process. This feedback will be collected through surveys, interviews, and informal discussions. A dedicated feedback channel (e.g., an online platform or email) will be established to facilitate communication.

Learning Workshops: Periodic learning workshops will be organized to reflect on the progress made, share experiences, and identify areas for improvement. These workshops will provide a platform for stakeholders to discuss challenges, celebrate successes, and collaboratively develop solutions.

Documentation of Lessons Learned: A dedicated section of the project management tool will be used to document lessons learned throughout the implementation process. This documentation will be reviewed regularly and will inform future actions and strategies.

Adaptation of the Action Plan: Based on the feedback received and the insights gained from monitoring activities, the Action Plan will be adapted as necessary. This flexibility will ensure that the actions remain relevant and effective in addressing the identified barriers.

Monitoring the implementation of the Action Plan is essential for ensuring that the targeted actions effectively address the non-technological barriers within the EcoSite. By employing a combination of methodologies, establishing clear indicators, adhering to reporting timelines, and integrating feedback and learning mechanisms, stakeholders will be able to track progress, assess impact, and continuously improve the implementation process. This comprehensive monitoring framework will not only



enhance accountability but also foster collaboration and innovation among stakeholders, ultimately contributing to the success of the EcoSite and its sustainability goals.

Through this structured approach, the EcoSite can adapt to emerging challenges and opportunities, ensuring that the actions taken are both impactful and aligned with the needs of the community and the environment.

7. Governance Structure

Governance Structure for the Action Plan

The successful implementation of the Action Plan requires a well-defined governance structure that ensures accountability, stakeholder engagement, and effective oversight of actions. This section outlines the governance framework, detailing the ownership of the implementation, the roles of various stakeholders, and the collaborative mechanisms that will be established at the regional and municipal levels.

1. Ownership of Implementation

Ownership of the Action Plan is critical for its success. The governance structure will designate specific entities responsible for overseeing the implementation of actions, ensuring that there is clarity in roles and responsibilities. The following entities will take ownership of the Action Plan:

Lead Agency: A designated lead agency will be responsible for the overall coordination and management of the Action Plan. This agency will serve as the primary point of contact for stakeholders and will oversee the implementation of actions, monitor progress, and report on outcomes. The lead agency will be selected based on its expertise, capacity, and existing relationships with stakeholders.

Steering Committee: A multi-stakeholder steering committee will be established to provide strategic guidance and oversight for the Action Plan. This committee will consist of representatives from key stakeholder groups, including local government, community



organizations, businesses, and academic institutions. The steering committee will meet regularly to review progress, address challenges, and make decisions regarding the direction of the Action Plan.

Working Groups: Specific working groups will be formed to focus on particular actions or themes within the Action Plan. These groups will consist of stakeholders with relevant expertise and interest in the specific areas being addressed. Working groups will be responsible for developing action plans, implementing activities, and reporting on progress to the steering committee.

2. Governance Structure

The governance structure for the Action Plan will be designed to facilitate collaboration, communication, and decision-making among stakeholders. The following components will be integral to the governance framework:

Regional and Municipal Collaboration: The governance structure will operate at both regional and municipal levels to ensure that actions are aligned with local needs and priorities. Regional authorities will provide oversight and support for municipal-level initiatives, while municipalities will implement actions tailored to their specific contexts.

Stakeholder Engagement: Engaging a diverse range of stakeholders is essential for the success of the Action Plan. The governance structure will include mechanisms for stakeholder engagement, such as public consultations, workshops, and forums. These engagement activities will ensure that the voices of community members, businesses, and other stakeholders are heard and considered in decision-making processes.

Communication Channels: Clear communication channels will be established to facilitate information sharing among stakeholders. This may include regular newsletters, an online platform for updates and resources, and social media channels to promote engagement and awareness of the Action Plan.



Decision-Making Processes: The governance structure will outline decision-making processes to ensure transparency and accountability. Decisions will be made collaboratively, with input from the steering committee and working groups. A consensus-based approach will be encouraged, but clear protocols will be established for resolving conflicts and making final decisions when necessary.

3. Roles and Responsibilities of Stakeholders

The governance structure will delineate the roles and responsibilities of various stakeholders involved in the implementation of the Action Plan. Key stakeholders and their roles include:

Local Government: Local government entities will play a crucial role in implementing the Action Plan at the municipal level. They will be responsible for allocating resources, facilitating stakeholder engagement, and ensuring that actions align with local policies and regulations. Local government representatives will also serve on the steering committee to provide insights and guidance.

Community Organizations: Community organizations will be instrumental in mobilizing local residents and fostering community engagement. They will help identify local needs, facilitate workshops and consultations, and provide feedback on the implementation of actions. Community organizations will also represent the interests of marginalized groups to ensure inclusivity.

Businesses and Industry Representatives: Businesses will be engaged as key stakeholders in the implementation of the Action Plan. They will provide insights into market dynamics, contribute resources, and collaborate on initiatives that promote sustainability and innovation. Business representatives will participate in working groups and the steering committee to ensure that economic considerations are integrated into the Action Plan.



Academic Institutions: Academic institutions will contribute research expertise and data analysis to support the implementation of the Action Plan. They will conduct studies to assess the impact of actions, evaluate progress, and provide evidence-based recommendations. Academic representatives will also participate in working groups and contribute to knowledge sharing.

Civil Society and Advocacy Groups: Civil society organizations and advocacy groups will play a vital role in promoting transparency, accountability, and social equity in the implementation of the Action Plan. They will advocate for the inclusion of diverse perspectives and ensure that the needs of vulnerable populations are addressed.

4. Collaborative Mechanisms

To foster collaboration among stakeholders, the governance structure will incorporate various collaborative mechanisms:

Joint Planning Sessions: Regular joint planning sessions will be held to facilitate collaboration among stakeholders. These sessions will provide an opportunity for stakeholders to share updates, discuss challenges, and collaboratively develop solutions. Joint planning will enhance coordination and ensure that actions are aligned with the overall goals of the Action Plan.

Capacity Building Initiatives: Capacity building initiatives will be organized to enhance the skills and knowledge of stakeholders involved in the implementation of the Action Plan. Training sessions, workshops, and seminars will be conducted to equip stakeholders with the tools and resources needed to effectively contribute to the Action Plan.

Monitoring and Evaluation Framework: A monitoring and evaluation framework will be established to assess the progress and impact of the Action Plan. This framework will involve regular reporting, data collection, and analysis to inform decision-making



and ensure accountability. Stakeholders will be engaged in the evaluation process to gather diverse perspectives and insights.

Feedback Mechanisms: Feedback mechanisms will be integrated into the governance structure to ensure that stakeholders can provide input on the implementation of actions. Surveys, focus groups, and public consultations will be conducted to gather feedback and inform adjustments to the Action Plan as needed.

The governance structure for the Action Plan is designed to ensure effective oversight, stakeholder engagement, and accountability in the implementation of actions. By establishing clear ownership, delineating roles and responsibilities, and fostering collaboration among stakeholders, the governance framework will facilitate the successful execution of the Action Plan. This structured approach will not only enhance the effectiveness of actions but also promote a sense of shared ownership and commitment among stakeholders, ultimately contributing to the sustainability and resilience of the EcoSite.

Through ongoing engagement, capacity building, and adaptive management, the governance structure will support the continuous improvement of the Action Plan, ensuring that it remains responsive to the evolving needs of the community and the environment.

8. Conclusion

Wrap-Up and the Role of the Action Plan in Overcoming Non-Technological Barriers to Upscale Symbiosis in the EcoSite.

The path to sustainable development in the EcoSite faces significant non-technological barriers that hinder symbiotic practices. This Action Plan is designed to tackle these challenges through collaboration among local authorities, industries, and stakeholders.

Key Elements Summary:





1. **Identification of Barriers:** The Action Plan identifies key non-technological barriers, including governance issues, financial constraints, policy challenges, skills gaps, social dynamics, and information flow deficiencies, setting the stage for targeted interventions.
2. **Stakeholder Engagement:** Emphasizing stakeholder involvement, the plan outlines strategies for engaging local authorities, industries, and community organizations, fostering ownership and commitment.
3. **Governance Structure:** A proposed governance framework, including a lead agency and steering committee, ensures effective oversight and coordination, promoting accountability and transparency.
4. **Capacity Building:** The plan includes initiatives for training and capacity building to equip stakeholders with the necessary skills to implement symbiotic practices effectively.
5. **Monitoring and Evaluation:** A robust framework for monitoring and evaluation allows stakeholders to track progress, identify improvements, and adapt the Action Plan as needed.

Action Plan's Role in Addressing Barriers:

The Action Plan serves as a comprehensive framework to overcome non-technological barriers. It addresses organizational challenges by establishing clear governance structures and promoting collaboration among stakeholders. By involving local authorities and adopting a multi-stakeholder approach, the plan enhances legitimacy and trust.

To tackle financial constraints, the Action Plan identifies funding sources and encourages partnerships between public and private sectors, facilitating the implementation of symbiotic practices.

In summary, the Action Plan is a vital tool for fostering collaboration and addressing barriers, ultimately driving the success of symbiosis in the EcoSite.



Annex I – Workshop on Non-technological Barriers

(~1-2 pages)

- What was the topic of the workshop?
- Who was invited and who has attended the workshop?
- What was the key outcome of the workshop?
- Include the agenda and pictures from the event, as well as the scan of any relevant material produced by participants



ANNEX 3: Action Plan – Danish EcoSite



DANISH ECOSITE **Action Plan to Overcome** **Non-Technological Barriers** **to Implement Industrial-** **Urban Symbiosis**

**Bornholm Energy and Utility, March
2025**

Action Plan to Overcome Non-technological Barriers to implement Industrial-Urban Symbiosis

Task 5.2: Develop a list of actions to overcome non-technological barriers for exploitation of cross-company symbiosis

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1. The EcoSite in a nutshell

The Danish EcoSite is located on the island of Bornholm in the Baltic Sea, in and around the small town of Svaneke. The town has a population of 1,100 people and covers an area of about 6 km². The island of Bornholm is a unique test platform with a solid foundation of data in a secluded energy system, with a large production of renewable energy, up to 1% of all of Denmark.



The EcoSite treats municipal wastewater and organic waste with waste from the brewing industry, and involves the following public and private actors, who are also partners in the SYMSITES project:

BEOF The island's multi-utility company operating the wastewater treatment plant

SVANEKE BRYGHUS (BRYG) A local brewery

FINN HARILD (GARD) A local farmer from Frennegård

BOFA The municipal waste handling company

For the past 16 years, Bornholms Energi & Forsyning has been a pioneer when it comes to analysis, tests, demonstrations and data within future energy and utility technology. The multi-utility company is located at Bornholm and has participated in international innovation projects with a total budget of approximately 161 million EUR.

Svaneke is a small village in the municipality of Bornholm, mainly known for agriculture, pictures town, arts and crafts and its brewing industry. While the brewing

industry produces large volumes of wastewater and solid waste, the large presence of agriculture requires high volumes of water to meet the demand for irrigation.

2. Objectives & scope

The primary objective of this action plan is to address and overcome non- technological barriers that hinder the implementation and scaling up of wastewater reuse practices on Bornholm. These barriers include regulatory, administrative, logistical, economic, and social challenges that must be resolved to facilitate the successful adoption of water reuse systems. By focusing on these non-technological barriers, the plan aims to create a supportive environment for pilot projects and their subsequent upscale, ensuring alignment with regional and national strategies for sustainable water management.

This report assumes that the wastewater regulation EU 741/2020, which sets minimum requirements for water reuse, will be adopted by Denmark. The Ministry of the Environment has stated in September 2021 that the regulation will be adopted, but has at the time of writing not yet started the implementation work. This regulation aims to ensure the safety of reclaimed water for agricultural irrigation, encouraging water reuse practices across the EU.

The action plan is based on the outcome of a workshop held on March 20th at Bornholm. The workshop is described thoroughly in the appendix.

3. Status quo & local context

Overview of Bornholm's industrial and urban sectors

Industrial Sectors

Fishing: Historically, fishing has been a cornerstone of Bornholm's economy, significantly contributing to local livelihoods. However, the fishing industry has declined drastically. Processing has moved to countries with cheaper labor, and the fishing biomass is in poor condition, resulting in very small fishing quotas **Agriculture:** The agricultural sector includes both crops farming and animals, primarily cows and pigs. In terms of wastewater resource reuse, sludge is reused in the farming industry, thereby recirculating phosphorus and nitrogen. While no wastewater is reused for farming on Bornholm, a handful of farmers have permission to use groundwater and surface water, primarily for irrigation of potatoes.

Tourism: As the largest source of income, tourism attracts visitors to Bornholm's scenic landscapes and rich cultural heritage. This sector provides substantial employment opportunities and supports local businesses such as restaurants, hotels, and retail shops.

Arts and Crafts: In recent years, there has been a notable rise in arts and crafts, adding to the island's cultural and economic diversity.

Innovative Projects: Bornholm serves as a test platform for renewable energy projects, including wind and solar power, positioning the island at the forefront of sustainable innovation.

Sustainability Goals: The island is committed to becoming a leader in sustainable energy and waste management, aligning with broader environmental objectives.

Urban Sectors

Population: Bornholm is home to approximately 39,000 residents, comprising a mix of urban and rural communities.

Key Towns: The island's key towns include Rønne (the largest town and administrative center), Nexø, Hasle, Aakirkeby, and Svaneke.

Resource Management: There is a strong focus on circular economy practices, including recycling and waste reduction, to promote sustainability.

Utilities

Waste Management: Bornholm has implemented advanced waste management systems, aiming for a zero-waste future through innovative circular economy initiatives that recycle and reuse materials.

Energy Production: The island boasts high renewable energy production, contributing significantly to Denmark's overall energy mix. This includes wind and solar power projects that enhance energy sustainability. In the future, Bornholm could become an energy hub due to the plans of establishing a wind turbine park south of Bornhol and a AC/DC transformer station on land. Read more at [Energy Island Bornholm](#).

Agriculture: While this sector remain significant, it is gradually shifting towards more sustainable practices to ensure environmental and economic resilience. This transition is supported by initiatives like Grøn Trepert, which aims to transform Denmark's agricultural landscape through sustainable land use (conversion of 10- 15% of the land to forest), reduced greenhouse gas emissions, and enhanced biodiversity.

4. Existing Strategies on Bornholm

1. Bright Green Island Strategy

Vision: Transform Bornholm into a green, sustainable, and carbon-neutral island by 2025.

Goals: Includes eight goals developed with input from local residents, businesses, and politicians, focusing on sustainability, climate action, and green energy.

2. Bornholm Shows the Way – Without Waste 2032

Objective: Achieve zero waste by 2032 through comprehensive recycling and reuse initiatives.

Implementation: Involves innovative waste management practices, reducing reliance on incineration, and promoting circular economy principles.

5. Key local stakeholders

Bornholm Regional Municipality:

Role: Governs the entire island, managing public services, regional development, and implementing sustainability strategies.

Bornholms Energi & Forsyning:

Role: Multi-utility company involved in energy production, waste management, and water supply. Participates in international innovation projects.

BOFA (Bornholm's Waste Management Company):

Role: Manages waste collection, recycling, and education on sustainable practices. Key player in the zero-waste initiative.

6. Identification and Actions to Overcome Non-Technological Barriers

The non-technical barriers listed below are based on the outcomes of the workshop. This list also includes technical barriers, as it was challenging to envision a future with wastewater reuse without discussing these pivotal factors for realizing wastewater reuse.

A1: Bundling Applications

Barrier Addressed: Long processing times for environmental permits.

Stakeholders to be Involved: Municipality, farming industry.

Time for Implementation: Short-term (1-3 years). Expected

Outputs & Outcome(s):

- Streamlined Application Process: By bundling multiple permits together, the administrative burden is reduced, and the process becomes more efficient.
- Reduced Administrative Burden: Municipal staff can handle applications more effectively, leading to faster approval times.
- Faster Approval Times: Farmers and other stakeholders receive permits more quickly, enabling timely implementation of water reuse projects.
- Example: A farmer applying for a permit to create a basin also submits an application for irrigation use. Both permits are processed simultaneously, reducing wait times.

A2: Joint trenching

Barrier Addressed: Infrastructure needs for water reuse.

Stakeholders to be Involved: Municipality, BEOF.

Time for Implementation: Long-term Expected

Outputs & Outcome(s):

- Efficient Infrastructure Development: Integrating water reuse piping during other infrastructure projects avoids redundant work and ensures future readiness.
- Cost Savings: Combining projects reduces overall costs and maximizes resource utilization.
- Future Readiness: Long-term planning ensures that the infrastructure is prepared for future water reuse needs.
- Example: When laying down new sewage pipes, additional piping for reclaimed water is installed simultaneously, preparing for future water reuse.

A3: Reclaimed Water Storage

Barrier Addressed: Storage and distribution of reclaimed water. Stakeholders to be Involved: Farming industry.

Time for Implementation: Medium-Long term (5-15 years).

Expected Outputs & Outcome(s):

- Effective Water Storage Solutions: Utilizing natural features like sand quarries and clay-rich areas for water storage enhances water retention.
- Utilization of Natural Features: Leveraging existing landscapes reduces the need for artificial storage solutions.
- Enhanced Water Retention: Natural storage areas are better suited for holding water, ensuring a reliable supply for agricultural use.

- Example: A local farmer uses an abandoned sand quarry to store reclaimed water, taking advantage of its natural water-holding properties.

A4: Alternative Uses for Reservoirs

Barrier Addressed: Limited uses for reclaimed water for irrigation during October-March and in years with enough precipitation during spring/summer.

Stakeholders to be Involved: Farming industry.

Time for Implementation: Medium-Long term (5-15 years).

Expected Outputs & Outcome(s):

- Diversified Use of Reclaimed Water: Using reservoirs for growing algae, plants for protein extraction, or animal feed supports sustainable agricultural practices.
- Sustainable Agricultural Practices: Expanding the use of reclaimed water reduces reliance on potable water and promotes resource efficiency.
- Economic Benefits: Alternative uses can generate additional income for farmers and contribute to the local economy.
- Example: A farmer uses reclaimed water reservoirs to cultivate algae, which is then processed into animal feed, creating a new revenue stream.

A5: Incorporating Biodiversity

Barrier Addressed: Environmental impact of water reuse projects.

Stakeholders to be Involved: Environmental agencies, farming industry. Time for Implementation: Medium-term (2-3 years).

Expected Outputs & Outcome(s):

- Support for Local Ecosystems: Designing water basins to include habitats for local wildlife enhances biodiversity.
- Enhanced Biodiversity: Water reuse projects that support local ecosystems contribute to environmental sustainability.
- Positive Environmental Impact: Incorporating biodiversity considerations ensures that water reuse projects have minimal negative impact on the environment.
- Example: A new water basin is designed with shallow areas and vegetation to support amphibians and birds, promoting local biodiversity.

A6: Drainage Water Reuse

Barrier Addressed: Regulatory barriers to water reuse.

Stakeholders to be Involved: Farmers, regulatory bodies.

Time for Implementation: Medium-term (2-3 years).

Expected Outputs & Outcome(s):

- Reduced Nitrogen Loss: Reusing drainage water helps recirculate nitrogen back onto fields, reducing nutrient loss.
- Sustainable Farming Practices: Integrating drainage water reuse supports sustainable agriculture and improves soil health.
- Regulatory Compliance: Obtaining necessary permissions ensures that water reuse practices comply with regulations. Synergies with “Minivådområder” should be explored further.
- Example: A farmer receives permission to collect and reuse drainage water from fields, reducing fertilizer costs and nitrogen loss to the Baltic Sea.

A7: Using Lake/river Water

Barrier Addressed: Legislative restrictions on water sources.

Stakeholders to be Involved: Policy makers, environmental agencies.

Time for Implementation: Long-term (ongoing).

Expected Outputs & Outcome(s):

- Legislative Changes: Advocating for changes in legislation to allow the use of lake/river water for irrigation provides additional water sources.
- Increased Water Sources: Expanding the range of water sources available for irrigation supports agricultural needs.
- Policy Development: Developing guidelines for the sustainable use of lake water ensures environmental protection.
- Example: Local policymakers work to amend regulations, allowing farmers to use lake/river water for irrigation during dry seasons.

A8: Pricing Strategy

Barrier Addressed: Economic barriers to water reuse. Stakeholders

to be Involved: Regulatory bodies, water utilities. Time for

Implementation: Medium-term (2-5 years).

Expected Outputs & Outcome(s):

- Incentivized Use of Reclaimed Water: Implementing pricing strategies that make reclaimed water cheaper encourages its use.
- Conservation of Potable Water Resources: Making drinking water more expensive promotes the use of reclaimed water for non-potable purposes.
- Economic Efficiency: Pricing strategies that reflect the true cost of water use support sustainable resource management.

- Example: A water utility introduces tiered pricing, where reclaimed water is significantly cheaper than potable water, encouraging its use for irrigation and industrial purposes.

A9: Optimal Plant Location

Barrier Addressed: Inefficient location of treatment plants.

Stakeholders to be Involved: Urban planners, municipalities. Time

for Implementation: Long-term (ongoing).

Expected Outputs & Outcome(s):

- Efficient Water Distribution: Locating new wastewater treatment plants near reclaimed water users reduces transportation costs and improves efficiency.
- Reduced Transportation Costs: Strategic placement of treatment plants minimizes the need for long-distance water transport.
- Improved Accessibility: Ensuring treatment plants are accessible to users supports effective water reuse practices.
- Example: A new wastewater treatment plant is built near agricultural fields, reducing the need for extensive piping and transportation of reclaimed water.

A10: Pollutant Assessment

Barrier Addressed: Health and environmental risks of reclaimed water.

Stakeholders to be Involved: Environmental scientists, regulatory bodies. Time

for Implementation: Medium-term (2-5 years)

Expected Outputs & Outcome(s):

- Safe and Effective Water Reuse: Assessing pollutants in reclaimed water ensures that it meets safety standards for use.
- Compliance with Standards: Identifying and mitigating risks associated with pollutants supports regulatory compliance.
- Environmental Protection: Understanding the impact of pollutants on nature, soil, and humans ensures that water reuse practices are environmentally sustainable.
- Example: Regular testing of reclaimed water for contaminants like heavy metals and pharmaceuticals ensures it is safe for agricultural use.

A11: Treatment Technologies

Barrier Addressed: Technological barriers to water reuse. Stakeholders

to be Involved: Water treatment experts, municipalities. Time for

Implementation: Medium-term (2-3 years).

Expected Outputs & Outcome(s):

- Implementation of Suitable Treatment Technologies: Evaluating and selecting appropriate technologies ensures effective water treatment.
- Improved Water Quality: Advanced treatment technologies enhance the quality of reclaimed water, making it suitable for various uses.
- Technological Innovation: Adopting innovative treatment solutions supports the long-term sustainability of water reuse practices.
- Example: A municipality invests in membrane filtration technology to improve the quality of reclaimed water, making it suitable for irrigation and industrial use.

7. Summary Overview of actions to Overcome Barriers

Description of Activity	Barrier Addressed	Stakeholders to be Involved	Time for Implementation	Expected Outputs & Outcome(s)
A1 Bundling Applications	Long processing times for environmental permits	Municipality, farming industry	Short-term (1-3 years)	Streamlined application process, reduced administrative burden, faster approval times
A2 Joint trenching	Infrastructure needs for water reuse	Municipality, BEOF	Long-term (ongoing)	Efficient infrastructure development, cost savings, future readiness for water reuse systems
A3 Reclaimed Water Storage	Storage and distribution of reclaimed water	Farming industry	Medium-term (2-3 years)	Effective water storage solutions, utilization of natural features, enhanced water retention
A4 Alternative Uses for Reservoirs	Limited uses for reclaimed water	Farming industry	Medium-term (2-3 years)	Diversified use of reclaimed water, sustainable agricultural practices, economic benefits

Description of Activity	Barrier Addressed	Stakeholders to be Involved	Time for Implementation	Expected Outputs & Outcome(s)
A5 Incorporating Biodiversity	Environmental impact of water reuse projects	Environmental agencies, farming industry	Medium-term (2-3 years)	Support for local ecosystems, enhanced biodiversity, positive environmental impact
A6 Drainage Water Reuse	Regulatory barriers to water reuse	Farmers, regulatory bodies	Medium-term (2-3 years).	Reduced nitrogen loss, sustainable farming practices, regulatory compliance
A7 Using Lake Water	Legislative restrictions on water sources	Policy makers, environmental agencies	Long-term (ongoing)	Legislative changes, increased water sources for irrigation, policy development
A8 Pricing Strategy	Economic barriers to water reuse	Regulatory bodies, water utilities	Medium-term (2-3 years)	Incentivized use of reclaimed water, conservation of potable water resources, economic efficiency
A9 Optimal Plant Location	Inefficient location of treatment plants	Urban planners, municipalities	Long-term (ongoing)	Efficient water distribution, reduced transportation costs, improved accessibility
A10 Pollutant Assessment	Health and environmental risks of reclaimed water	Environmental scientists, regulatory bodies	Medium-term (2-5 years)	Safe and effective water reuse, compliance with standards, environmental protection

Description of Activity	Barrier Addressed	Stakeholders to be Involved	Time for Implementation	Expected Outputs & Outcome(s)
A11 Treatment Technologies	Technological barriers to water reuse	Water treatment experts, municipalities	Medium-term (2-3 years)	Implementation of suitable treatment technologies, improved water quality, technological innovation

8. Activity Monitoring and Evaluation

Monitoring the implementation of the Action Plan is essential to ensure progress. Below is a suggestion for a monitoring and evaluation plan.

Key Methodologies

Regular Progress Reviews: Conduct periodic reviews to assess the status of each action plan. This includes checking milestones, timelines, and deliverables.

Stakeholder Feedback: Collect feedback from involved stakeholders (municipalities, farmers, regulatory bodies) to understand their experiences and challenges.

Data Collection and Analysis: Gather quantitative and qualitative data on water reuse practices, infrastructure development, and environmental impact.

Site Inspections: Perform regular site inspections to ensure compliance with standards and evaluate the effectiveness of implemented solutions.

Indicators to be Used

Permit Processing Time: Measure the time taken to process bundled applications compared to individual applications.

Infrastructure Development: Track the progress of infrastructure projects, including the installation of water reuse piping and storage systems.

Water Quality: Monitor the quality of reclaimed water through regular testing for pollutants and contaminants.

Usage Rates: Measure the amount of reclaimed water used for various purposes.

Biodiversity Impact: Assess the impact of water reuse projects on local ecosystems and wildlife.

Cost Savings: Calculate the cost savings achieved through integrated infrastructure projects and efficient water reuse practices.

Consumer Acceptance: Survey consumer willingness to buy food irrigated with reclaimed water.

Reporting Timelines

Monthly Reports: Provide monthly updates on the progress of each action plan, highlighting key achievements and challenges.

Quarterly Reviews: Conduct comprehensive quarterly reviews to evaluate overall progress and make necessary adjustments.

Annual Reports: Prepare detailed annual reports summarizing the outcomes, lessons learned, and recommendations for future actions.

Feedback and Learning Mechanisms

1. **Stakeholder Workshops:** Organize workshops to facilitate knowledge sharing and collaborative problem-solving among stakeholders.
2. **Surveys and Questionnaires:** Use surveys and questionnaires to gather feedback from stakeholders and consumers.
3. **Continuous Improvement:** Implement a continuous improvement process to refine action plans based on feedback and evaluation results.
4. **Public Communication:** Maintain transparent communication with the public to build trust and support for water reuse initiatives.

9. Governance Structure

Ownership of Implementation

The implementation of the Action Plan to overcome barriers to water reuse will be a collaborative effort involving multiple stakeholders. The primary entities responsible for taking ownership of the implementation are:

Municipality of Bornholm: The local government will play a central role in coordinating and overseeing the implementation of the action plan. They will be responsible for regulatory approvals, infrastructure development, and ensuring compliance with local and national policies.

Bornholm Energy and Utility (BEOF): As the multi-utility company operating on the island, BEOF will be instrumental in managing water

treatment, storage, and distribution systems. They will also provide technical expertise and support for infrastructure projects.

Farming Industry: Local farmers and agricultural cooperatives (BLF, VKST) will be key stakeholders in implementing water reuse practices. They will collaborate with the municipality and BEOF to integrate reclaimed water into their operations.

Environmental Agencies: Agencies focused on environmental protection and biodiversity will ensure that water reuse projects are sustainable and have minimal negative impact on local ecosystems.

Ministry of the Environment: The national ministry will provide regulatory oversight, support policy development, and ensure alignment with national environmental goals.

DANVA: The Danish Water and Wastewater Association (DANVA) will offer expertise in water management, support best practices, and facilitate collaboration among water utilities.

Governance Structure

The governance structure needed to oversee the actions will include the following components:

1. **Steering Committee:** A steering committee will be established to provide strategic direction and oversight for the implementation of the action plan. The committee will include representatives from the municipality, BEOF, farming industry, environmental agencies, Ministry of the Environment, and DANVA.
 - **Responsibilities:** Setting priorities, approving project plans, monitoring progress, and making high-level decisions.
 - **Meetings:** Quarterly meetings to review progress, address challenges, and adjust strategies as needed.
2. **Project Management Team:** A dedicated project management team will be responsible for the day-to-day management and coordination of the action plan. This team will include project managers, technical experts, and administrative staff.
 - **Responsibilities:** Implementing action plans, coordinating with stakeholders, managing resources, and ensuring timely completion of tasks.
 - **Reporting:** Monthly progress reports to the steering committee and other stakeholders.
3. **Stakeholder Working Groups:** Working groups will be formed to focus on specific aspects of the action plan, such as infrastructure development,

regulatory compliance, and public engagement. Each working group will include relevant stakeholders and subject matter experts.

- **Responsibilities:** Developing detailed project plans, conducting research, and providing recommendations to the project management team.
 - **Meetings:** Regular meetings (monthly or bi-monthly) to discuss progress and collaborate on tasks.
4. **Public Engagement and Communication:** A communication strategy will be developed to keep the public informed and engaged throughout the implementation process. This will include public meetings, newsletters, and online updates.
- **Responsibilities:** Ensuring transparency, building public support, and addressing any concerns or feedback from the community.
5. **Monitoring and Evaluation Committee:** A separate committee will be established to monitor and evaluate the progress and impact of the action plan. This committee will include independent experts and representatives from key stakeholder groups.
- **Responsibilities:** Conducting regular evaluations, analyzing data, and providing feedback to the steering committee and project management team.
 - **Reporting:** Annual evaluation reports with recommendations for improvements.

Collaboration and Coordination

Effective collaboration and coordination among stakeholders are crucial for the success of the action plan. The following mechanisms will be put in place to facilitate collaboration:

1. **Regular Stakeholder Meetings:** Regular meetings will be held to ensure ongoing communication and collaboration among all stakeholders.
2. **Shared Information Platforms:** Online platforms will be used to share information, documents, and updates, ensuring that all stakeholders have access to the latest information.
3. **Joint Training and Workshops:** Training sessions and workshops will be organized to build capacity and ensure that all stakeholders are equipped with the necessary knowledge and skills.

10. Conclusion

This action plan addresses barriers to water reuse on Bornholm by involving key stakeholders such as the Municipality of Bornholm, BEOF, farmers and farmers association. Key actions include streamlining permit processes, integrating water reuse infrastructure, utilizing natural storage features, diversifying water uses, supporting biodiversity, reusing drainage water, advocating for legislative changes, implementing pricing strategies, optimizing treatment plant locations, ensuring water safety, and adopting advanced treatment technologies.

Monitoring involves regular reviews, stakeholder feedback, data analysis, and site inspections, with key indicators like permit times, infrastructure progress, and water quality. The governance structure includes a steering committee, project management team, stakeholder working groups, public engagement strategies, and a monitoring and evaluation committee.

This collaborative effort aims to achieve sustainable and efficient water management practices, providing significant environmental, economic, and social benefits for Bornholm.

11. Future perspectives

The successful implementation of this action plan depends on several key factors. Securing adequate resources, including financial investments and technological advancements, is crucial. Political support is essential to drive the plan forward, and continued collaboration with stakeholders is also crucial.

At the time of writing, it has not been decided who will own the action plan, highlighting the need for clear governance and ownership to ensure its success.

Annex I – Workshop on Non-technological Barriers

Invitations

Stakeholders received their invitations via email. If no response was received, they were followed up with a phone call. We were fortunate that one of our team members also operates a farm, which provided a strong entry point for engaging with local farmers and the Bornholm Agriculture and Food (BLF).

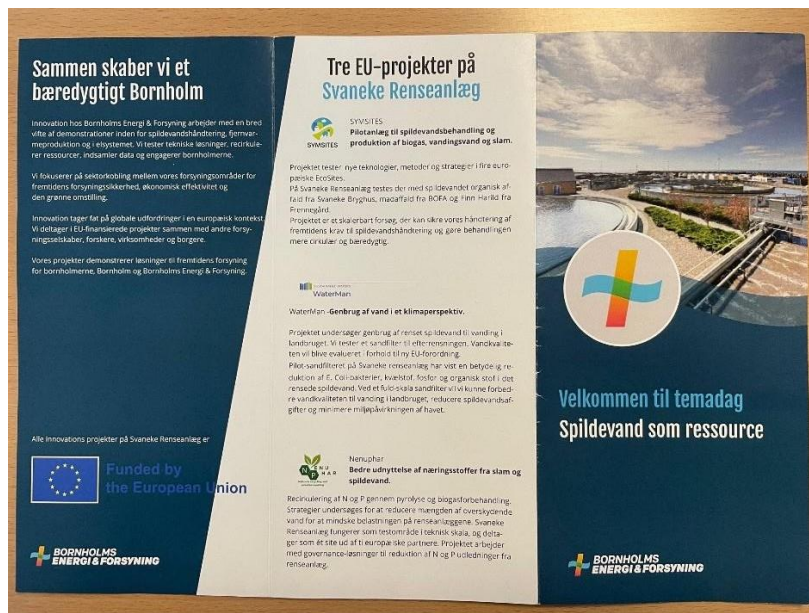
We established contact with the chairman of BLF, who agreed to distribute the invitation to all members of the association across the island. Given our long-standing collaboration with the municipality through various projects, it was natural to reach out to key municipal representatives directly by phone.

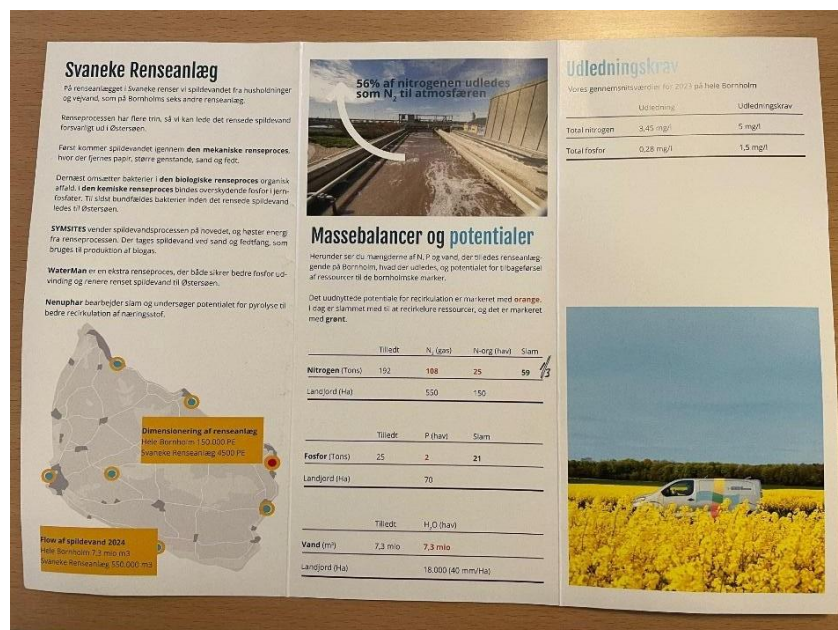
Interested stakeholders were encouraged to provide their direct email addresses and contact details for continued engagement.

Agenda

The workshop took place at two locations. It began with a tour of Svaneke Wastewater Treatment Plant, which features two ongoing pilot plants presented during the thematic day. The workshop was conducted in Danish.

At the start of the tour, participants were handed a flyer. The flyer provided a brief overview of each project, explained the purpose of the development initiatives, and included tables showing the mass balances for N, P, and water in wastewater. It also outlined the emissions and potential if fully utilized.





The theme of the day was: 'Spildevand som ressource' – Wastewater as a Resource.

Agenda:

Time	Activity
15:00 – 15:15	Welcome to Svaneke treatment plant
15:15 – 16:30	Wastewater treatment process at the facility and presentation of the projects on site
16:30 – 16:45	Transport to Møbelfabrikken, Nexø
16:45 – 16:55	Quick summary from Svaneke Rens
16:55 – 18:30	Workshop – Barriers from a Bornholm perspective
18:30 – 19:00	Dinner, networking

Participants

A total of 23 participants confirmed their attendance, with three last-minute cancellations and two no-shows. Ultimately, 18 participants were present at the workshop, distributed as follows:

- Academia (6%) – 1 participant from the research sector.
- Civil Society (11%) – 2 representatives from agricultural organizations.
- Private Sector (72%) – 13 participants, including 7 farmers who are all members of Bornholm's Agricultural Association (BLF), with some also serving on the board.
- Public Sector (11%) – 2 representatives from Bornholm's Regional Municipality.

The strong representation from the private sector, particularly farmers, highlights the agricultural community's vested interest in nutrient recirculation and wastewater reuse. The presence of municipal representatives facilitated discussions on governance and regulatory frameworks, ensuring direct dialogue between farmers and decision-makers.

The thematic day began with a guided tour at Svaneke Wastewater Treatment Plant, where participants had the opportunity to see firsthand how wastewater is processed and discuss the potential for nutrient recovery and water reuse.

Following the site visit, participants traveled to Møbelfabrikken, where the workshop was held. Given Bornholm's compact size, the 10-minute transport time was ideal, allowing attendees to settle in with coffee, snacks, and locally produced apple juice while reflecting on the site visit. The session officially resumed with a recap of the key takeaways from Svaneke Wastewater Treatment Plant, setting the stage for a more structured discussion on non-technical challenges in water reuse such as governance and regulations.

The first part of the workshop focused on knowledge-sharing. Participants sat in a semi-circle, allowing for an open and inclusive discussion format. Farmers were encouraged to share their perspectives on the reuse of treated wastewater and the recirculation of nitrogen (N) and phosphorus (P) in agriculture.

The second part of the workshop shifted focus towards development of the action plan. Participants were divided into four groups, each tasked with discussing potential solutions, shared responsibilities, and initial actions needed to overcome the barriers identified. A recurring theme was that farmers were more than willing to use surface water, drainage water and treated wastewater on their fields, but the administrative burden and legal restrictions made it nearly impossible.

The co-design session

The development of this action plan through the workshop was guided by principles from "The Art of Co-Design" by Jeremy Kerr and the method of future backcasting.

The Art of Co-Design emphasizes solving problems through creative collaboration. This approach involves engaging diverse stakeholders in the design process to ensure that solutions are tailored to their needs and contexts. By involving the Municipality of Bornholm, BEOF, the farming industry, we ensured that the action plan was co- created with input from all relevant parties. This collaborative process helped to build consensus, foster innovation, and ensure that the solutions were practical and widely supported.

Future Backcasting is a planning method that starts with defining a desirable future and then works backwards to identify the steps needed to achieve that future. In developing this action plan, we envisioned a future where water reuse is seamlessly integrated into Bornholm's water management practices, contributing to sustainability and resilience. We then worked backwards to identify the barriers that need to be overcome and the actions required to address them. This method allowed us to create a clear roadmap from the present to the desired future, ensuring that each step is aligned with long-term goals.

By combining the principles of co-design with the strategic approach of future backcasting, we developed an action plan that is both visionary and grounded in practical steps. This ensures that the plan is not only ambitious but also achievable, with a clear path to implementation and measurable outcomes.

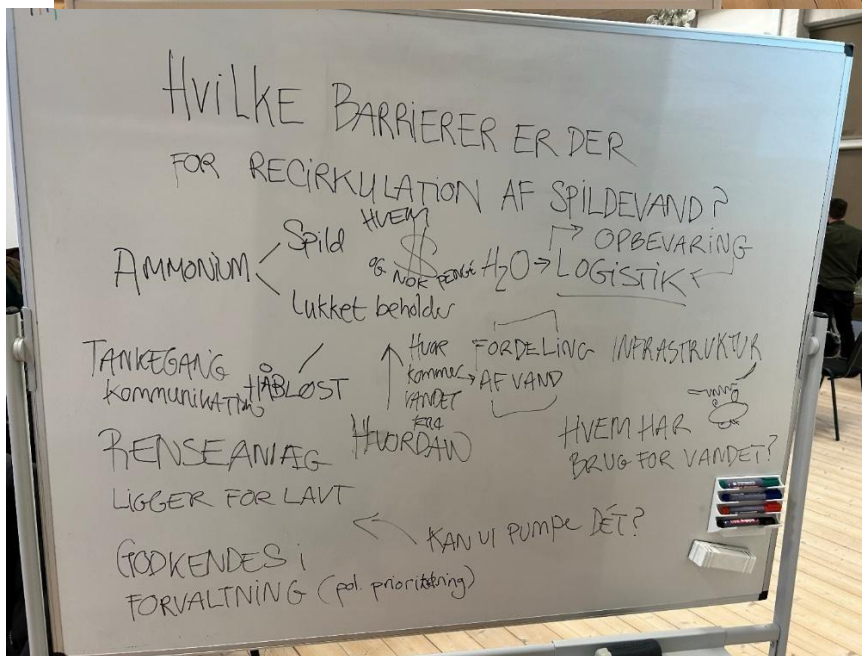
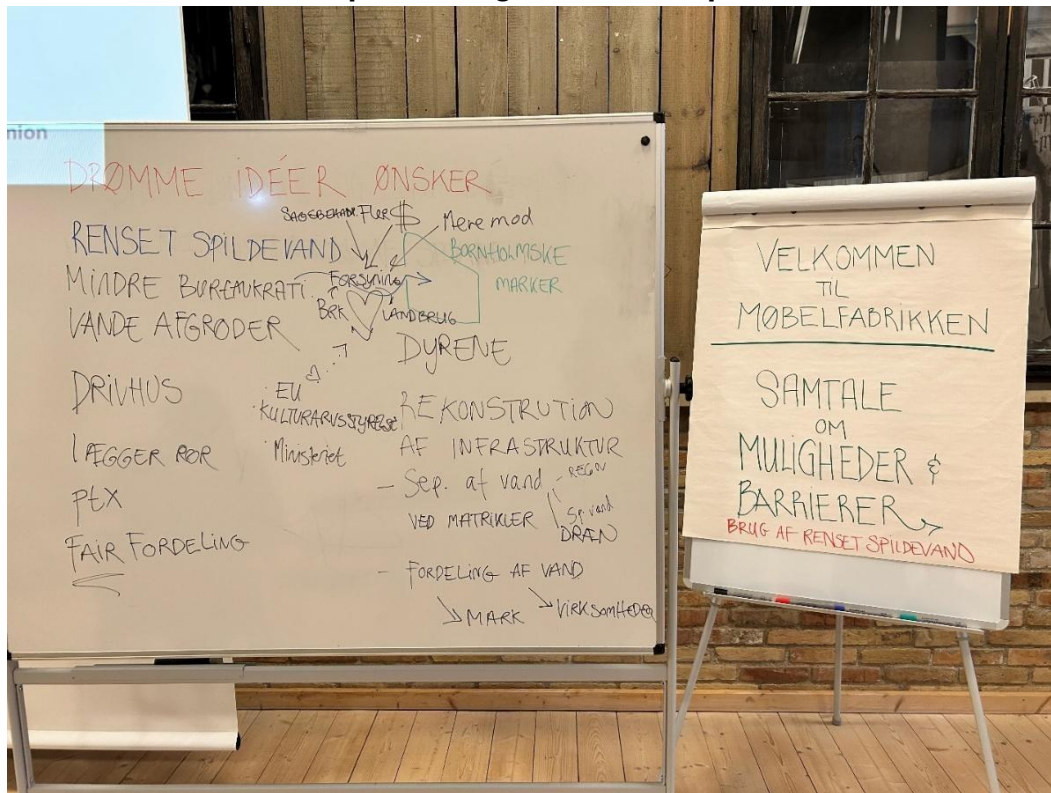
Photos from the workshop

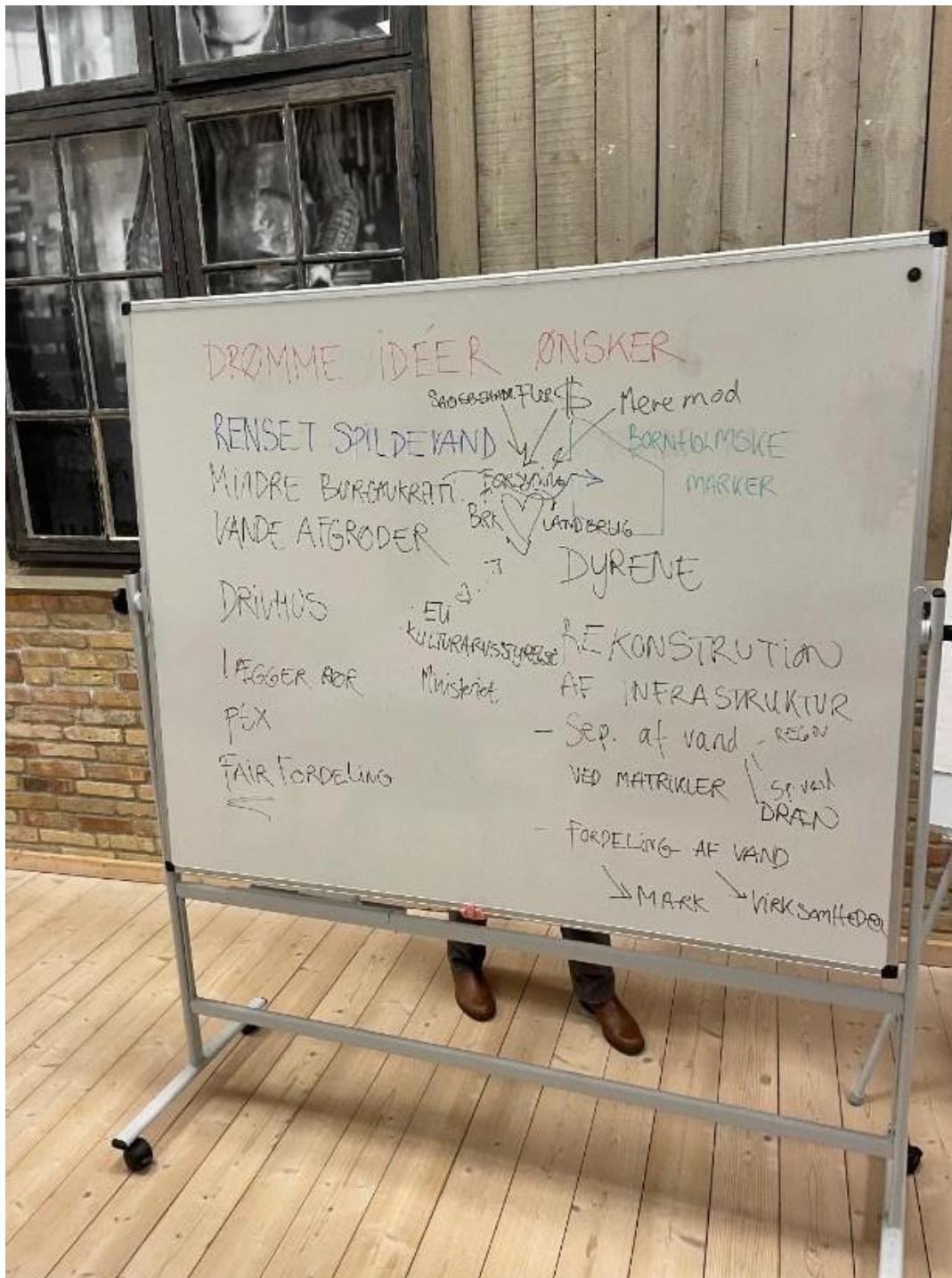






Photos of material developed during the workshop







The invitation for the workshop

Velkommen til temadag om spildevand som ressource



Hvordan renses vi spildevand på Svaneke Renseanlæg? Hvordan er massebalancerne for nitrogen? Og kan man genanvende rensset spildevand på de bornholmske marker?

Vi vil gerne invitere dig til

Temadag d. 20. marts 2025 fra 15:00-19:00

Mødested er Svaneke Rensningsanlæg kl. 15:00, Aarsdalevej 71B, 3740 Svaneke.

Herefter kører vi til Møbelfabrikken, hvor samtalen fortsætter, og der inviteres til lidt mundgodt.

Tilmelding skal ske inden d. 12. marts til dsl@beof.dk af hensyn til forplejning

Vi starter med en rundvisning på Svaneke Renseanlæg. Her vil vi vise dig:

- hvordan vi i Bornholms Energi & Forsyning renses og bortleder bornholmernes spildevand
- hvordan vi arbejder på at udnytte endnu flere af spildevandets ressourcer i fremtiden. Med fokus på at føre nitrogen og fosfor tilbage til de bornholmske marker og tilbageholde vandet for at afbøde tørke om sommeren.

Temadagen afholdes som en del af Bornholms Energi & Forsynings deltagelse i EU-projekterne SYMSITES, WATERMAN og NENUPHAR. I projekterne undersøges nye muligheder for ressourceanvendelse fra rensset spildevand. Det spiller ind i Bornholms Energi & Forsynings fremtidige ambition om at få trukket flere ressourcer ud af det rensede spildevand - til bornholmske afgrøder og for mindre udledning til Østersøen.

Vi glæder os til at se dig,

Med venlig hilsen

Daniel Sereth Larsen, projektleder SYMSITES,

Paulo Martins Silva, projektleder WATERMAN

Jonathan Møller, projektleder NENUPHAR



Signatures of participants



SYMSITES

Temadag om spildevand som ressource den 20. marts 2025

SYMSITES Non-Technological Barrier Workshop Registration Form

Danish Ecosite, March 2025

Per Dam	No show	☐ I agree
Jacob Dam Nielsen	Jacob Dam Nielsen	☒ I agree
Finn Harild	Cancelled	☐ I agree
Jens Hansen	Jens Hansen	☒ I agree
Lærke Lina Skovbjerg	Lærke Lina Skovbjerg	☒ I agree
Kristen Harild	Kristen Harild	☒ I agree
Lennarth Westh	Cancelled	☐ I agree
Kennet Hemmingsen	Kennet Hemmingsen	☒ I agree
Anne Marie Kaas	Anne Marie Kaas	☒ I agree
Mathias Kjærgaard Knudsen	Mathias Kjærgaard Knudsen	☒ I agree
RASMUS BRUNKE	Rasmus Brunke	☒ I agree
Deborah Gerezgher	Deborah Gerezgher	☒ I agree
		☐ I agree
		☐ I agree
		☐ I agree
		☐ I agree

This project has received funding from the European Union's Horizon Europe program under GA Project 101058426.



SYMSITES



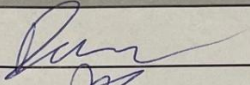
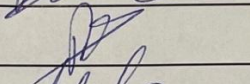
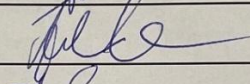
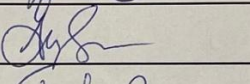
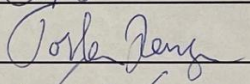
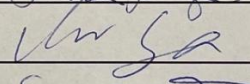
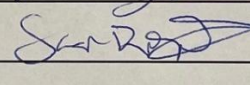
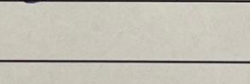
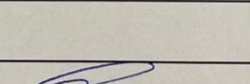
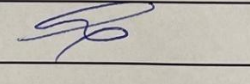
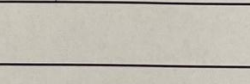
Funded by
the European Union



Temadag om spildevand som ressource den 20. marts 2025

SYMSITES Non-Technological Barrier Workshop Registration Form

Danish Ecosite, March 2025

Name (BLOCK CAPITALS)	Signature	¹ Video consent
Daniel Larsen		☐ I agree
Paulo Silva		☒ I agree
Jonathan Møller		☒ I agree
Anne Mette		☒ I agree
Torben Jørgensen		☒ I agree
Anne Skaarup		☒ I agree
Sara Björkqvist		☒ I agree
Helle Dorethe Thers	 <i>Cancelled</i>	☐ I agree
Michael Brandt-Bernbom	 <i>Cancelled</i>	☐ I agree
Anette Hansen		☒ I agree
Christian Kaare Sommer	 <i>No shade</i>	☐ I agree

¹ By attending the activities taking place during this Workshop, I consent to the recording of images and videos. These recordings can be used for other legitimate purposes as long as it is necessary for the SYMSITES Project, excluding any commercial use. The images/recordings subject to this consent form can be processed (i.e., stored, reproduced, exhibited, adapted, etc.) by the SYMSITES Consortium in the framework of the Project activities, using any kind of current or future media, and by any means known or unknown to date.

This project has received funding from the European Union's Horizon Europe program under GA Project 101058426.



Funded by
the European Union

ANNEX 4: Action Plan – Spanish EcoSite



SPANISH ECOSITE

Action Plan to Overcome Non-Technological Barriers to Implement Industrial- Urban Symbiosis

[FACSA, 2024]

Action Plan to Overcome Non-technological Barriers to implement Industrial-Urban Symbiosis at the Spanish Ecosite

Task 5.2: Develop a list of actions to overcome non-technological barriers for exploitation of cross-company symbiosis

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3.	Status quo & local context.....	4
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1. The EcoSite in a nutshell

The Spanish EcoSite is a pioneering initiative aimed at treating industrial and urban wastewater (WW) from the municipality of Alcoy, along with organic solid waste (BW) from the town of Muro de Alcoy. The primary objectives of this EcoSite are to produce green hydrogen (H_2), high-quality reclaimed water, and high-value-added new resources through the use of innovative technologies such as an anaerobic membrane bioreactor (AnMBR) with magnetic membrane vibration (MMV) and tertiary treatment. The Spanish EcoSite is managed by Sociedad de Fomento Agrícola Castellonense, S.A. (FACSA) and includes a consortium of partners, each bringing their expertise to the project. These partners are the Asociación de Investigación de la Industria Textil (AITEX) which leads the consortium, Fomento Valencia Medioambiente SL (FOVASA), a waste collection company; Katholieke Universiteit Leuven (KUL), which is responsible for the MMV system; Francisco Jover SA (JOV), a textile industry partner; and Germaine De Capuccini SAU (GERM), a cosmetics industry partner.

The pilot plant consists of several main units, including a BW treatment unit, an anaerobic digestion unit, and membrane units. One of the key innovations of the Spanish EcoSite is the use of an AnMBR with MMV. This technology combines anaerobic digestion with membrane filtration, allowing for the efficient treatment of wastewater and the production of biogas. The MMV system enhances the performance of the membranes by reducing fouling and improving filtration efficiency. The reclaimed water produced by the EcoSite can be used for various purposes, including irrigation and industrial processes, thereby reducing the demand for fresh water and

fostering the symbiosis of the area (Figure 1).

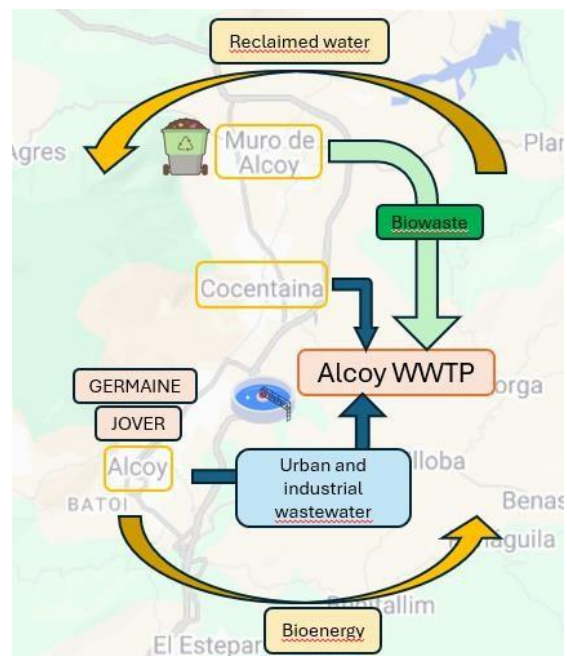


Figure 1. Industrial-Urban symbiosis at the Spanish EcoSite

2. Objectives & scope

The action plan for the Spanish EcoSite within the SYMSITES project is a comprehensive strategy aimed at addressing various aspects of industrial-urban symbiosis (I-US) and enhancing the sustainability of wastewater and organic solid waste treatment.

Scope of the Action Plan: The scope of this action plan is to scale up the pilot project at a regional level, addressing regulatory, financial, and social barriers. The plan builds on existing strategies and aims to further develop these strategies after the project has ended. The system-boundary of this plan is regional, focusing on the municipality of Alcoy and the town of Muro de Alcoy. The primary objectives include:

- **Scaling up the pilot:** The plan aims to scale up the pilot project addressing regulatory barriers by working with local authorities to ensure compliance with environmental regulations. Financial barriers will be tackled by seeking funding and investment opportunities, while social barriers will be addressed through community engagement and awareness campaigns.
 - **Regulatory Compliance (#Barrier 1):** Ensuring that the pilot project complies with all relevant environmental regulations and standards. This involves working closely with local and regional authorities to navigate regulatory requirements and obtain necessary permits.
 - **Financial Sustainability (#Barrier 2):** Securing funding and investment to support the scaling up of the pilot project. This includes exploring various funding sources, such as government grants, private investments, and public-private partnerships.
 - **Community Engagement (#Barrier 3):** Engaging with the local community to raise awareness about the benefits of the project and address any concerns. This involves organizing informational sessions, workshops, and other outreach activities to build community support.
- **Defining standards for symbiotic exchange (#Barrier 4):** The plan also aims to define a method or standard for determining who pays for what in a symbiotic exchange. This involves addressing communication barriers, as well as the lack of established procedures for symbiotic exchanges. By creating clear guidelines and standards, the plan seeks to facilitate smoother and more efficient exchanges between different stakeholders. This includes defining roles and responsibilities, establishing pricing mechanisms, and creating procedures for dispute resolution.

3. Status quo & local context

Alcoy, located in the Valencian Community (Spain), is a historically significant industrial city renowned for its textile and papermaking industries, which grew due to the region's natural resources, especially water from the Serpis River. While these traditional sectors still play a critical role, Alcoy has diversified into manufacturing sectors like plastics, machinery, metallurgy, and renewable energy, supported by infrastructure that blends industrial, commercial, and residential spaces. Although manufacturing remains central, the service sector—particularly tourism, retail, and hospitality—has grown, fostering a balanced urban economy. The city emphasizes sustainability, with initiatives in water conservation, renewable energy, and circular economy practices to reduce waste and resource use, aligning with EU sustainability goals. Alcoy's economic output is largely manufacturing-driven, contributing around 25-30% to the local GDP, with exports like textiles and paper products reaching European markets. The city is focused on industrial modernization and advanced manufacturing, aiming for a resilient economy that honors its industrial legacy while adapting to modern environmental and economic demands.

The key stakeholders in the Spanish EcoSite include industries, local governments, research institutions, the civil society and public entities (Figure 2). Each stakeholder plays a vital role in the project's success:

- **Industries:** The textile and cosmetics industries provide industrial waste streams that are treated at the EcoSite. These industries benefit from the reclaimed water and green hydrogen produced by the EcoSite managed by FACSA, which can be used in their manufacturing processes.
- **Research, Technological Institutions and Universities:** Technological research centers such as AITEX or universities such as UPV drive innovation, provide expertise, and support sustainable growth through research, technology, and workforce development. Their involvement ensures efficient, scalable, and impactful symbiotic exchanges.
- **Local Governments:** The municipalities of the area (*i.e.*, Alcoy and Muro de Alcoy) support the project by providing urban wastewater and facilitating regulatory compliance and contacts with public institutions (*i.e.*, public schools). They also engage with the local community to raise awareness about the benefits of the EcoSite.
- **Regional Public Entities:** Organizations such as EPSAR (Public Entity for Wastewater Treatment) can provide technical expertise and supervise the day-to-day operations of the EcoSite. They ensure that the project meets its objectives and complies with environmental regulations.

Therefore, the Spanish EcoSite represents a collaborative effort between the stakeholders presented in order to enhance symbiosis in the region. By integrating industrial and urban waste streams, the EcoSite maximizes resource recovery and contributes to the circular economy.

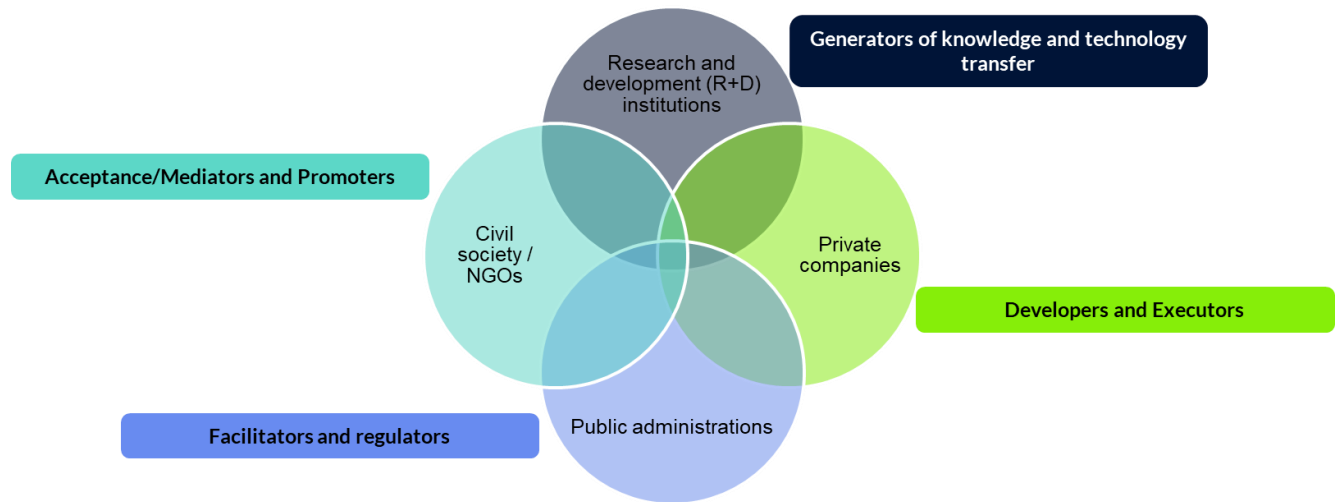


Figure 2. Stakeholders involved in the urban-industrial symbiosis

4. Identification of Non-Technological Barriers

The following section will provide a more in-depth analysis of the barriers mentioned above. Each barrier will be explored in detail to better understand its impact and implications.

Barrier #1

What is the barrier? Is it a broader or specific barrier? The regulatory barrier represents the lack of support and prioritization from the competent authority. This is a broader barrier as it affects multiple aspects of the project implementation.

How is it hindering the implementation or upscaling of the symbiosis at the EcoSite? This lack of support and prioritization hinders the implementation or upscaling of the symbiosis at the EcoSite by delaying decision-making processes, reducing the allocation of necessary resources, and creating uncertainties that can affect the project's progress and stakeholder engagement.

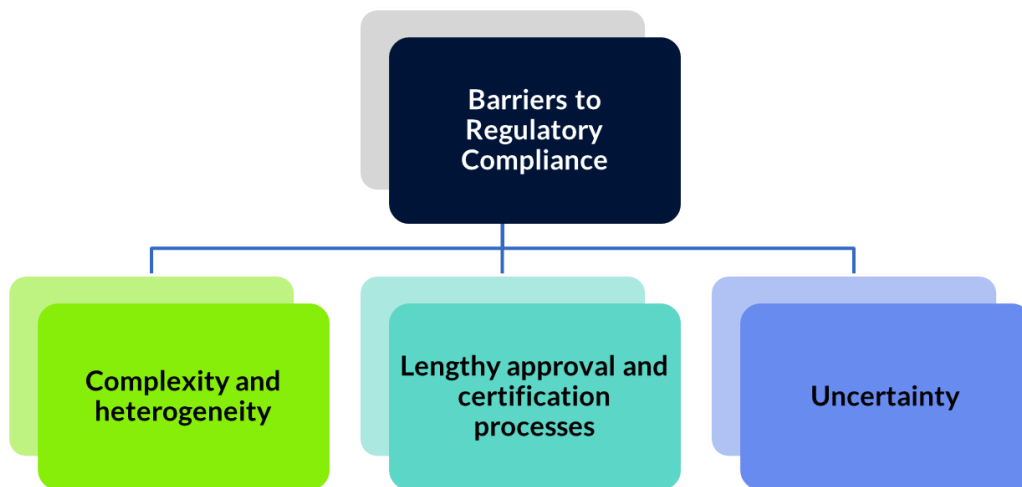


Figure 3. Non-technological barriers associated with the regulatory and compliance barrier

What is the best case / desired outcome to address this barrier? The desired outcome to address this barrier would be to ensure that the technology and products obtained (bioenergy, reclaimed water and sludge) comply with the relevant regulations and have a consistent support

The regulatory framework is particularly relevant considering the products generated in the pilot plant, which are detailed below.

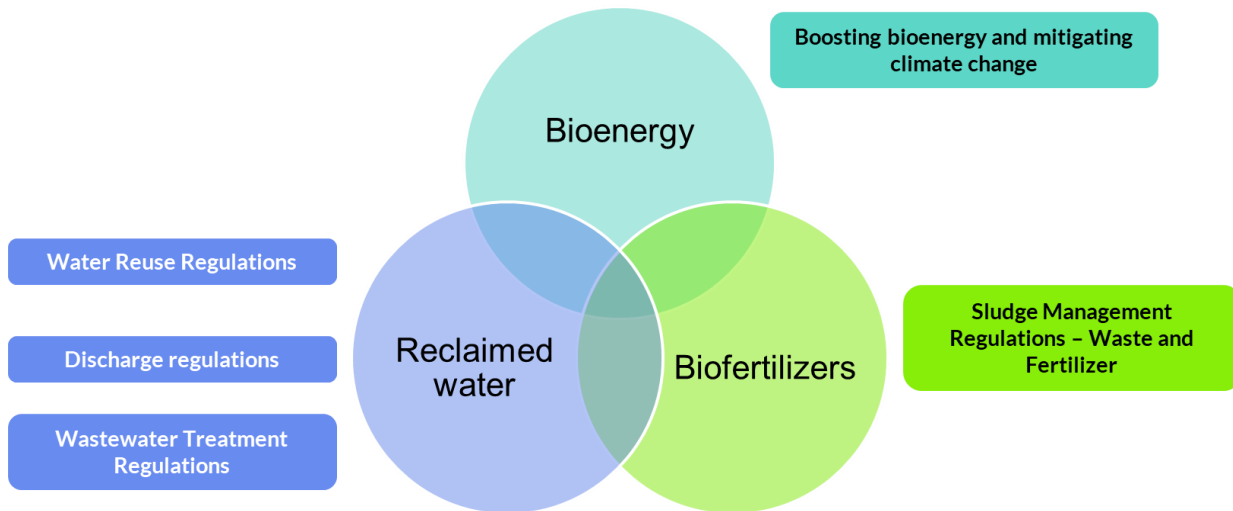


Figure 4. Valuable outputs from the project SYMSITES at the Spanish EcoSite whose regulatory compliance might be challenging

In the case of SYMSITES, regulatory compliance applied to high value-added products obtained at the exit of the process can be one of the most critical aspects. In a context of urban-industrial symbiosis, it is essential to ensure that all our actions are aligned with current regulations. For example, the technology we employ must meet established standards to ensure that products such as reclaimed water, biofertilizers, and bioenergy are safe and viable. In addition, we face challenges related to strict regulations in wastewater treatment and discharges. This regulatory framework, although necessary, can generate barriers in terms of approval times and technological adaptations. That is why, since the beginning of the project, we have been working to ensure that our solutions not only comply with these regulations, but also demonstrate their positive impact on the environment and local communities.

There are various regulations at the European, national, and regional levels aimed at promoting bioenergy and combating climate change. These frameworks align with broader climate action goals, such as reducing greenhouse gas emissions, increasing renewable energy use, and transitioning to a more sustainable energy system. Among these policies, a significant focus is placed on biogas, a key form of bioenergy. Biogas plays a crucial role in decarbonizing sectors like waste management, energy production, and agriculture. Numerous initiatives and funding programs specifically target biogas development, recognizing its potential to provide renewable energy while also addressing organic waste treatment and reducing methane emissions. At our pilot plant, biogas is the primary bioenergy product we generate, and therefore we should be aligned with these policies to contribute to renewable energy solutions and support the transition to a low-carbon economy.

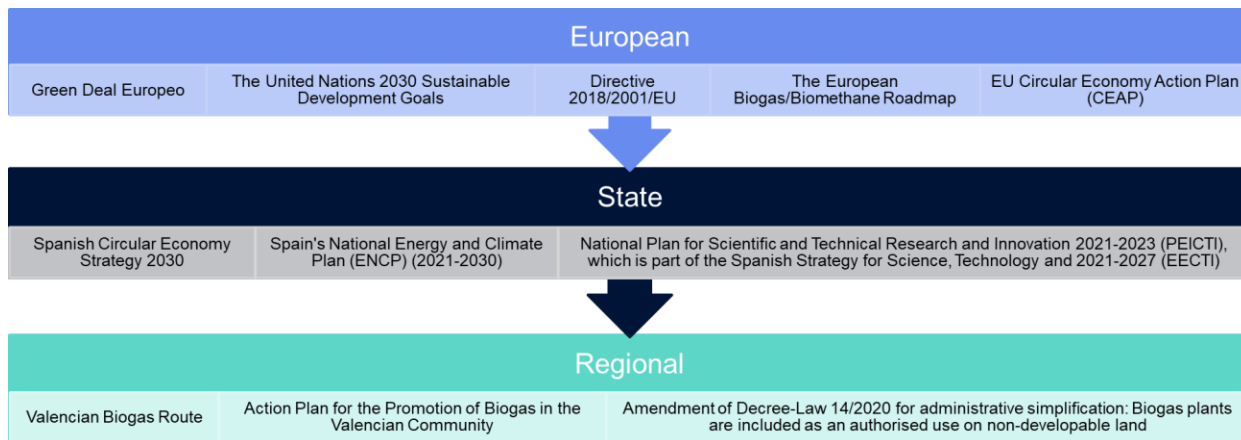


Figure 5. Different regulations promoting biogas at European, National and Regional levels

Similarly, the water sector is governed by regulations at European, national, and regional levels, covering areas such as wastewater, reclaimed water, and discharges into water bodies. These frameworks aim to ensure the sustainable management and quality of water resources. Within the context of our project, discharge regulations are particularly relevant, as they determine the potential uses of treated water. If the treated water cannot be reused, the proposed technology must ensure that the water meets the quality standards required for safe discharge into natural water bodies. This adds an important layer of responsibility for the system, as it must align with stringent environmental guidelines to minimize ecological impact while maximizing the potential for resource recovery and water reuse. These regulations play a critical role in shaping the objectives and technical specifications of the project.

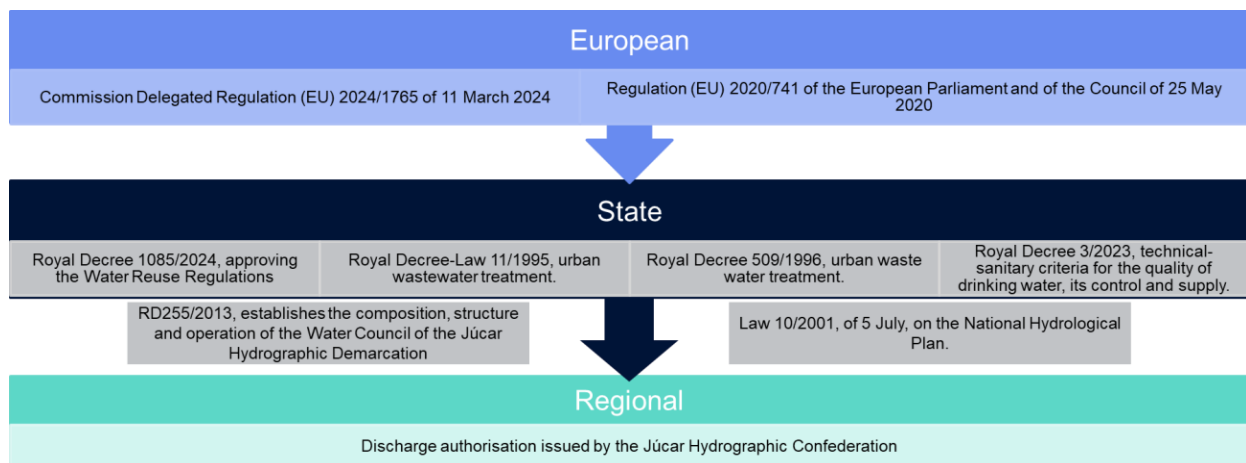


Figure 6. Different regulations for wastewater and water reuse at European, National and Regional levels

The management of sludge, a byproduct of water treatment processes, is also regulated at European, national, and regional levels. These regulations outline the

conditions under which sludge can be safely used or treated. One common application is its use as a fertilizer or soil amendment, leveraging its organic matter and nutrient content to improve soil health and support sustainable agriculture. However, this use is subject to strict guidelines to ensure it does not pose risks to the environment or human health. Alternatively, sludge can be treated as waste, requiring appropriate disposal or further processing methods to comply with environmental standards. These laws are essential for defining the pathways for sludge management, balancing its potential as a valuable resource with the need to minimize its environmental footprint. The project must consider these frameworks to guide the sustainable and compliant handling of sludge.

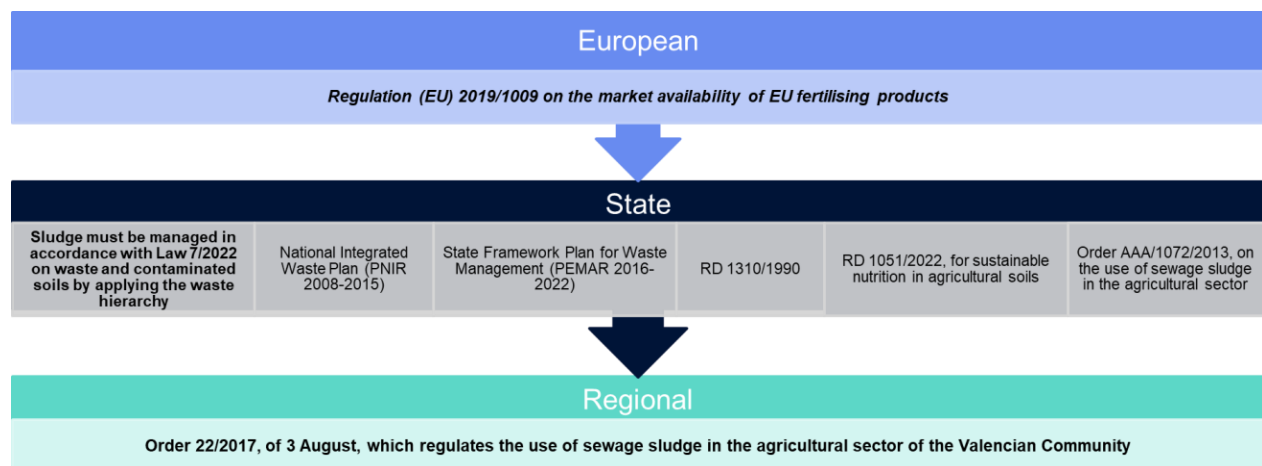


Figure 7. Different regulations for sludge at European, National and Regional levels

Barrier #2

What is the barrier? Is it a broader or specific barrier? The barrier is the lack of funding and investment. This is a broader barrier as it affects the overall financial sustainability of the project.

How is it hindering the implementation or upscaling of the symbiosis at the EcoSite? The lack of funding and investment hinders the implementation or upscaling of the symbiosis at the EcoSite by limiting the resources available for ongoing operations, maintenance, and expansion. This can lead to delays, reduced project scope, and potential failure to achieve the desired outcomes. Additionally, these types of projects require significant investments in land, design, equipment, materials, energy, and staff training. But it's not just the upfront costs: operating expenses such as electricity, chemicals, and maintenance are also a long-term challenge. In addition, risks such as uncertainty in demand for derivatives, rising material or energy costs, regulatory changes and long return on investment periods are faced. Some of the barriers that we can identified are described in the next Figure:

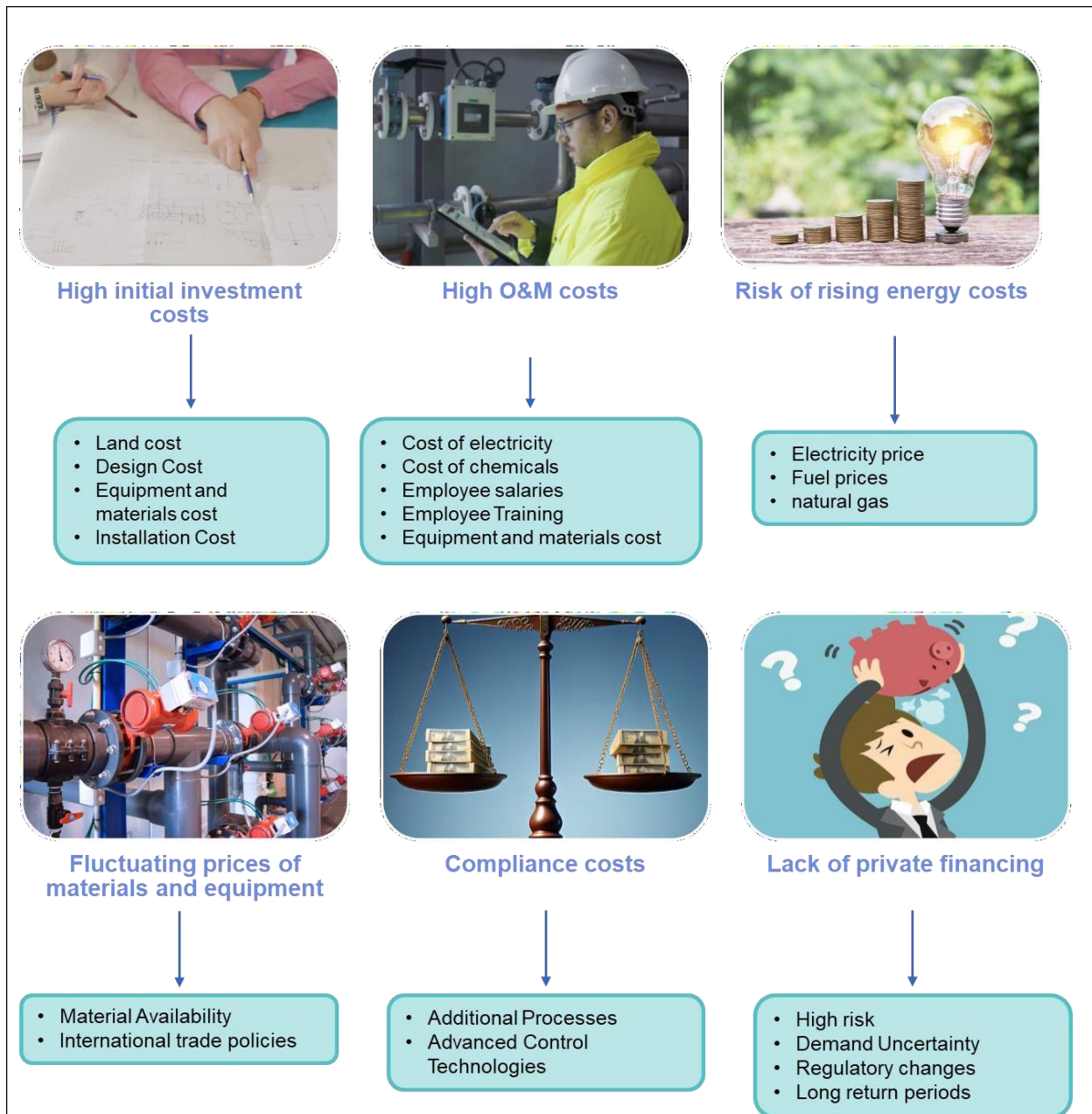


Figure 8. Financial barriers that can be found when up-scaling Symsites

What is the best case / desired outcome to address this barrier? The best case or desired outcome to address this barrier would be to secure stable and long-term funding sources. This could involve attracting private investors, securing government grants, or establishing public-private partnerships to ensure the financial sustainability of the project.

Which stakeholders does it concern and why should these stakeholders be involved to address this barrier? This barrier concerns financial institutions, government agencies, and private investors. These stakeholders should be involved

because they have the resources and influence to provide the necessary funding and investment to support the project's long-term financial sustainability.

Barrier #3

What is the barrier? Is it a broader or specific barrier? The barrier is the lack of community awareness and involvement. This is a broader barrier as it affects the overall acceptance and support of the project by the local community. **How is it hindering the implementation or upscaling of the symbiosis at the EcoSite?** The lack of community awareness and involvement hinders the implementation or upscaling of the symbiosis at the EcoSite by creating resistance to change, reducing participation in project activities, and limiting the overall impact of the project. Without community support, it becomes challenging to achieve the desired outcomes and ensure the long-term sustainability of the project. Some of the communication barriers are described in the next Figure:

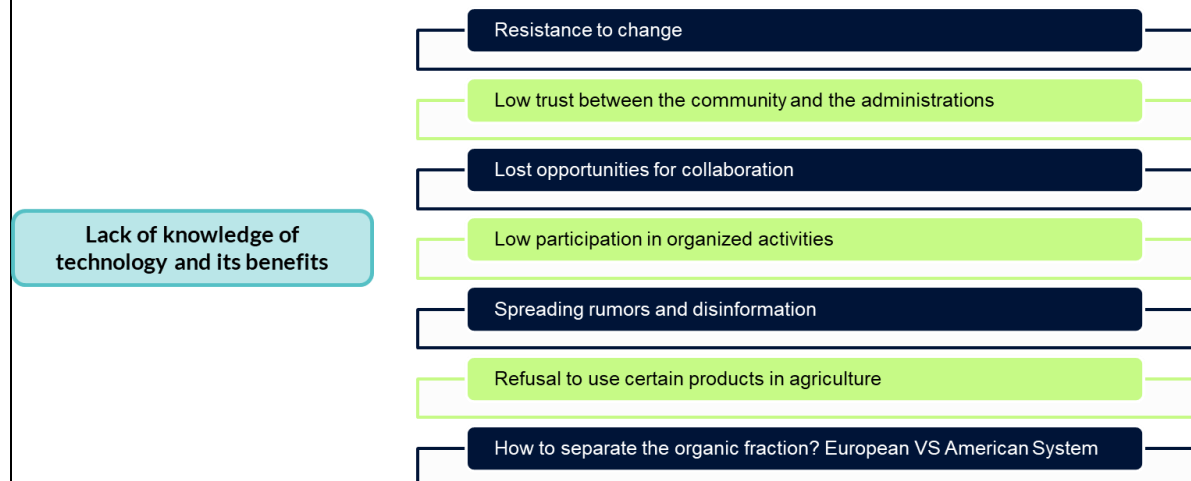


Figure 9. Identified communication barriers

What is the best case / desired outcome to address this barrier? The best case to address this barrier would be to achieve active and informed community participation. This could involve organizing informational sessions, workshops, and other outreach activities to raise awareness about the benefits of the project and address any concerns. Building strong relationships with community members and stakeholders is essential to gain their support and involvement.

Which stakeholders does it concern and why should these stakeholders be involved to address this barrier? This barrier concerns local community members, civil society organizations, private companies, and local authorities. These stakeholders should be involved because they play a crucial role in shaping community perceptions and attitudes towards the project. Their involvement is

essential to ensure that the project receives the necessary support and participation from the community.

Barrier #4

What is the barrier? Is it a broader or specific barrier? The barrier is the lack of established communication channels and formal procedures for facilitating symbiotic exchanges **among stakeholders**.

How is it hindering the implementation or upscaling of the symbiosis at the EcoSite? The absence of clear guidelines and structures makes it challenging to build efficiency among stakeholders. Without formalized procedures, misunderstandings or conflicts can arise, slowing down or limiting the growth of the EcoSite's symbiotic activities. Why does this lack of collaboration exist? Some of the reasons behind are collected in the next Figure:



Figure 10. Barriers influencing basic standards for symbiotic exchange

What is the best case / desired outcome to address this barrier? The ideal outcome is the development of a well-defined framework with standardized communication protocols, clear roles and responsibilities, transparent pricing mechanisms, and effective dispute resolution processes. This would lead to smoother, more efficient exchanges, enabling the EcoSite to expand its symbiotic activities.

Which stakeholders does it concern and why should these stakeholders be involved to address this barrier? This concerns all stakeholders involved in the symbiotic exchanges, including suppliers, service providers, regulatory bodies, and

EcoSite management. Their involvement is essential to ensure that the framework addresses everyone's needs and interests, fosters trust, and promotes collaboration necessary for long-term, scalable symbiosis.

5. Workshop activities

Once a technical description of the project was presented to ensure that all attendees understood the technologies involved, the products generated, and the waste materials, as well as the points where urban-industrial symbiosis was identified, the focus shifted to explaining the non-technological barriers. Following this, a discussion was held to address these barriers, allowing participants to explore and debate the challenges that could impact the project's implementation and success.

The interactive tool used during the session was the Mentimeter platform. The results of the questions and answers gathered through this tool can be viewed at the end of this document.

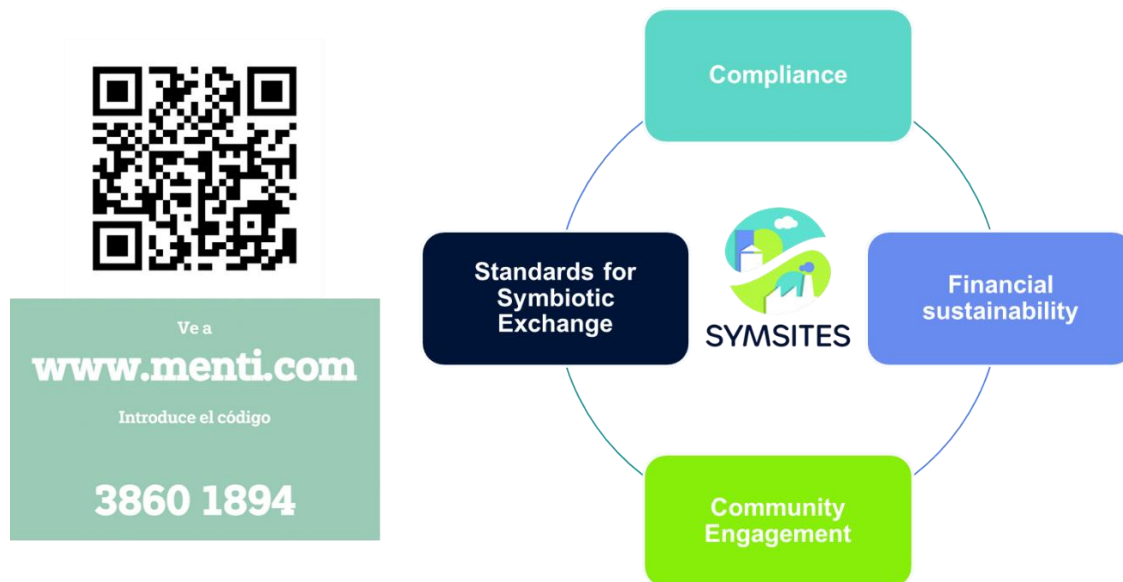


Figure 11. Activity carried out during the workshop to boost debate among the participants (See results at the end of this document)

The workshop was quite innovative, as evidenced by the fact that the majority of the attendees registered in Menti (16 out of 20, representing 80%) had never participated in a similar event before. Participants found the session particularly interesting, primarily because it fostered collaboration among different stakeholders and addressed real-world problems. At the beginning of the session, a preliminary question was posed to gauge participants' initial understanding of the topic and to

identify the barriers they expected to discuss. This approach was instrumental in setting the stage for the day and provided valuable insights into the context of the workshop.

Subsequently, the workshop focused on exploring **regulatory barriers** in greater detail. A comprehensive explanation was provided to outline the most common challenges and their implications for various projects. Participants were then engaged in a discussion via Menti to share their experiences, specifically whether they had encountered any of these barriers in their own work. This interactive approach allowed for a richer understanding of the practical impact of these obstacles. In addition, attendees were asked to prioritize the barriers they believed to be the most significant compared to the ones presented. While the responses varied across the group, certain challenges stood out as the most pressing. The findings revealed that excessive bureaucracy, prolonged approval timelines, and the rigidity of regulatory frameworks were considered the most critical issues hindering progress. This prioritization exercise underscored the widespread nature of these challenges and their significance for the stakeholders involved.

The workshop also addressed **financial barriers**, providing a detailed overview of the common financial challenges faced by stakeholders in similar contexts. Participants were asked if they had personally experienced any of these barriers in their projects, fostering a deeper understanding of the practical difficulties involved. Following this, they were invited to prioritize the financial barriers they deemed most significant based on their own experiences and perspectives. The results of this prioritization exercise revealed clear trends. The most pressing financial barrier, with 26% of the votes, was uncertainty about long-term financial sustainability. This was followed by challenges in accessing public funding, which garnered 22% of the votes. Lastly, the lack of specific programs to support initiatives was identified as a key issue by 17% of the participants. These insights provided a valuable perspective on the financial constraints faced by the attendees, emphasizing the importance of addressing these areas to support future projects.

Similarly, participants were asked about the **communication barriers** they had encountered in their experiences. The discussion highlighted several critical challenges in this area. The most significant issue identified was the low level of trust between the community and administrative bodies, which received 25% of the votes. This was followed by resistance to change, highlighted by 22% of participants, and two equally pressing barriers—lack of knowledge combined with complex technical

language, and the spread of rumors and misinformation—each garnering 19% of the votes. These findings underscore the multifaceted nature of communication challenges, particularly the need to build trust, simplify technical communication, and actively counter misinformation to improve collaboration and engagement.

Finally, participants were asked to consider more practical scenarios, focusing on potential global barriers that might arise even when industrial symbiosis becomes feasible. The responses shed light on significant challenges that could hinder its success. Key issues raised included the lack of genuine willingness to achieve symbiosis, insufficient commitment from stakeholders, and misalignment of objectives and priorities among different parties. The latter emerged as the most critical barrier, receiving 36% of the votes, highlighting the importance of shared goals in collaborative efforts. Additionally, poor information sharing was identified as a significant challenge, accounting for 25% of the votes, followed by the absence of a dedicated figure to facilitate communication, which received 20%. These insights emphasize the need for clear communication channels, aligned priorities, and proactive facilitation to ensure the effective implementation of symbiotic projects on a broader scale.

With these insights in hand, the workshop transitioned into a dynamic debate, paving the way for the development of a comprehensive action plan, which will be detailed in the following section.

6. Actions to Overcome Barriers

Name of the activity	Barrier addressed	Description	Stakeholders to be involved	Time for implementation	Expected outputs & outcome(s)
A1	Compliance with waste regulations	Bottlenecks identification: Compliance with waste regulations imposes strict criteria that must be met, which can delay the adoption of	Regulatory bodies, local governments, industry stakeholders	Medium-term	Regulatory flexibility or amendments supporting innovative technologies and processes

Name of the activity	Barrier addressed	Description	Stakeholders to be involved	Time for implementation	Expected outputs & outcome(s)
		new technologies and processes			
A2		Conduct workshops with regulatory bodies to discuss and align on waste regulations	Regulatory bodies, local governments, industry stakeholders	Short-term	Improved understanding and alignment on waste regulations
A3		Develop a compliance roadmap for waste regulations	Regulatory bodies, local governments, industry stakeholders	Long-term	Clear guidelines and steps for compliance with waste regulations
A4		Secure long-term funding and investment	Financial institutions, government agencies, private investors	Long-term	Stable and long-term funding sources ensuring financial sustainability
A5	Lack of long-term funding and investment	Establish public-private partnerships	Financial institutions, government agencies, private investors	Medium-term	Increased investment and resource allocation for the projects
A6		Apply for government grants and subsidies	Government agencies, private investors	Short-term	Additional funding to support project activities
A7	Lack of community awareness and involvement	Organize informational sessions for the community	Local community members, civil society organizations,	Short-term	Increased community awareness and participation

Name of the activity	Barrier addressed	Description	Stakeholders to be involved	Time for implementation	Expected outputs & outcome(s)
A8		Conduct workshops and outreach activities	local authorities Local community members, civil society organizations, local authorities	Medium-term	Stronger relationships and engagement with the community
A9		Develop and distribute informational materials	Local community members, civil society organizations, local authorities	Short-term	Better informed community members and stakeholders
A10	Symbiotic exchange	Create a figure to connect the stakeholders	All stakeholders involved	Short-term	Increase communication among stakeholders and better definition of roles

7. Activity Monitoring and Evaluation

To effectively monitor the implementation of the Action Plan, it is crucial to establish a comprehensive monitoring framework.

Key Methodologies:

- *Regular Progress Reviews:* Periodic reviews will be set to assess the progress of each activity. This will be done through meetings, reports, and site visits.
- *Data Collection and Analysis:* Data collection methods will be implemented to gather quantitative and qualitative data on the progress and impact of the actions. This can include surveys or interviews.

- *Performance Indicators:* The effectiveness of the actions will be measured using key performance indicators (KPIs) such as completion rates, resource utilization, and cost efficiency.
- *Reporting Timelines:* An annual progress report to provide updates on the status of each activity will be prepared highlighting any issues, and outline the next steps. This report will summarize the achievements, challenges, and lessons learned throughout the year. These reports should be shared with all relevant stakeholders.

Stakeholder Feedback:

Feedback from stakeholders will be collected through surveys, focus groups, and meetings to understand their perspectives and identify areas for improvement.

8. Conclusion

To wrap up, we have discussed various non-technological barriers that can hinder the implementation and upscaling of symbiosis at the EcoSite. These barriers include compliance with waste regulations, lack of long-term funding and investment, and lack of community awareness and involvement. For each barrier, we outlined specific activities, identified the stakeholders involved, and described the expected outcomes. The Action Plan plays a pivotal role in overcoming these barriers by providing a structured approach to address each challenge. By conducting workshops with regulatory bodies, developing compliance roadmaps, and securing long-term funding, the plan ensures that regulatory and financial obstacles are mitigated. Additionally, organizing informational sessions and outreach activities helps to raise community awareness and foster engagement.

Collaboration with local authorities, industries, and other stakeholders is crucial for the success of the Action Plan. Local authorities can provide regulatory support and facilitate the alignment of waste regulations with innovative technologies. Industries can contribute resources and expertise, while community organizations can help in raising awareness and building trust among local residents. By working together, these stakeholders can create a supportive environment that enables the successful implementation and upscaling of symbiosis at the EcoSite.

In summary, the Action Plan not only addresses the specific barriers but also emphasizes the importance of stakeholder collaboration. This collaborative approach ensures that all parties are aligned and committed to the project's success, ultimately leading to a more sustainable and effective symbiosis at the EcoSite.

Annex I – Workshop on Non-technological Barriers

- What was the topic of the workshop?

The topic of the workshop titled 'Non-technological barriers: SYMSITES Project' was to identify and discuss the non-technological barriers that could affect the implementation of the technologies developed in the SYMSITES project on an industrial scale. The workshop aimed to bring together representatives from public administrations, private companies, technology centres, and universities to collaboratively address these barriers. The workshop was carried out in Spanish following the next agenda of the day:



**Barreras no tecnológicas:
Proyecto SYMSITES**

PROGRAMA

09:00 h	Registro
09:15 h	Bienvenida
09:25 h	Breve presentación del proyecto SYMSITES
09:40 h	Presentación de las barreras no tecnológicas que han sido identificadas
10:00 h	Actividad interactiva con los participantes
10:30 h	Pausa café
11:00 h	Debate: Propuesta del plan de acción para hacer frente a las barreras
11:45 h	Desplazamiento a la EDAR de Alcoy
12:10 h	Visita a la planta piloto del proyecto SYMSITES
12:45 h	Cierre de la jornada

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- **Who was invited and who has attended the workshop?**

The workshop on non-technological barriers titled 'Non-technological barriers: SYMSITES Project' was held on November 26th, 2024, in Alcoy (Alicante), specifically at the facilities of AITEX and the WWTP of Alcoy. It was organized by FACSA with the collaboration of FOVASA and AITEX. A list of the signatures of the attendees is facilitate at the end of this report.

- **What was the key outcome of the workshop?**

The key outcome of the workshop on non-technological barriers titled 'Non- technological barriers: SYMSITES Project' was the development of an Action Plan to address the identified barriers. The workshop successfully brought together different stakeholders to collaboratively identify and discuss the non-technological barriers that could affect the implementation of the technologies developed in the SYMSITES project on an industrial scale.

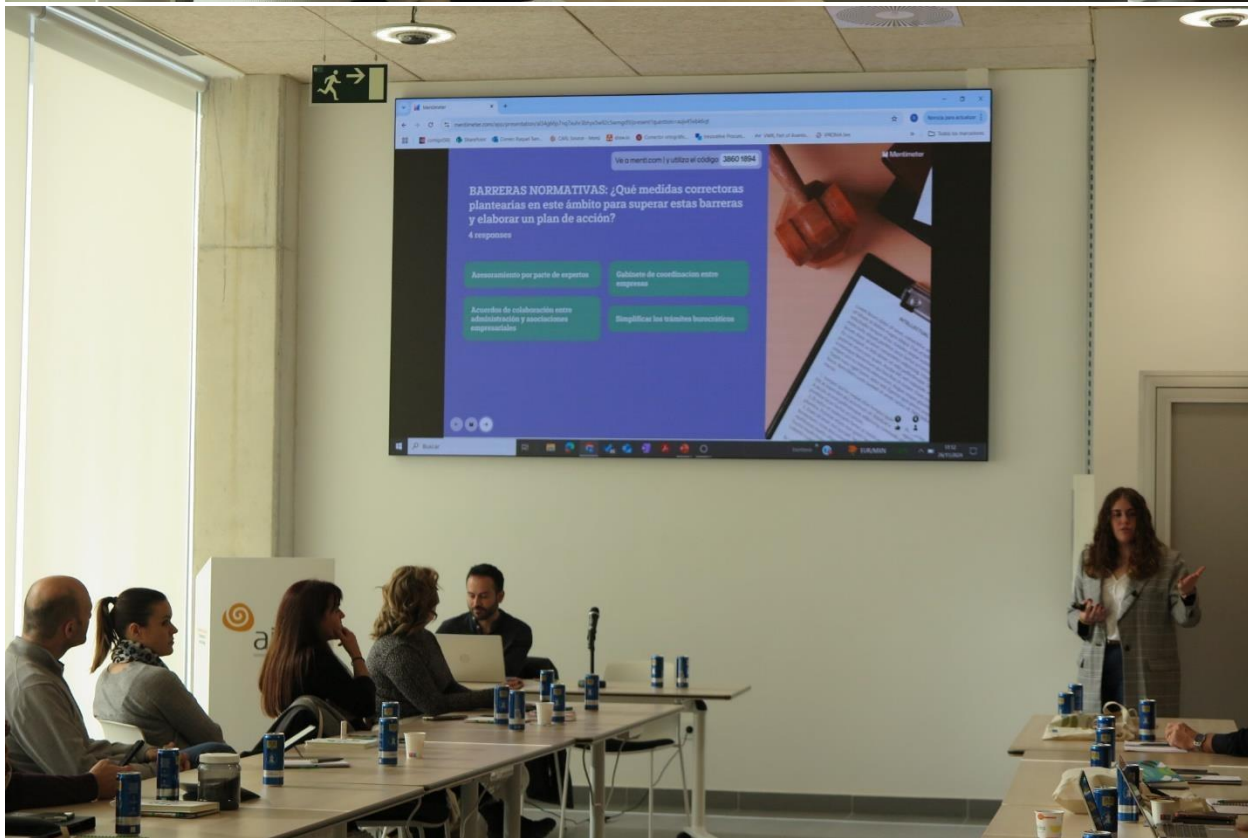
- **Include the agenda and pictures from the event, as well as the scan of any relevant material produced by participants**

The agenda and some pictures of the event are also attached at the end of this report.

Annex II- Pictures of the event









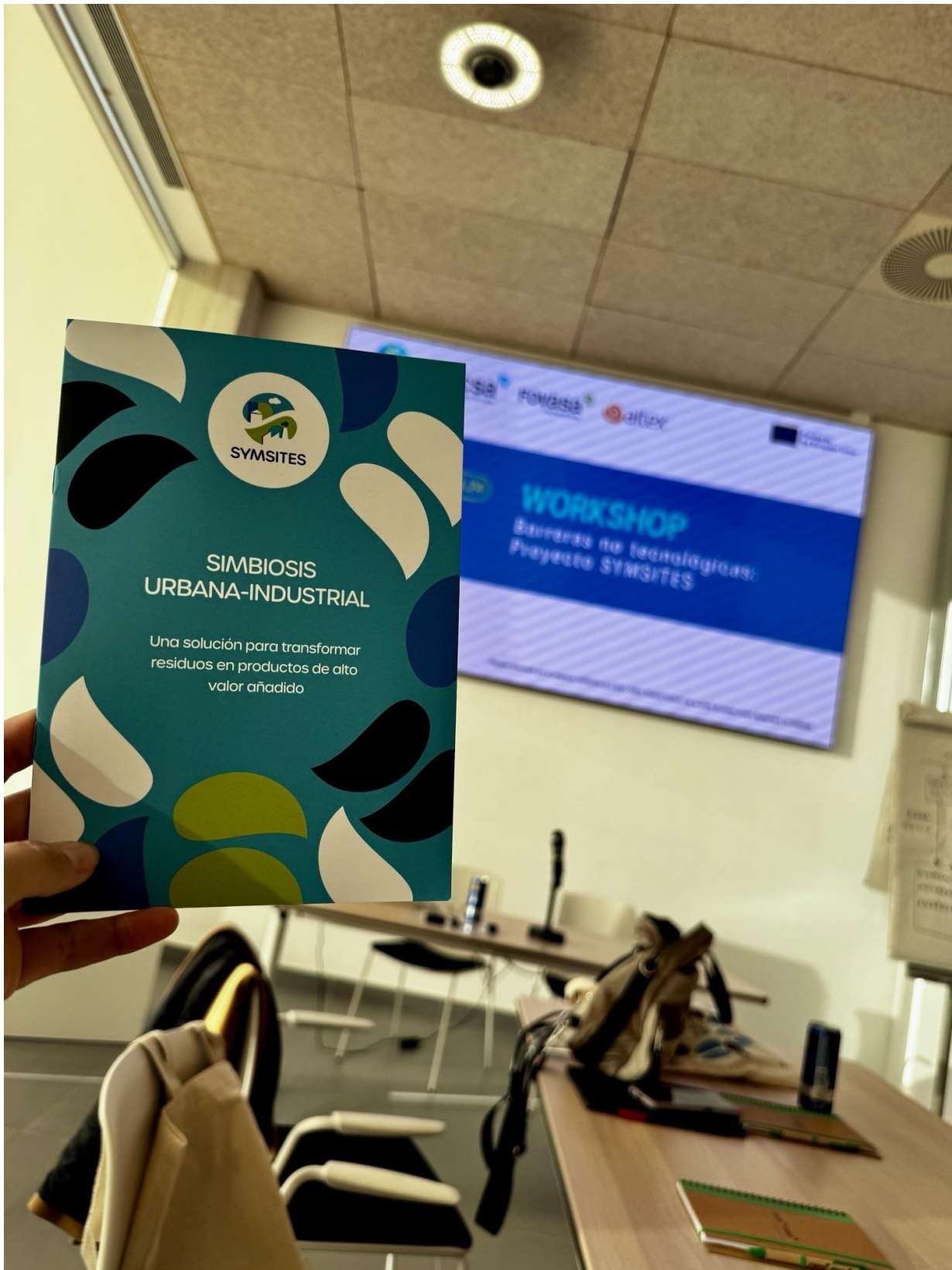
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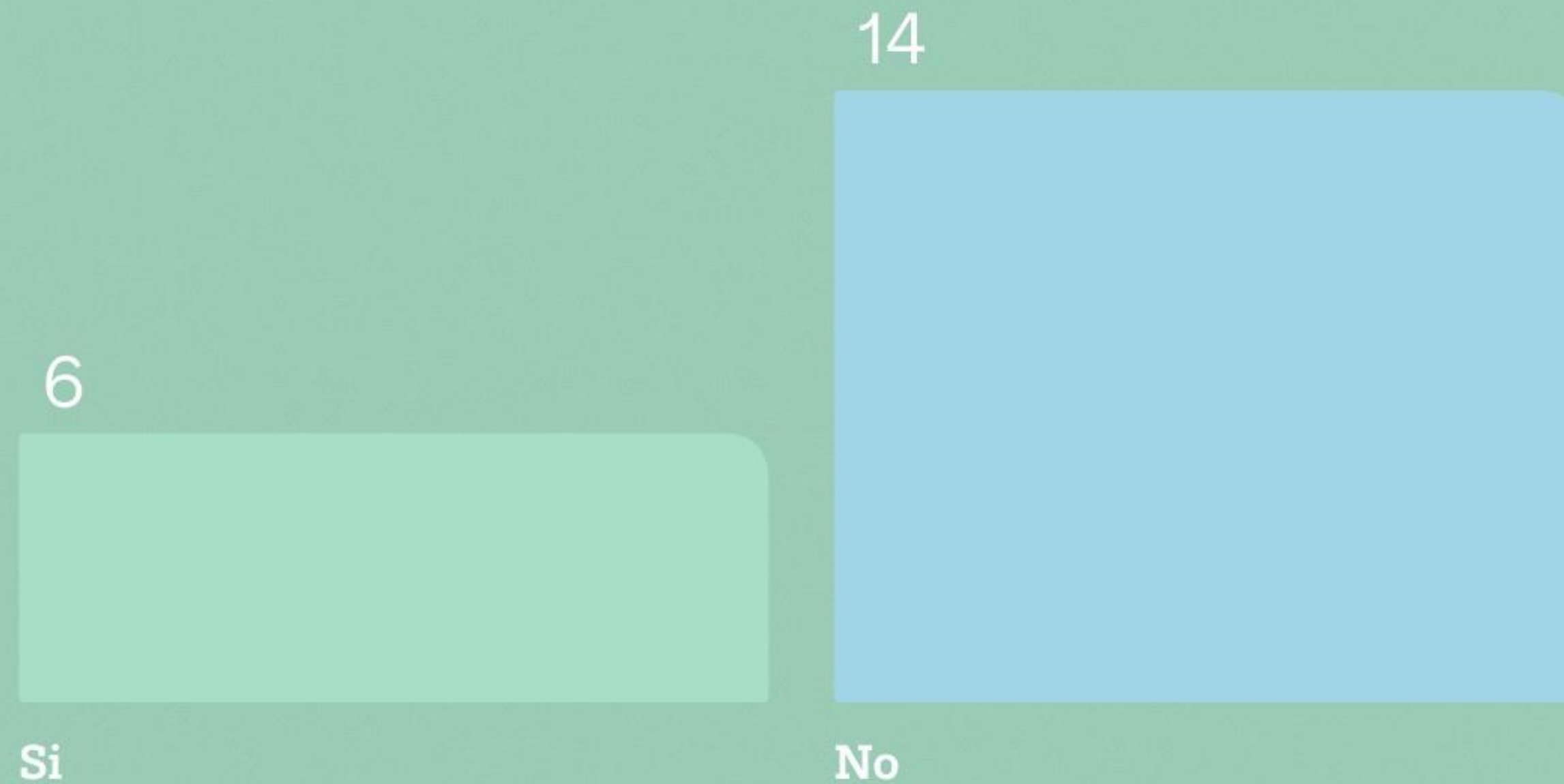


Annex III – Attendees and Menti results

Workshop Barreras - Proyecto Symsites



¿Has participado anteriormente en workshops o eventos que traten sobre barreras no tecnológicas en proyectos de innovación?



¿Qué aspecto te resulta más novedoso o interesante de un workshop enfocado en superar barreras no tecnológicas?



¿Qué barreras no tecnológicas crees que se enfrentarían al implantar SYMSITES a escala real?

Falta de formación

El coste económico de escalarlo

Financera a

Conciencia social

La falta de cooperacion de empresas

Economicas...

Establecer colaboradores público privadas

FINANCIACION

¿Qué barreras no tecnológicas crees que se enfrentarían al implantar SYMSITES a escala real?

Falta de infraestructuras

Los conocimientos técnicos para el correcto funcionamiento de la planta de tratamiento

Falta informacion

Disponibilidad de espacio

Barreras legales para la ejecución

Coste económico

Económica

Robustez de las tecnologías

¿Qué barreras no tecnológicas crees que se enfrentarían al implantar SYMSITES a escala real?

Económico

Legislacion

Burocracia y solicitud
de permisos

Tempos con la
administración

Economico

Los microplasticos se habla
de ellos pero no hay
estandares para su analisis

BARRERAS NORMATIVAS: ¿Os habéis encontrado en alguna ocasión con alguna normativa que os impida avanzar en la implantación de algún proyecto?

Nueva exigencia depuración cuaternaria para cosmética

Normativa de reutilización de agua

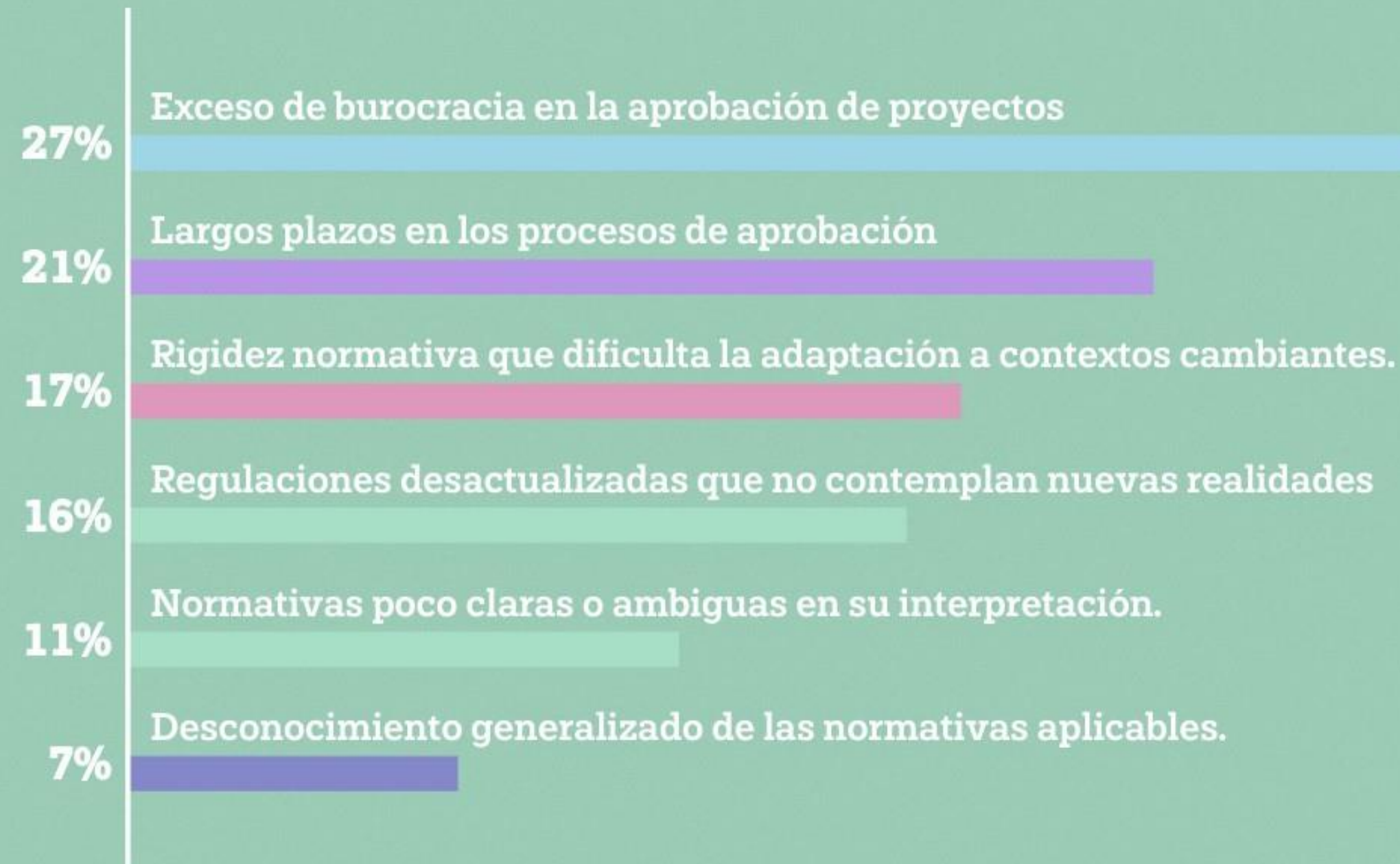
No

La legislación local y regional

Los microplasticos, no hay estandares para su control y analisis

Permisos de la CH y usos del agua

BARRERAS NORMATIVAS: ¿Cuáles consideras las principales barreras normativas no tecnológicas que dificultan el avance de proyectos o cambios?



BARRERAS FINANCIACIÓN: ¿Os habéis encontrado con alguna barrera financiera que os impida avanzar en la implantación de algún proyecto?

Contratacion de personal

Coste del nuevo modelo obtenido

Falta liquidez de la administración

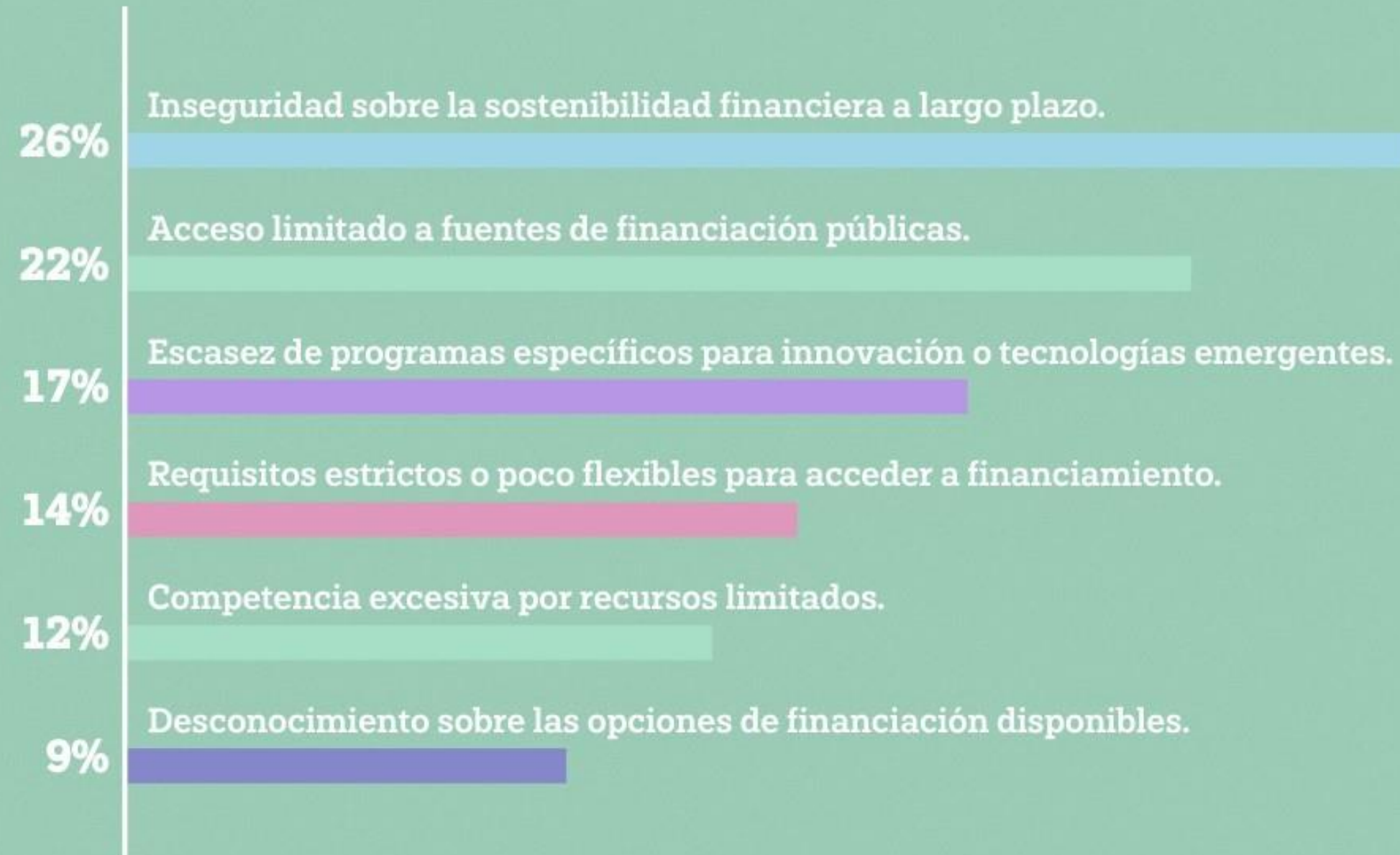
Añadiria los plazo de puesta en funcionamiento. Lia costes relacionados con esto

Las subvenciones son en función de la tipología fel proyecto - hasta que TRL se pretende llegar

Difícil inversión de la empresa privada si los resultados no están contratados.

Derivar personal productivo de procesos diarios, a la investigación o nuevo proyecto

BARRERAS FINANCIACIÓN: ¿Cuáles crees que son las principales barreras de financiación para implementar proyectos como SYMSITES?



BARRERAS COMUNICACIÓN: ¿Cuáles han sido las principales barreras de comunicación que habéis enfrentado durante la implantación de algún proyecto?

Desconocimiento del propósito y beneficio del proyecto.

Los mensajes desde la administración en relación a la separación de residuos genera esa desconfianza en el ciudadano y provoca que se valore poco o nada

Falta de conocimiento de la tecnología a implantar

Comodidad, si requiere esfuerzo no se hace

Formacion de clientes y consumidores

Desconocimiento información técnica

Falta de conocimiento del público en general sobre la importancia de la economía circular

La oposicion al cambio, hauy que informar y formar

BARRERAS COMUNICACIÓN: ¿Cuáles han sido las principales barreras de comunicación que habéis enfrentado durante la implantación de algún proyecto?

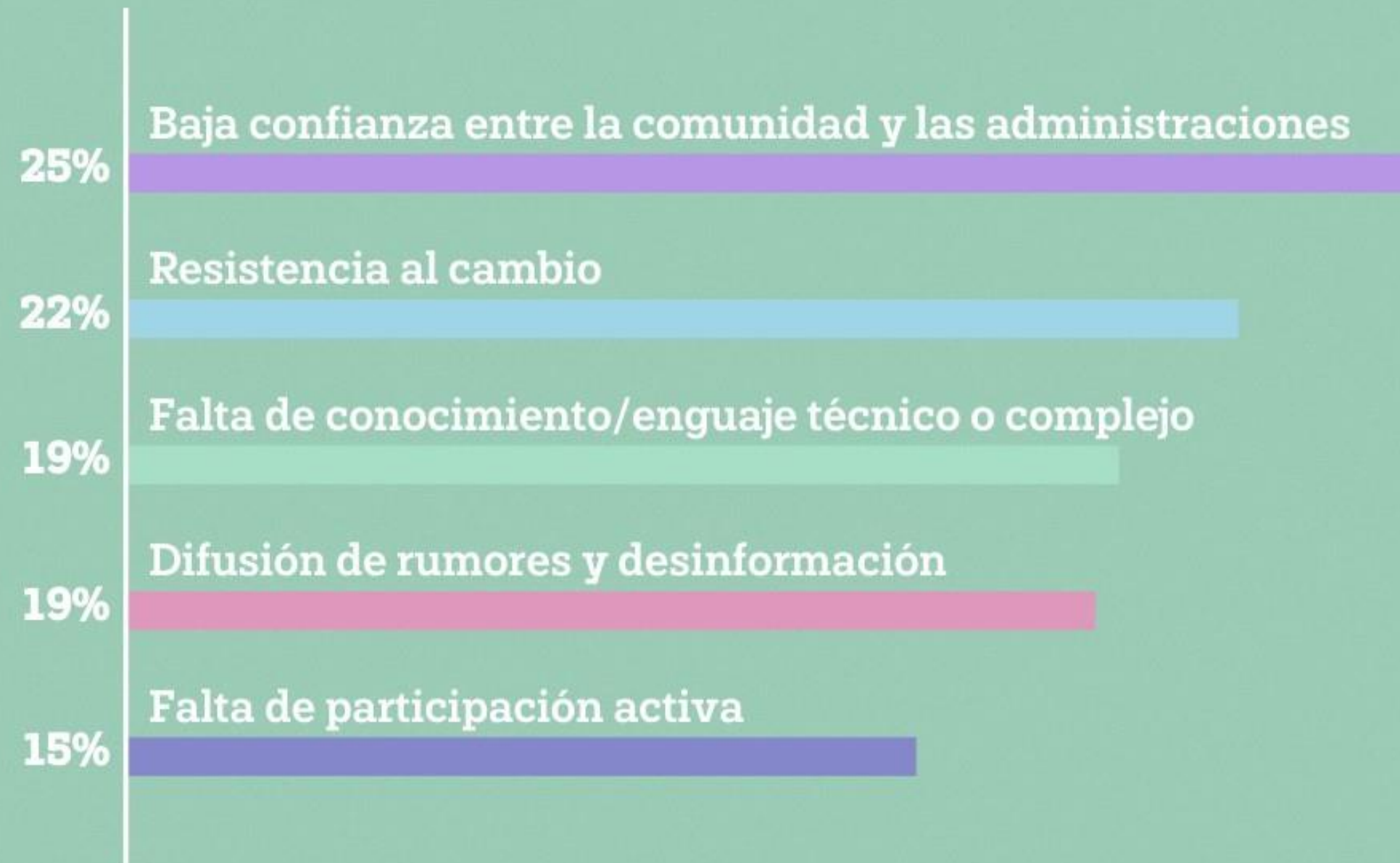
La comunicación con la administración es a veces difícil, habiendo voluntad para mejorar la situación

Lenguaje demasiado tecnico, nada coloquial

Falta formación a la comunidad

Falta de educación/información

BARRERAS COMUNICACIÓN: ¿Cuáles crees que son las principales barreras de comunicación para implementar proyectos como SYMSITES?



BARRERAS INTERCAMBIO: ¿Cuáles han sido las principales barreras de comunicación entre actores que habéis enfrentado en la implantación de un proyecto?

La ausencia de voluntad real de compartir información entre empresas privadas.

Hacer un seguimiento en la implantación del proyecto a lo largo del tiempo

Burocracia excesiva

Objetivos contrapuestos entre actores

Colaboracion empresa-administracion-i+d

Falta de compromiso, inactividad

Desconfianza y protagonismo

sobreinformacion, mucho ruido y a veces picas nueces

BARRERAS INTERCAMBIO: ¿Cuáles han sido las principales barreras de comunicación entre actores que habéis enfrentado en la implantación de un proyecto?

Comunicación entre diferentes organismos, confederaciones, entidades de saneamiento, ayuntamientos

Conflicto de intereses entre administración e industria

El interés de la Administración y la empresa privada no están alineados

Desconfianza

Falta de comunicación y participación conjunta entre empresas

BARRERAS INTERCAMBIO: Enfocado a las diferentes partes interesadas, ¿cuáles crees que son las barreras principales entre ellas?



BARRERAS NORMATIVAS: ¿Qué medidas correctoras plantearías en este ámbito para superar estas barreras y elaborar un plan de acción?

Asesoramiento por parte de expertos

Gabinete de coordinación entre empresas

Acuerdos de colaboración entre administración y asociaciones empresariales

Simplificar los trámites burocráticos

Unificar las normativas

Reuniones periódicas con todos los actores implicados

Reuniones de trabajo entre los entes implicados, para estar alineados, y no lanzar normativas unilaterales

Canales de comunicación más directos

BARRERAS NORMATIVAS: ¿Qué medidas correctoras plantearías en este ámbito para superar estas barreras y elaborar un plan de acción?

Normativas realistas
que cuenten con el
tejido empresarial



BARRERAS FINANCIACIÓN: ¿Qué medidas correctoras plantearías en este ámbito para superar estas barreras y elaborar un plan de acción?

Presentar proyectos de máxima calidad en el contexto competitivo

Taxonomía de la UE facilita financiación de negocios sostenibles

Convocatorias menos restrictivas

Proponer ventajas económicas sobre los objetivos alcanzados por el proyecto para atraer inversión privada al mismo.

Establecer líneas de comunicación fluida con la administración

Evaluación periódica de los proyectos para solicitar financiación constante según se cumplan hitos del proyecto





BARRERAS COMUNICACIÓN: Enfocado a la población, ¿qué crees que sería más efectivo para superar las barreras sociales al cambio?

1.º

Mayor sensibilización a través de campañas y talleres

2.º

Uso de lenguaje más accesible

3.º

Fomentar el debate público

4.º

Hacer más merchandising e información escrita

BARRERAS COMUNICACIÓN: ¿Qué otras medidas correctoras plantearías en este ámbito para superar estas barreras y elaborar un plan de acción?



Para la sociedad mejor visual que escrito

Fomentar el hábito de solicitar respuesta ante una cuestión. A veces las consultas quedan en el aire

Comunicar el proyecto de forma sencilla y con ejemplos que afecten al día a día de la mayoría de las personas

Hacer uso de canales de comunicación actuales, ej. Influencers

Fomentar las visitas a las instalaciones donde se llevan a cabo los proyectos y explicar el trabajo realizado con lenguaje sencillo y conciso

Formación a nivel de clientes, cadena de transmisión

Visitas regulares a plantas para que la gente verifique que los residuos se están gestionando correctamente y tienen un objetivo

Posibilidad de visitas "puertas abiertas" a instalaciones de tratamiento

BARRERAS COMUNICACIÓN: ¿Qué otras medidas correctoras plantearías en este ámbito para superar estas barreras y elaborar un plan de acción?

Dar valor a la necesidad de cambio

Talleres informativos a la población

Mostrar a toda la sociedad el destino final de los residuos (vertederos, EDAr) concienciación visual



BARRERAS INTERCAMBIO: *¿Qué consideras que debería promoverse más para una SU-I efectiva entre diferentes actores?*



SYMSITES Non-Technological Barrier Workshop Registration Form

Spanish Ecosite, 26th November 2024

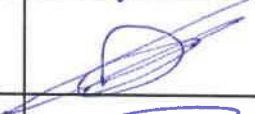
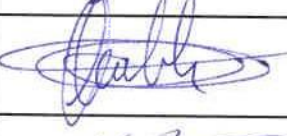
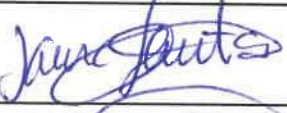
Nr	Asistentes	Firma	¹ Consentimiento (video/fotos)
1	ALBERT MOTA, JOAQUÍN		☒ De acuerdo
2	BERNABEU TEROL, ROSANA		☒ De acuerdo
3	BLANES COMPANY, MARÍA		☒ De acuerdo
4	BLANES, VICENTE		☐ De acuerdo
5	CAMARENA FERRER, ALEJANDRO		☒ De acuerdo
6	CANO CASANOVA, LAURA		☒ De acuerdo
7	FERRER VILLA, ADRIÁN		☐ De acuerdo
8	GARCÍA SÁNCHEZ, ESTHER		☒ De acuerdo
9	GARCÍA MARTÍNEZ, BELÉN		☒ De acuerdo
10	GARCÍA CASES, ALBERTO		☒ De acuerdo
11	GISBERT MIRALLES, JAVIER		☒ De acuerdo

¹ By attending the activities taking place during this Workshop, I consent to the recording of images and videos. These recordings can be used for other legitimate purposes as long as it is necessary for the SYMSITES Project, excluding any commercial use. The images/recordings subject to this consent form can be processed (i.e., stored, reproduced, exhibited, adapted, etc.) by the SYMSITES Consortium in the framework of the Project activities, using any kind of current or future media, and by any means known or unknown to date.

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SYMSITES Non-Technological Barrier Workshop Registration Form

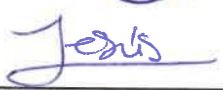
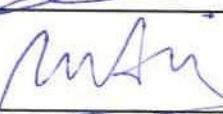
Spanish Ecosite, 26th November 2024

12	GRAU, LEÓN		☒ De acuerdo
13	HERRERO, ELENA		☒ De acuerdo
14	JOVER, ALEJANDRO		☒ De acuerdo
15	LORA GARCÍA, JAIME		☐ De acuerdo
16	MAGDALENA CADELO, JOSE ANTONIO		☒ De acuerdo
17	MARTÍNEZ BERNAL, NOELIA		☒ De acuerdo
18	PAREDES MELLADO, VICENTE		☒ De acuerdo
19	PÉREZ HERNÁNDEZ, EMMA		☒ De acuerdo
20	PLA, MARILÓ		☒ De acuerdo
21	REIG, CARLA		☐ De acuerdo
22	RICO ESTEVE, ÓSCAR		☒ De acuerdo
23	RIPOLL, LLUIS		☒ De acuerdo
24	SÁNCHEZ MOYA, MARÍA JOSÉ		☐ De acuerdo
25	SANTOS SILVESTRE, LAURA		☒ De acuerdo
26	SOLSONA, SILVIA		☒ De acuerdo

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SYMSITES Non-Technological Barrier Workshop Registration Form

Spanish Ecosite, 26th November 2024

27	TAMARIT CORONADO, RAQUEL		☒ De acuerdo
28	TZANOV, TZANKO		☒ De acuerdo
29	VALERO CANALS, FRANCISCO		☐ De acuerdo
30	YAGÜE MARTÍNEZ, JESÚS		☒ De acuerdo
31	ZURIAGA AGUSTÍ, ELENA		☒ De acuerdo
32	MIGUEL AMOROS NAVARRO		☒ De acuerdo
33	Ignacio Pardo Cabell		☐ De acuerdo
34			☐ De acuerdo
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37			☐ De acuerdo
38			☐ De acuerdo
39			☐ De acuerdo
40			☐ De acuerdo
41			☐ De acuerdo

This project has received funding from the European Union's Horizon Europe program under GA Project 101058426.

ANNEX 5: Action Plan – Austrian EcoSite



[AUSTRIAN ECOSITE] Action Plan to Overcome Non-Technological Barriers to Implement Industrial- Urban Symbiosis

Template for the Action Plan to Overcome Non-technological Barriers to implement Industrial-Urban Symbiosis

Task 5.2: Develop a list of actions to overcome non-technological barriers for exploitation of cross-company symbiosis

Contents

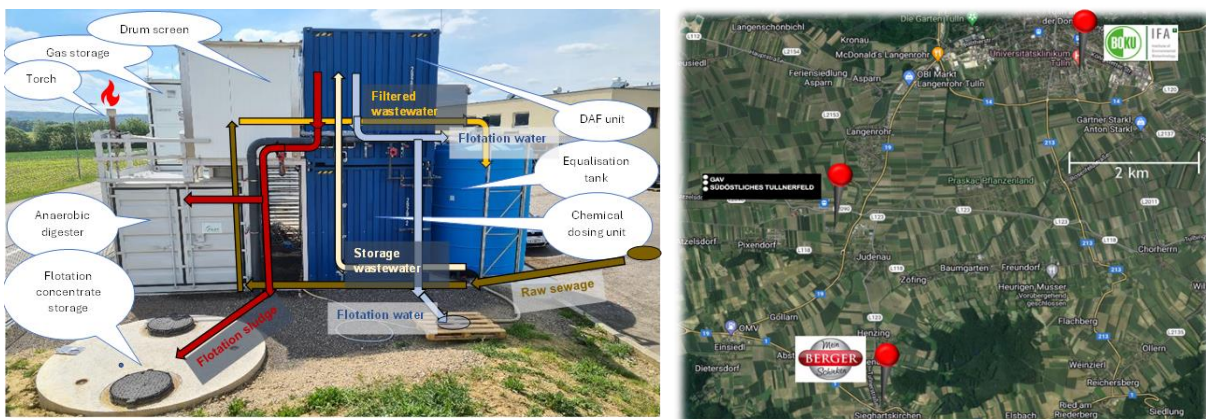
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9. The EcoSite in a nutshell

The Austrian EcoSite is based in Sieghartskirchen in Lower Austria at the production facilities of berger Schinken (project partner BER). The company has approximately 650 employees and produces 30,000 t/year (115 t/d) of ham, meat and sausage products. Therefore, large amounts of fresh water are needed for different processes in production resulting in water demands of 146,459 m³/year (~ 563 m³/d). Most of the water is used for cleaning processes leading to large amounts of wastewater of 131,813 m³/year (~ 506 m³/d). The difference of 14,645 m³ goes into the products or is lost as steam (e.g., cooling water). Only 9% of the freshwater demand can be derived from a water well, the remaining 91% have to be bought from the local water supplier.

The wastewater is currently treated by the municipal wastewater treatment plant GAV (project partner GST), treating wastewater from a total area of 131 km² and a population of 15,947.

The aim of the Austrian EcoSite is to reduce the burden on the municipal wastewater treatment plant, produce energy in the form of biogas with an anaerobic fermentation process, and supply treated water for reuse and fertiliser to the municipality or others.



The Industrial Urban Symbiosis (I-US) concept at the Austrian EcoSite:

- **Treated wastewater** (after ultrafiltration) can be reused for:
 - Irrigating municipal green spaces (e.g. public trees, soccer fields) in the city of Sieghartskirchen
 - Street cleaning in urban areas of Sieghartskirchn
- After Reverse Osmosis as **cooling water** at company Berger Schinken (BER)

- **Organic kitchen waste** from school canteens in Sieghartskirchen is collected by company Berger Schinken (BER) and:
 - Used for **biogas production** in the anaerobic digester of the pilot plant
- **Biogas** generated can:
 - Supply energy (heat and electricity of CHP) to Berger's operations
 - Provide **waste heat** for **district heating** (e.g. residential buildings, public pool)
- **Anaerobic digestate** is:
 - Distributed as **fertiliser** to local cooperative farmers (who deliver pigs to their slaughterhouse)
 - An improved alternative to raw manure (higher nutrient availability, reduced emissions)
- **Nutrient recovery** processes allow:
 - Production of **ammonium sulphate fertiliser** from hydrogen sulphide in biogas
 - Recovery of **ammonium** from permeate for agricultural use (see D2.2)

10. Objectives & scope

Objective of this action plan is to overcome most important non-technical barriers in Austria which hinder to realize EcoSite projects in Austria. Scope should not only be the regional level (EcoSite Tullnerfeld, Sieghartskirchen) but the planned actions should solve the barriers/challenges on national level.

This can only work if the relevant regional and also national authorities (municipality, regional government, Federal Ministry) participate.

Furthermore, national associations of following branches participate:

- National waste and water association (ÖWAV)
- National biogas association (Kompost & Biogas Verband)
- Regional Economic agency (Lebensmittelcluster Niederösterreich)
- Municipalities adapting to climate change (KLAR! Regionen)

These associations represent the interests of their members on regional and also national level. The objective is also to identify the responsible regional and national authorities and policy makers to address the non-technological barriers and discuss solutions with the responsible contact persons.

1.) Scaling up the Austrian pilot plant at Berger Schinken:

- a. Financial barrier: securing regional and national fundings to reduce investment costs
- b. Policy & regulations and information flows: involve the municipality as soon as possible to facilitate the process with regional government (province of Lower Austria) to obtain the necessary permits

2.) Identification of further locations/industries for pilot plants:

- a. Visits to Austrian EcoSite/pilot plant – best practice example
- b. Lessons learnt from EcoSite Tullnerfeld on the topic of financial barriers and policy & regulations
- c. More results/experience on the topic of reuse of cleaned wastewater to finally reach the implementation of the "REGULATION (EU) 2020/741 on minimum requirements for water reuse"

11. Status quo & local context

The Austrian Symsites EcoSite is situated in the region of "Tullnerfeld" approximately 40 km west of the capital Vienna. Key stakeholders in the EcoSite are industries, local governments and research institutions:

- Meat processing industry (company Berger Schinken; BER):
- Regional wastewater treatment plant (Abwasserverband südöstliches Tullnerfeld, GST)
- BOKU-University, IFA-Tulln (BOKU)
- Engineering companies Spiter (SP) and AAT Biogas Technology (AAT)

The meat processing company "Fleischwaren Berger Schinken GmbH" in the village of Sieghartskirchen is the biggest employer in the region with over 650 employees. It's a family business in the 5th generation with around 30,000 tons of meat and sausage products per year and a turnover of around 150 Mio. €/year. The daily wastewater volume is up to 650 m³/day which goes to the local wastewater treatment plant GST.

The local wastewater treatment plant treats the wastewater of 4 municipalities with a total population of approximately 16,000 inhabitants and a total area of 131 km². All in all, they treat wastewater of around 30.000 population equivalent.

One third (10.000 population equivalent) of the organics which is treated at GST comes from the meat processing company "Fleischware Berger Schinken GmbH".

So the municipality of Sieghartskirchen which is currently responsible for the wastewater treatment plant is very interested in the realization of the EcoSite and pilot plant to finally reduce the amount of wastewater going to the wastewater treatment plant. The wastewater treatment plant has already reached its maximum capacity.

BOKU University with the engineering companies Spitzer (SP) and AAT can now provide within the SYMSITES EcoSite a sustainable solution to reduce on the one hand the natural gas consumption and freshwater consumption of company BER and reduce the wastewater amount going to the wastewater treatment plant (GST).

12. Identification of Non-Technological Barriers

Finance
1. High investment & running costs for realizing wastewater treatment & biogas production projects for industry 2. Too little national financial funding support for projects on biogas production or wastewater treatment 3. No financial incentive for industry to clean their own wastewater or produce biogas 4. Energy prices are high = interest for alternative/renewables are high; energy prices are low = no interest any more in the industry 5. Disposal prices of organic waste of industry: the cheapest supplier/disposer gets the contract

Policy & Regulation
1. Austria has chosen the opt-out option of "REGULATION (EU) 2020/741 on minimum requirements for water reuse" 2. No regulations/framework on water reuse → legal uncertainty ○ Possible influence on the ground water ○ No Regulations in the food industry for water reuse 3. Delays in policy implementation affecting project timelines and stakeholder confidence 4. No pressure from government to the industry to invest in wastewater cleaning and biogas production

5. No regular external monitoring of wastewater quality of industry

Social

1. Concerns on using the digestate of the Austrian EcoSite as fertilizer on the surrounding agricultural areas
2. Acceptance of irrigation of crops with cleaned wastewater
3. Every citizen basically wants to support projects on the topic of renewable energies and wastewater treatment; however, "Not In My Back Yard"
4. Public resistance to new technologies and practices due to lack of understanding

Information Flows

1. Communication between industry companies and regional government/municipalities often difficult
2. Poor communication channels among stakeholders, leading to misinformation and lack of collaboration
3. Lack of data sharing platforms for best practices, hindering knowledge transfer

13. Actions to Overcome Barriers

Description of activity	Barrier addressed	Stakeholders to be involved	Time for implementation	Expected outputs & outcome(s)
1.) New EcoSites/best practice projects in Austria on topic of wastewater reuse (field trials) in agriculture	Social: Acceptance of irrigation of crops with cleaned wastewater	Austrian Water and Waste Management Association (ÖWAV); Universities, chamber of agriculture, farming associations,	Aim: until 2030	More knowledge and awareness on the quality of cleaned wastewater

2.) Creation of new "technical data sheet" on water quality on wastewater reuse – published by association "ÖWAV" (https://www.owav.at/)	Policy and Regulation: 1.) Austria has chosen the opt-out option of "REGULATION (EU) 2020/741 on minimum requirements for water reuse"; 2.) No regulations/framework on water reuse □ legal uncertainty	Austrian Water and Waste Management Association (ÖWAV); "Umweltbundesamt Österreich" (https://www.umweltbundesamt.at/en/), Federal Ministry on Climate and Water Management (https://www.bmluk.gv.at/en/)	Aim: until 2028	Austrian Government should implement the "REGULATION (EU) 2020/741 on minimum requirements for water reuse"
3.) Austrian Biogas Association (https://www.kompostbiogas.info/): negotiations with the Federal Ministry	Finance: 2. Too little national financial funding support for projects on biogas production or wastewater treatment	Austrian Biogas Association; Federal Ministry on Climate and Water Management (https://www.bmluk.gv.at/en/)	Aim: until 2030	Improvement of framework (higher fundings) conditions for biogas projects: e.g.: implementation of "renewable gas act" (EGG)
4.) Awareness raising events on high quality of digestate as fertilizer	Social: 1. Concerns on using the digestate of the Austrian	Farmers of city of Sieghartskirchen; Berger Schinken (BER); BOKU University (BOKU);	Aim: until 2026	Use of biogas digestate from BER as high valuable fertilizer

	EcoSite as fertilizer on the surrounding agricultural areas			
5.) awareness raising events: presenting "best practice examples" (Open day house, EcoSite Austria, international wastewater reuse projects,..)	Social: 3. Projects yes, but "Not In My Back Yard" Information flows: 2. Poor communication channels among stakeholders, leading to misinformation and lack of collaboration 3. Lack of data sharing platforms for best practices, hindering knowledge transfer	1.) Universities (e.g. BOKU) 2.) Austrian Biogas Association (https://www.kompast-biogas.info/) 3.) Association "KLAR" (https://klar-anpassungsregionen.at/) 4.) association "food cluster Lower Austria" (https://www.ecopuls.at/vernetzen/lebensmittel-cluster-niederoesterreich)	Aim: until 2030	Especially to reduce social barriers and to improve the information flows: reduce possible prejudices on the subject of biogas and wastewater reuse; accelerate the realization of such projects
6.) Scale up of pilot plant at Berger Schinken (BER) and Identification of other New	Finance: 4. Energy prices are high = interest for alternative/renewables are high; energy	1.) Austrian meat processing companies 2.) Austrian Biogas Association 3.) Universities	Aim: until 2030	Implementation of biogas production and wastewater treatment in e.g. Austrian slaughterhouses

EcoSites/best practice projects in Austria on topic of industrial wastewater reuse and biogas production	prices are low = no interest any more in the industry	(e.g. BOKU) 4.) Association "Food Cluster Lower Austria"		es
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14. Activity Monitoring and Evaluation

Within the SYMSITES project the Austrian EcoSite project partners reached lots of new stakeholder on the topic of biogas production, organic waste and wastewater reuse. This is a network of different Universities, food and beverage companies, associations and especially persons of the local and regional government who will work together in future to realize the actions mentioned above.

Especially the topic of wastewater reuse now arrived in Austria, mainly due to out stakeholder meetings and barrier workshop. The Austrian Biogas Association, Food & beverage association and the "KLAR" association is regularly organising events for their members. BOKU as Austrian EcoSite manager will be invited to present the Symsites project results and will coordinate the implementation of the action plan. Together a roadmap will be established including milestones and regular online meetings to implement the actions within the following years.

For each of the 6 actions a responsible organisation is nominated. BOKU will coordinate the whole implementation and will monitor the progress and impact of the actions.

15. Governance Structure

BOKU as Austrian EcoSite manager will be responsible for the implementation and governance of the action plan. The expected outputs should be reached with following stakeholder collaboration:

BOKU University (<https://boku.ac.at/en/>):

Will coordinate the implementation of the action plan and of new research projects on the topic of water reuse and biogas production of wastewater and biowaste.

Austrian Biogas Association (<https://www.kompost-biogas.info/>):

Represents the interests of the Austrian Biogas industry and is the lobbying organisation to negotiate with the Austrian government to improve the framework conditions for biogas production in Austria.

**Food Association Lower Austria
(<https://www.ecoplus.at/vernetzen/lebensmittel-cluster-niederoesterreich>):**

Members of this association are the companies of food & beverage industry in the province of Lower Austria and is part of the regional business agency. Owner is the province of Lower Austria.

KLAR regions Austria (<https://klar-anpassungsregionen.at/>):

With the KLAR programme, the Climate and Energy Fund (Austrian Government) is currently supporting 91 Austrian regions with over 800 municipalities and more than 2.2 million inhabitants in reducing the damage caused by climate impacts and exploiting the opportunities that arise to avoid climate change.

Austrian Water Association (<https://www.oewav.at/#>):

Its primary function is to develop technical standards, guidelines, and recommendations for sustainable water and waste management in Austria. It serves as a neutral platform that brings together experts from government, industry, science, and civil society and serves as lobbying organisation for the interests of the Austrian water- and waste industry.

This consortium brings together the industry, regional municipalities, biogas plants, wastewater-treatment plants and the Austrian Policy Makers. The Austrian SYMSITES EcoSite serves as best practice example and together with the mentioned organisations the action plan will be implemented to overcome the non-technological barriers in Austria.

Mr. Andreas Farnleitner (Co-Head of Department for Water Quality and Health) and Mr. Harald Hofmann (Head of Municipal Water Management, Province of Lower Austria / Water Division) are in the management board of the Austrian Water Association (ÖWAV). They participated in the workshop on non-technological barriers and in the panel discussion on the topic of water reuse.

The following has already been achieved:

1. Mr. Harald Hofman already had a meeting at the Austrian Federal Ministry of Climate and Environmental Protection, Regions and Water Management. He already discussed the topic of wastewater reuse and the EU Regulation on minimum requirements for water reuse with the head of "section 1 – Water management" Mrs. Monika Mörth. There will be discussions on taking back the "opt-out option" and implementing the EU regulation.
2. Within the stakeholder forums, the workshop on non-technological barriers and the cooperation with the "Austrian Biogas association" and the "Food Association Lower Austria" we received requests from following industry companies:
 - Slaughterhouse "Grossfurtner GmbH" (<https://www.grossfurtner.at/>): they already have a biogas plant and a flotation unit. However, they are now also interested in cleaning the water after the flotation unit to produce process water. Discussion with Mr. Alexander Schumergruber (technical managing director).
 - Meat processing company "Hochreiter Gruppe" (<https://www.hochreiter-gruppe.at/>). They have a flotation unit and are interested to implement a biogas plant and reuse the wastewater after membrane cleaning. Discussion with Mr. Alexander Stumptner (technical managing director).

3. Our Symsites project partner Berger Schinken (BER) is interested to upscale the EcoSite/pilot plant in Sieghartskirchen to produce electricity and district heating. Together with symsites partner AAT and BOKU the full-scale biogas plant design was finalised. Also, the biogas potential of the food residues of the canteen of the kindergarten and the schools will be evaluated. Additionally, there are considerations to mobilize the organic fractions in the residual waste of the city of Sieghartskirchen for biogas production. Sorting tests of the residual waste will be carried out to measure the determine the quantity of organics. In Austria approximately 20% - 30% of the residual waste are still organic fractions which can be used for biogas production.

16. Conclusion

Within the barrier workshop and within the last 3 stakeholder forums and discussions with industry, biogas plant operators, farmers, local municipalities and regional authorities (State Government of Lower Austria) several non-technological barriers have been identified. Most important areas are:

1. Financing topics
2. Policy & Regulation
3. Social topics
4. Information flows

From the identified non-technological barriers together with the stakeholders 6 most important actions/activities were defined to be implemented within the next years:

1. New research projects (responsible BOKU, Universities)
2. New "technical data sheet" on wastewater reuse (responsible: association "ÖWAV")
3. Improvement of legal framework for new biogas projects (responsible: Austrian Biogas Association)
4. Awareness raising events on quality of biogas digestate/fertilizer for farmers (responsible: Berger Schinken)
5. Awareness raising events presenting Austrian "EcoSite" (responsible BOKU)
6. Scale up of Austrian EcoSite at Berger Schinken and identification of other regions in Austria for implementation (responsible Berger Schinken and BOKU)

The 6 actions will be implemented together with the Austrian Symsites partners and in cooperation with following associations:

- Austrian Biogas Association (<https://www.kompost-biogas.info/>)
- Association „food cluster Lower Austria”
(<https://www.ecoplus.at/vernetzen/lebensmittel-cluster-niederoesterreich>)
- Association “KLAR” (<https://klar-anpassungsregionen.at/>)
- Austrian Water Association ÖWAV (<https://www.oewav.at/#>)

Annex I – Workshop on Non-technological Barriers

The Austrian Workshop on non-technical barriers was organised along the 3rd stakeholder forum (agenda stakeholder - forum: <https://www.one-water.at/components/53380>).

Agenda of the workshop and panel discussion:

1. Presentation of Symsites Project: "New technologies for industrial and urban symbiosis using the example of water treatment" presented by Mr. Bernd Maderner from company Berger Schinken (BER)
2. Presentation "Wastewater reuse for agricultural irrigation" presented by Mr. Harald Hofmann (Head of Municipal Water Management, Province of Lower Austria / Water Division)
3. Workshop and Discussion on non-technological barriers and wastewater reuse with 5 experts:

- **DI Wolfgang Gabauer**

Project Lead SYMSITES, Head of the Biogas Research Group at the Institute for Environmental Biotechnology, BOKU; also an active farmer

- **Univ.-Prof. Dr. Andreas Farnleitner**

Professor at Karl Landsteiner Private University and TU Vienna, Co-Head of Department for Water Quality and Health

- **DI Dr. Christian Loderer**

Civil Engineer, Johann Steinbacher ZT GmbH

- **Prof. Dr. Werner Fuchs**

BOKU University, Institute for Environmental Biotechnology, Specialist in Water and Membrane Technologies

- **DI Harald Hofmann**

Head of Municipal Water Management, Province of Lower Austria / Water Division

4. Online survey (software mentimeter) on wastewater reuse and non-technological barriers with 12 questions (see questions + results below).

5. Questions and answers/results of panel discussion/workshop:

1. Agriculture (Fuchs to Gabauer)

1. What is the general sentiment in agriculture regarding water supply?
2. Is wastewater reuse even a topic of discussion in farming circles? Does it fit the image of Austria as a model country for organic farming?
3. Which types of crops or agricultural practices could wastewater reuse be relevant for?

Gabauer states that the topic is currently receiving little attention among farmers. While increasing water scarcity is generally acknowledged, the focus remains on irrigation using conventional sources such as groundwater or surface water. The issue of wastewater reuse has not yet gained much traction in the agricultural sector. Of course, there are certain crops that are particularly suitable, as they undergo further processing that largely eliminates hygienic risks—such as sugar beets.

2. Safety & Regulation (Hofmann to Farnleitner)

1. We've heard that EU regulations provide a unified framework – are these sufficient in your view?

EU regulations provide the minimum requirements for water reuse and the national countries are required to transpose these criteria into national law. In my opinion they are sufficient but on these minimum parameters the countries can of course decide to implement additional higher quality standards.

2. Should Austria consider a higher safety standard? Or should the risk be avoided altogether?

Creation of new “technical data sheet” on water quality on wastewater reuse – published by the Austrian Water and Waste Management Association association “ÖWAV” on wastewater reuse from households. This can be the basis within the next years to establish a new technical data sheet implementing the minimum quality requirements of REGULATION (EU) 2020/741.

3. Current Demand & Challenges in Municipal Water Management (Fuchs to Loderer)

1. Is the municipal water sector prepared for this issue, or are other topics currently more pressing?

2. Are there inquiries coming from wastewater treatment plants? Has there been any notable interest?

Loderer states that, so far, that this topic is largely ignored and there has been no demand from the side of wastewater treatment plants, as other issues are currently the main focus. Fuchs asks whether civil engineering firms are preparing for this. Loderer explains that civil engineers see themselves as service providers for water and wastewater utilities. From their side, the topic is not being actively pursued as long as there is no demand. Accordingly, there is also little initiative coming from the civil engineers themselves.

4. Research Gaps (Hofmann to Fuchs)

1. Is the topic already well-researched? Do we have enough practical experience?
2. Are there specific areas that still require further investigation?

Fuchs states that, in general, there is a solid knowledge base for wastewater reuse, although some gaps still remain. He draws on his experience from previous projects in Algeria, Tunisia, Egypt, China, and Bangladesh, noting that different countries apply different approaches. For example, in one project in Bangladesh, the concept involved irrigating bamboo, a fast-growing construction material. In another nearby project, wastewater—after primary treatment—was used to grow algae, which served as fish feed in a pond. However, the fish were not accepted by the local population, as they were aware of the origin of the feed. Fuchs admits he shares some doubts as to whether safety standards were properly upheld in this particular case. Fuchs recommends preparing for the time after opt-out, which he believes is approaching soon. He suggests taking a proactive approach by conducting two to three best-practice examples with scientific backing to demonstrate the effectiveness of the approach and to address public concerns and fears.

5. Opt-Out Developments (Fuchs to Hofmann)

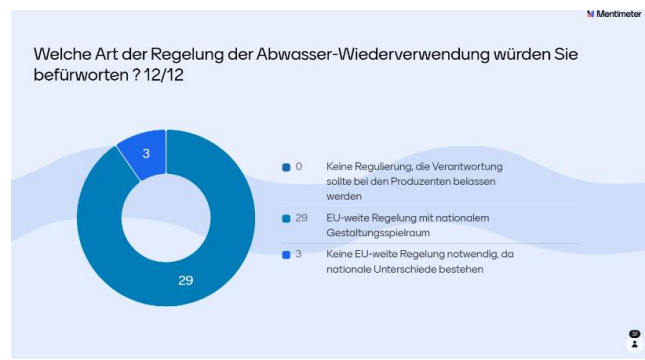
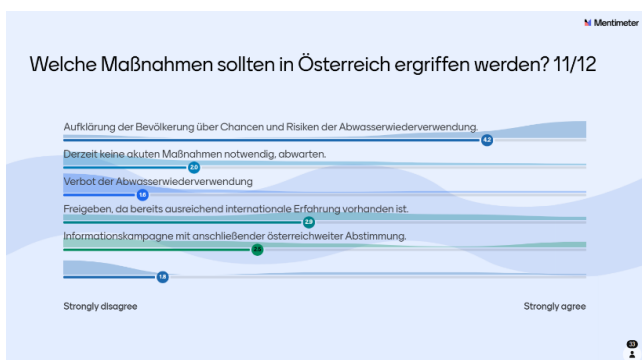
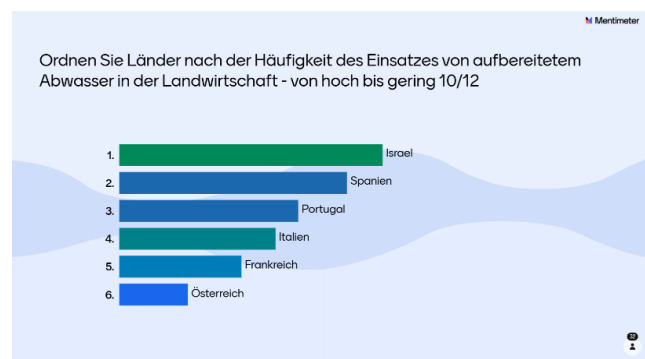
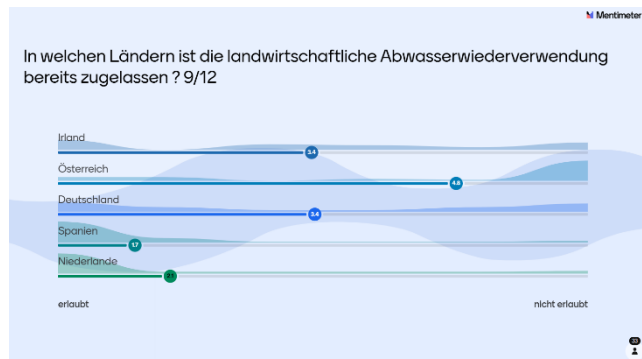
- Austria has chosen the “opt-out” route — are any changes to that expected
- Denmark has reportedly reversed course; and in Germany, there was scepticism, but preparations for approval are now underway — is Austria reconsidering?

Within the last years Austria and as we have seen from today’s presentations Austria has experienced floods and long dry periods in summer. Austria is basically a water rich country. However, the climate change shows us extreme weather conditions and therefore Austria has to adapt and the EU-regulation on minimum requirements on water reuse will be a useful option to adapt to climate change.

However, the regulation (EU) 2020/741 on minimum requirements for water reuse were more or less drawn up on the basis of experiences in Australia. So, first step will be to adapt it to Austrian standards and needs.

Online survey on the topic of wastewater reuse:





Summary of questions (12 questions, 34 persons answered using QR-Code link to questionnaire, software: mentimeter):

1. What is your professional background?

43% are from private companies/industry, 29% from Universities and 17% from public authorities, 6% from agriculture + 6% others

2. Do you know how agricultural wastewater reuse is regulated in Austria / in the EU?

All in all, 25 persons (out of 34 persons) have already heard/know the EU regulation

3. Estimate the water consumption of the sectors in % of the total consumption (for Austria)

35% industry, 33% agriculture, 22% private households, 9% snowmaking and irrigation of golf courses

4. What do you think about the reuse of wastewater for irrigation purposes?

Most votes on:

- The reuse of wastewater should be promoted to reduce the groundwater consumption
- Reuse should be made possible in compliance with all safety precautions.

5. Which pollutants could be carried away with the treated wastewater?

Most votes on:

- Bacterial pathogens (EHEC, cholera,..)
- Per- and polyfluorinated alkyl compounds (PFAS)

6. Which crops would you be in favour of irrigating with wastewater?

27% sugar beet, 22% vines, 19% fruit crops, 9% tomatoes, 4% salad, 9% pumpkins

7. Do you think wastewater reuse is safe?

23 persons: Yes, if the water is treated and disinfected in accordance with WHO standards, EU directives and other specified quality standards

9 persons: A certain risk will always remain

8. What is your opinion on possible safety measures?

24 persons: A graduated security concept should be applied depending on the type of use.

9. In which countries is agricultural wastewater reuse already authorised

Ireland: don't know

Germany: don't know

Austria: not allowed

Spain: allowed

Netherlands: allowed

10. Rank countries according to the frequency of use of reclaimed wastewater in agriculture.

1. Israel
2. Spain
3. Portugal
4. Italy
5. France
6. Austria

11. What measures should be taken in Austria?

Strongly agree:

- Informing the public about the opportunities and risks of wastewater reuse

Strongly disagree:

- Ban on wastewater reuse
- Currently no urgent actions needed

Disagree:

- Information campaign with subsequent Austria-wide coordination

In between:

- Release, as there is already sufficient international experience

12. What kind of regulation of wastewater reuse would you be in favour of?

29 persons: EU-wide regulation with national room for manoeuvre

3 persons: no EU-wide regulation necessary as there are national differences



List of participants of stakeholder forum and barrier workshop:

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Holzreiter	Christoph	Xylem Water Solutions Austria GmbH
Hörmann	Gerold	Kwizda Agro GmbH
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The participants came especially from following branches:

- Industry
- Regional and national authorities
- Research/Universities

