ULTIMATE

WATER SMART INDUSTRIAL SYMBIOSIS

Deliverable 6.4

Regional, national, industrial leadership and hubs for circularity- key actions of ULTIMATE demo cases

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Technical References

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Executive Summary

Summary of Deliverable

The ULTIMATE project (indUstry water-utiLiTy symbIosis for a Smarter wATer society) exemplifies the transformative potential of the circular economy (CE) within the European Union (EU) framework. Focusing on sustainable water management, ULTIMATE promotes industrial symbiosis, encouraging collaboration among various sectors to minimize waste and maximize resource efficiency. This initiative aligns closely with the EU's sustainability objectives, particularly through its integration with Hubs for Circularity (H4C), which facilitate regional partnerships and knowledge exchange to implement circular practices.

Context and Objectives:

The ULTIMATE project was designed to explore innovative water management strategies across nine diverse demo cases in Europe and Israel. Its main objectives include enhancing water efficiency, establishing symbiotic relationships between industries, and developing replicable models for circularity. The project aims to empower regional and industrial leadership, showcasing practical approaches for sustainable water management.

Methodology:
Key actions within the demo cases highlighted collaboration and stakeholder engagement as essential components in fostering a circular economy. Partnerships formed between water utilities, agriculture, and industry exemplify shared resource utilization that enhances water efficiency. The implementation of innovative technologies in water treatment further underscores advancements in efficiency and cost-effectiveness.

Main Results:

The ULTIMATE project has demonstrated that industrial symbiosis can significantly improve resource management, with hubs capable of recovering up to 80% of energy and 100% of materials. The project's diverse strategies provide valuable insights for H4C initiatives, creating a robust network of support for industries transitioning to circular practices.

Conclusions and Policy Relevance:

ULTIMATE's findings contribute to the EU's Water Resilience Strategy by emphasizing the need for effective management of water resources and innovative industry solutions. The project advocates for a holistic approach that combines technological advancements with policy support and community engagement. This alignment with broader EU policies, including the European Green Deal, positions ULTIMATE as a critical contributor to sustainable water management and circular economy frameworks.

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Exploitation Potential:

The methodologies and models developed through ULTIMATE can be leveraged by project partners and broader society to enhance water management practices. The establishment of Water-Smart Industrial Symbiosis Living Labs (WSIS-LLs) creates real-life environments for co-creation and experimentation, further facilitating the scaling of successful strategies.

By fostering collaboration and innovation, the ULTIMATE project not only presents successful water reuse models but also reinforces the importance of a comprehensive approach to achieving a circular economy in the water sector. For further reading on relevant EU policies and frameworks, please refer to the *EU Water Framework Directive* and the *European Green Deal*.

Disclaimer

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1. Introduction

The concept of a circular economy (CE) represents a transformative shift in how industries manage resources, aiming to minimise waste and maximise value through the continual use of resources. At its core, the circular economy promotes the rethinking of product life cycles, focusing on sustainability and resource efficiency. Industrial symbiosis complements this by fostering collaborative relationships between industries, enabling the exchange of resources, energy, and information to create closed-loop systems that enhance economic and environmental performance.

Within the European Union (EU) framework, Hubs for Circularity (H4C) serve as critical platforms for fostering industrial symbiosis, promoting collaboration between different sectors, and facilitating knowledge exchange. These hubs aim to empower regions and industries to implement circular practices effectively, aligning with EU sustainability goals. The Hubs4Circularity concept supports industrial areas to transition to a more circular net-zero emission system.H4C are anchored in this local ecosystem and bring the industrial symbiosis concept to regional scale. The Commission estimates that a hub is able to recover up to 80 per cent of energy used, 40 per cent fresh water, and reuse up to 100 per cent of materials.

The ULTIMATE project (indUstry water-utiLiTy symbIosis for a Smarter wATer society) exemplifies these principles by exploring and demonstrating innovative water management strategies across nine diverse demo cases located in different European and Israeli contexts. The anticipated outcomes of the ULTIMATE project include enhanced water efficiency, the establishment of symbiotic relationships between industries, and the development of replicable models that other sectors can adopt to transition towards a circular economy. By fostering regional and industrial leadership, ULTIMATE aims to showcase practical approaches to achieving sustainable water management and circularity.

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2. Key Actions in ULTIMATE Demo Cases

In ULTIMATE in total nine Water-Smart Industrial Symbiosis (WSIS) demo cases had been implemented over different geographical settings (Western, Central and Southern European, East Europe and Israel), see Figure 1.

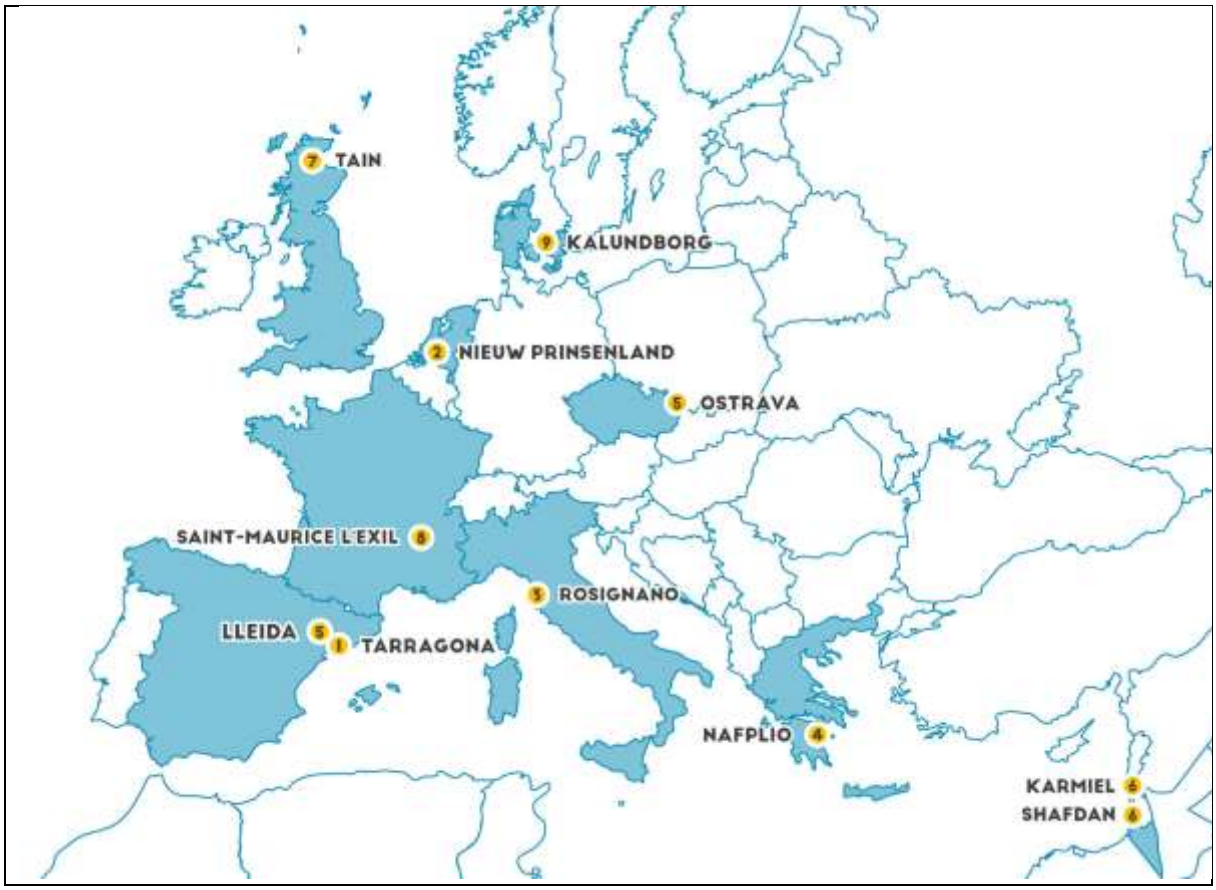

Figure 1 Map of ULTIMATE Demo Cases

The main objectives were to evaluate and demonstrate the performance at pilot scale and the technical feasibility of innovative technologies and symbiosis strategies. Symbiosis had been settled between different industrials sectors and service providers, see Figure 2.

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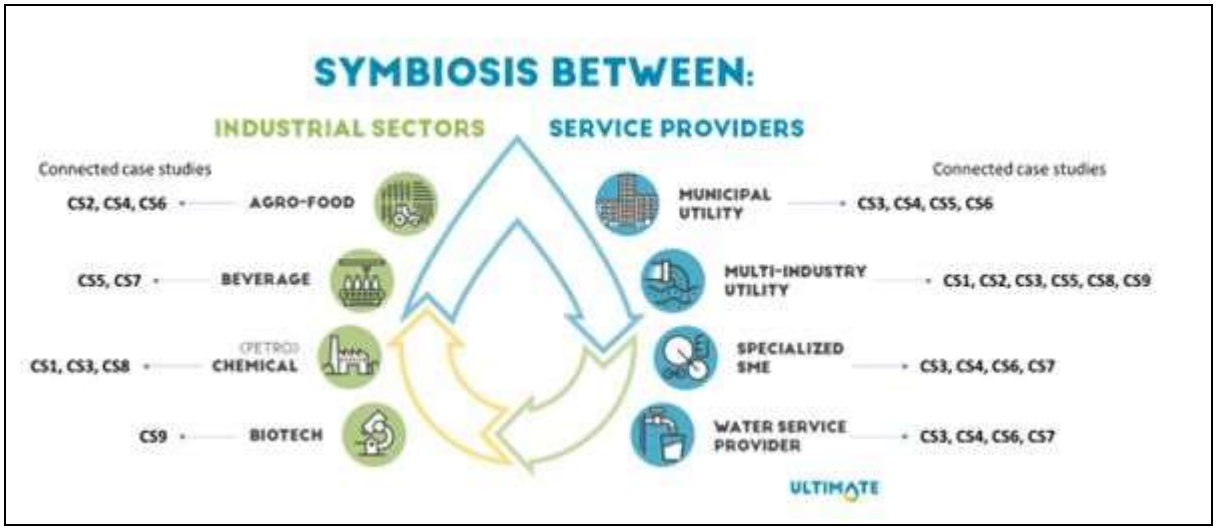

Figure 2 ULTIMATE Industrial Symbiosis established in the project.

How they are all interconnected with the goal to become water-smart is shown in Figure 3. With setting up different and individual concepts for WSIS locally at each of the demo cases, they can be interpreted as so called Hubs4Circularity.

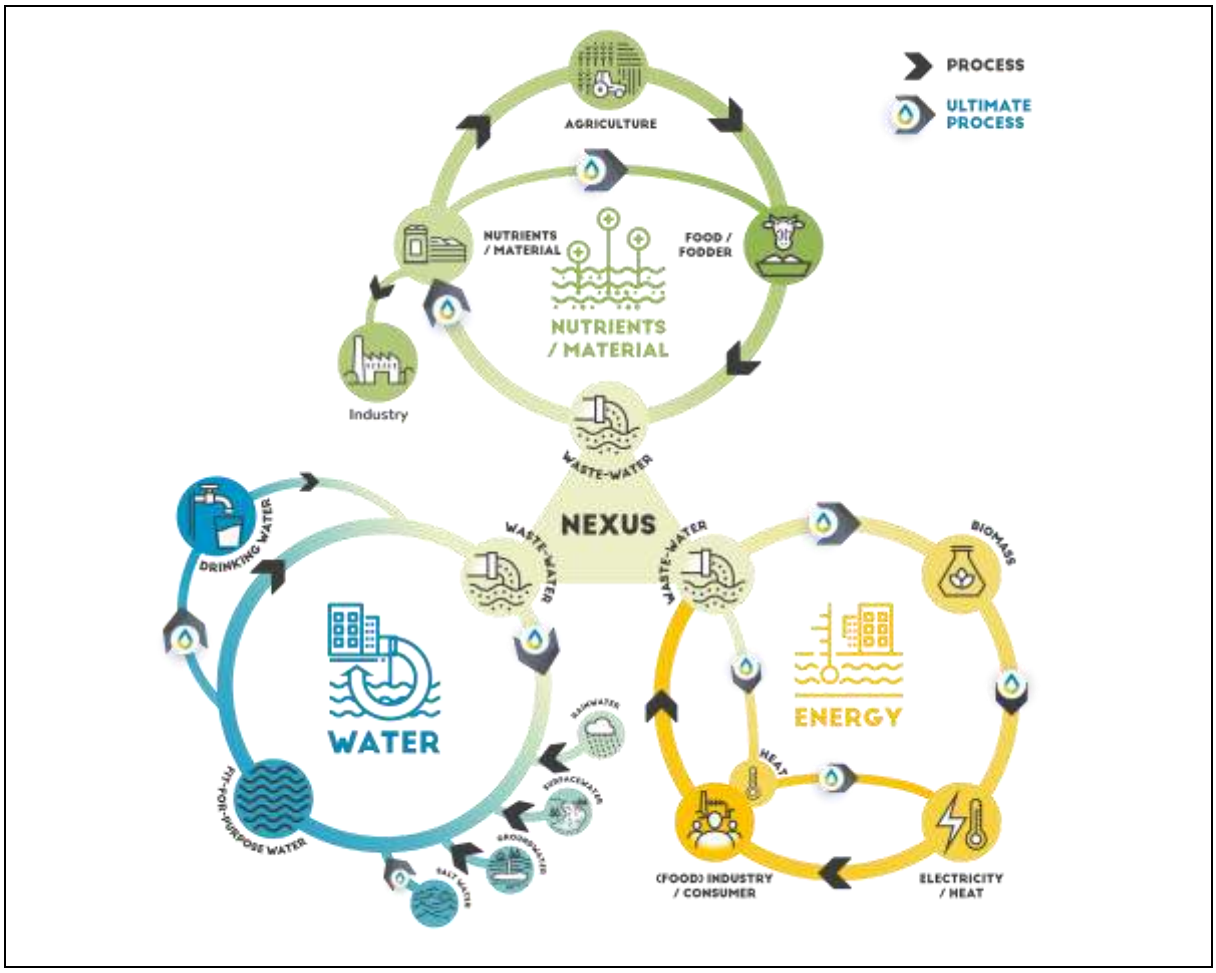

Figure 3 ULTIMATE nexus graphic.

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2.1. Demo Case 1, Tarragona (Spain) - Efficient ammonia removal for full-scale water recovery

This demo case focuses on increasing the capacity to recover water at an industrial complex of 30 petrochemical companies by 20% in Tarragona, Spain. The Petrochemical Complex of Tarragona is an industrial area that groups several companies related to the chemical and oil fields. The more than 30 companies that form this complex are mainly focused on the production of chlorine, alkaline salts, oxygen gas, fertilisers, insecticides, fuels, plastics and synthetic essences.

The increasing water demand from the industry outpaced the system's capacity, which led to the implementation of a reclamation plant to feed industrial water only and to avoid consuming resources of the drinking water production. AITASA operates the Water Reclamation Plant (WRP) of Camp de Tarragona producing water for boilers and cooling towers. This locally available additional water supply replaces surface water supplies, that, some years ago, were transferred from the Ebro River for use at the petrochemical park; as a result, an equivalent volume of surface water is available for urban water supply in the coastal areas of Tarragona province. By developing this new and locally available water supply source, industrial growth in a water scarce region has been supported, while promoting local industry's sustainability.

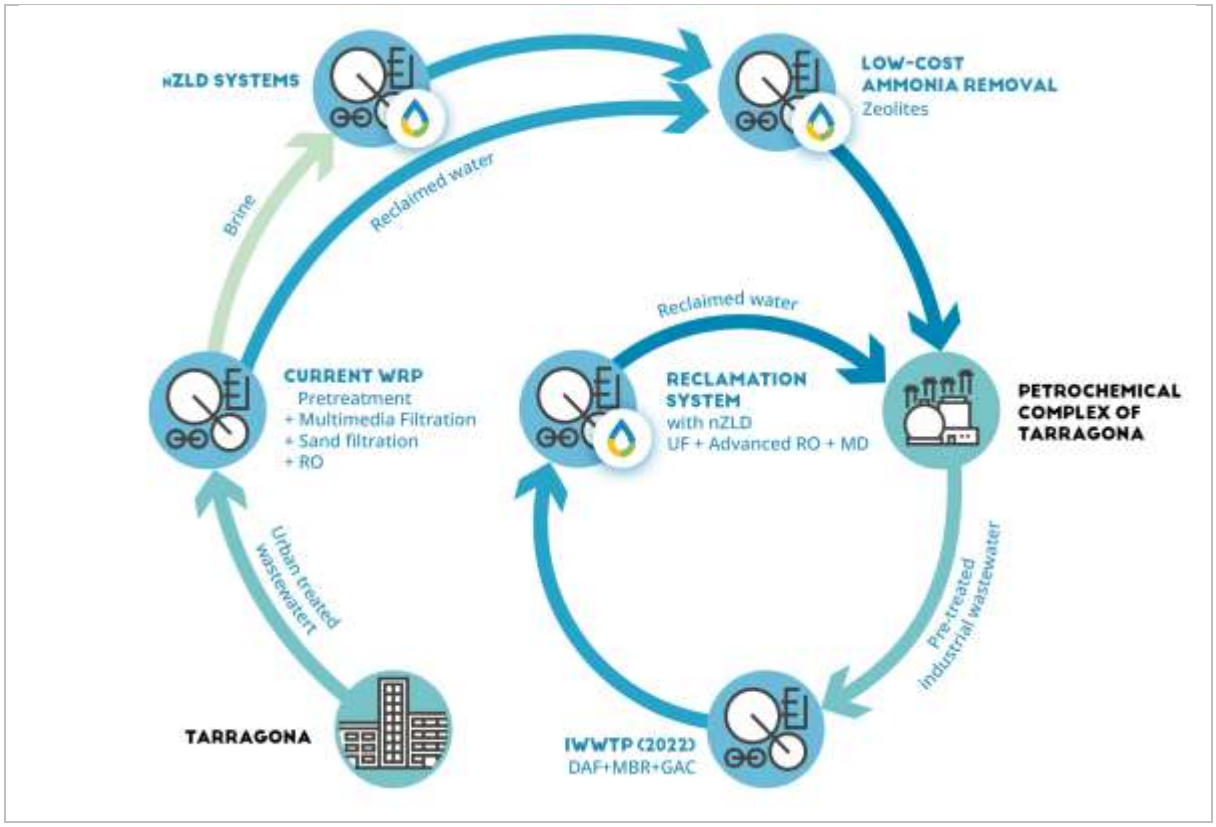

Figure 4 Overview industrial symbiosis at demo case 1 in Spain.

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Applied Technologies:

- Ammonium adsorption on zeolites
- Membrane distillation
- Reverse Osmosis

Key Innovations & Actions:

- Near Zero Liquid Discharge (or high-recovery systems) for water reclamation
- Increasing the water availability for industrial reuse in the complex

Legislation & Policy Recommendations:

Clarifying responsibilities and developing consistent guidelines for water reuse licensing and service provision across the EU are essential to ensure effective practices.

The strategic agenda proposes comprehensive coverage of all water reuse types, emphasising safety, environmental impact assessment, and the integration of reclaimed water into local water balances based on regional circumstances.
Future regulations should establish minimum standards for non-agricultural uses, enhance risk assessment, and promote research on innovative water reuse technologies and practices.

2.2. Demo Case 2, Nieuw Prinsenland (Netherlands) - Water Reuse and Heat Recovery for Horticulture

Located in the Netherlands, this demo case addresses the challenges faced by the horticultural sector in managing water resources. Exploring water and nutrient reuse opportunities for their facility, the local wastewater treatment facility is optimising their system for internal symbiosis within their own facility and external symbiosis with neighbouring greenhouses and industries. The ambitions are to reach zero liquid discharge and provide symbiotic internal and potentially external reuse of water and nutrients from greenhouse wastewater (approx. 10% of the total water input). The system to treat and reuse drainwater from 60 greenhouses (160 ha) is laid out maximum capacity of 60 m^3/h. In this setup, recycling would be provided internally for the greenhouses in the summer and in the winter months the excess recovered water and nutrients can be reuse in nearby industries or a central water bank.

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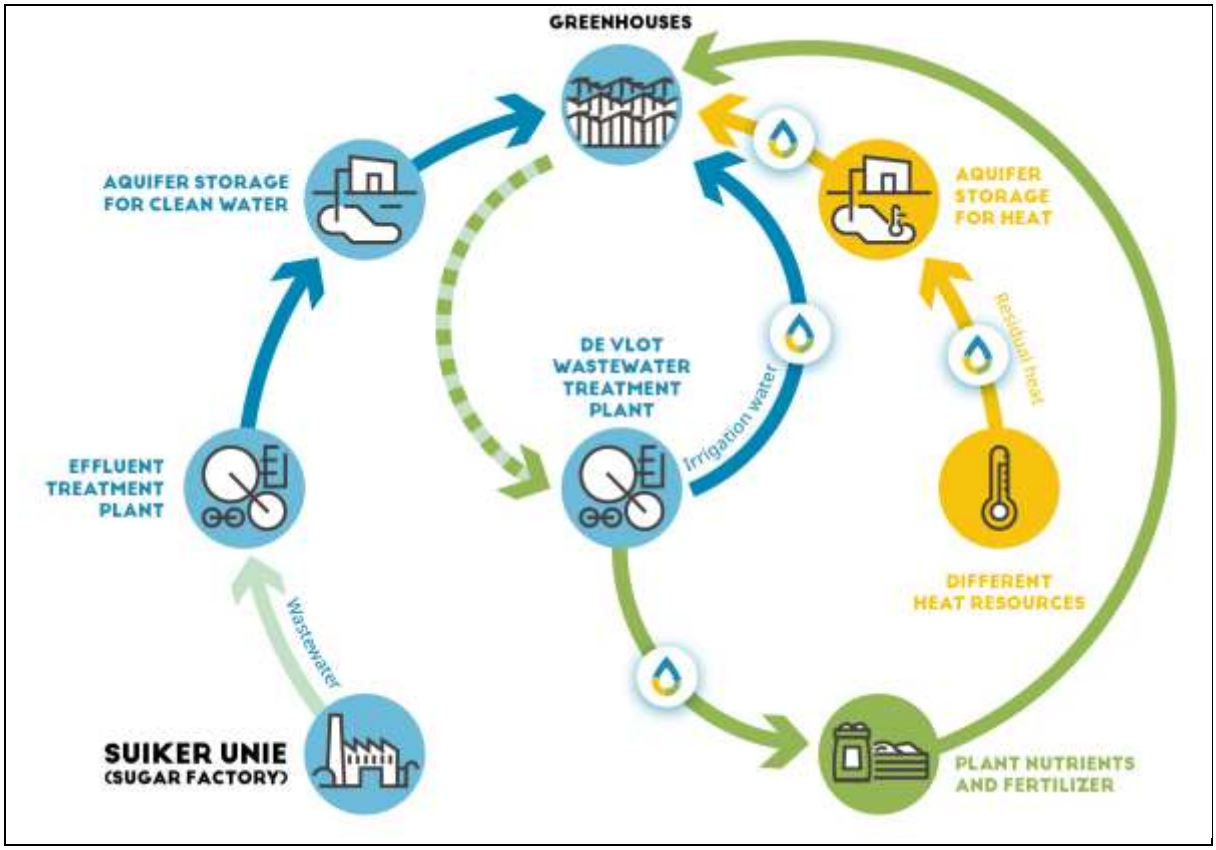

Figure 5 Overview industrial symbiosis demo case 2 in the Netherlands.

Applied Technologies:

- electrodialysis for treatment of greenhouse wastewater - specifically selective sodium removal - to produce a water quality fit for irrigation purposes
- feasibility of high-temperature aquifer thermal energy storage (HT-ATES)

Key Innovations & Actions:

- Treating greenhouse wastewater by filtration & advanced oxidation
- Distribution & reuse of the treated wastewater in the greenhouse industry
- Feasibility study on storage of residual heat using ATES managing heat demand in greenhouses

Legislation & Policy Recommendations:

Since test drillings for HT-ATES to characterise the subsurface are expensive and time consuming, they are considered as a barrier for market uptake. Hence, more research and demonstration projects are recommended to establish inexpensive, reliable and innovative technologies and their combinations to avoid uncertainties during planning of HT-ATES and to accelerate the planning process.

The highest risks are uncertain permit procedures and public perception. Further, the permit procedure for a HT-ATES requires usually several years. Therefore, it is

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suggested to accelerate this procedure and to promote the demonstration of full-scale pilot systems to develop suitable policies and to show in practice that HT-ATES is a renewable, clean and safe technique.

2.3. Demo Case 3, Rosignano (Italy) - Water Reuse and Material Recovery in the Chemical Industry

This demo case in Italy aims to maximise water reuse and will test the potential of industrial by-products for material recovery and reusage as reagents, adsorbents or coagulants for water treatment. Through the ARETUSA water reclamation facility, Solvay Chimica Italia Spa industry replaces high-quality groundwater with fit-for-purpose treated municipal wastewater for industrial use, while groundwater is more exploited for drinking water production to serve the coastal areas. Up to 3.8 Mio. m^3 per year of treated municipal wastewater is already reused by the industrial partner Solvay, freeing up Solvay private industrial wells for drinking water use.

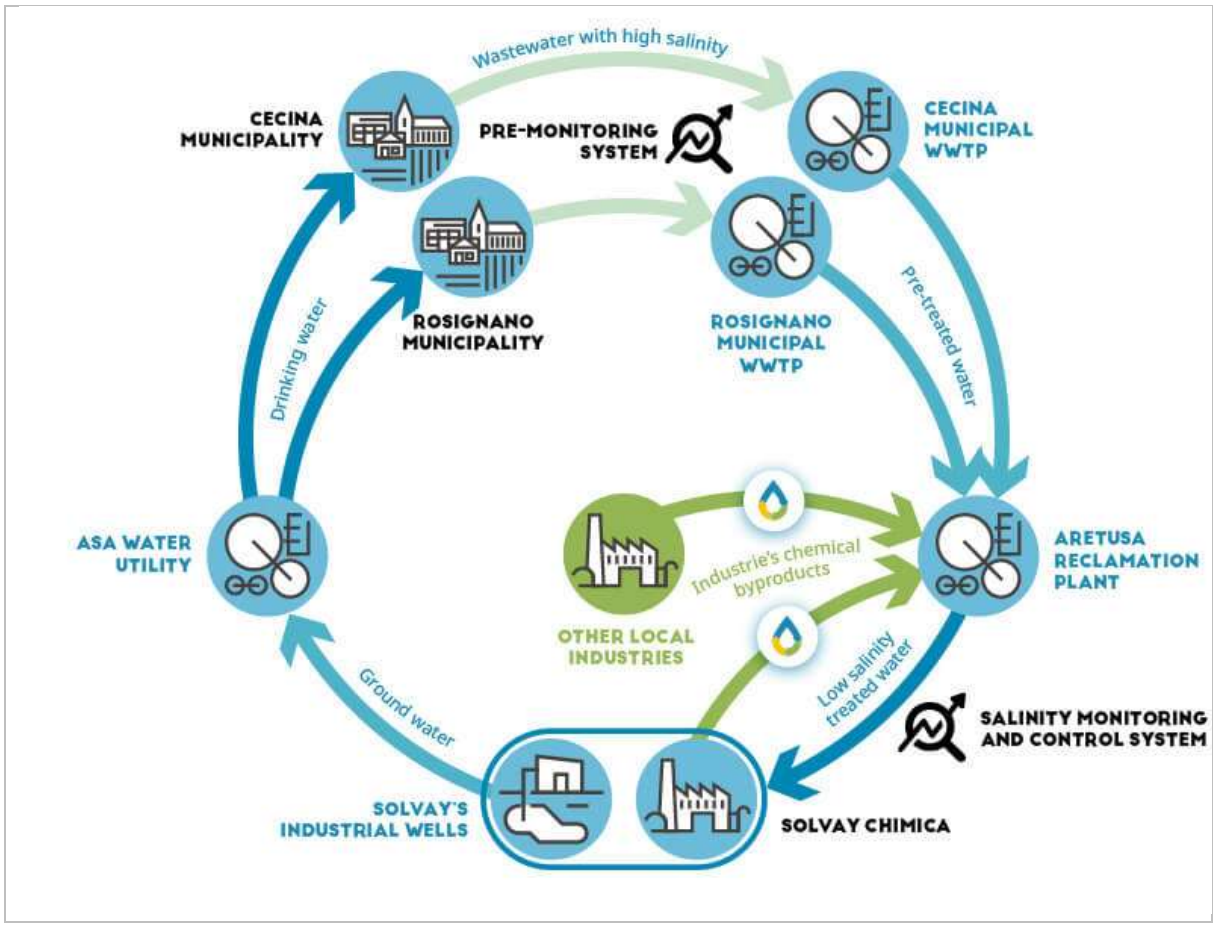

Figure 6 Overview industrial symbiosis in demo case 3 Italy.

Applied Technologies:

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- Adsorption with sludge-based renewable adsorbents
- Digitalisation of the sewer network and predictive smart equalisation contro
- Softening, coagulation and flocculation with alternative by-products
- UV Advanced Oxidation Process using spectroscopic sensors for monitoring purpose

Key Innovations & Actions:

- Analyses of seawater intrusion & chlorides content
- Impact validation of separation of saline wastewater
- Adsorption pilot system testing for organic material removal
- Studying possible reuse of chemical sludge

Legislation & Policy Recommendations:

Clarifying responsibilities and developing consistent guidelines for water reuse licensing and service provision across the EU are essential to ensure effective practices.

The strategic agenda proposes comprehensive coverage of all water reuse types, emphasising safety, environmental impact assessment, and the integration of reclaimed water into local water balances based on regional circumstances.
Future regulations should establish minimum standards for non-agricultural uses, enhance risk assessment, and promote research on innovative water reuse technologies and practices.
Assess the opportunity of eco-labels and certification schemes for circular by-products.

2.4. Demo Case 4, Nafplio (Greece) - Mobile Wastewater Treatment Unit

The demo case in Greece is developing a prototype of a mobile wastewater treatment unit to bring about circular economy in the fruit industry. Greener than Green Technologies has developed a methodology for the remediation of wastewater rendering it suitable for reuse, but also provides the ability to extract compounds of interest, or value-added compounds (VAC), form wastewater for further purification and commercial commercialisation. A prototype has been developed and installed in the facilities of Alberta, a juice manufacturer, near Nafplio. At first VACs are extracted by adsorption on suitable material, scubas polymeric resins. Suspended solids are then precipitated before further treatment by Advanced Oxidation process (AOP), where organic matter is decomposed by photocatalytic oxidation. The resulting is then subjected to biological treatment using a Small Bioreactor Platform (SBP) where bacteria encapsulated in a capsule made of a porous membrane decompose the remaining organic matter rendering the wastewater suitable for reuse; irrigation of nearby orchards, reuse within the facility for secondary uses such as cleaning or simply dispose of it in the local or municipal biological wastewater treatment plant as less organic burden as possible.

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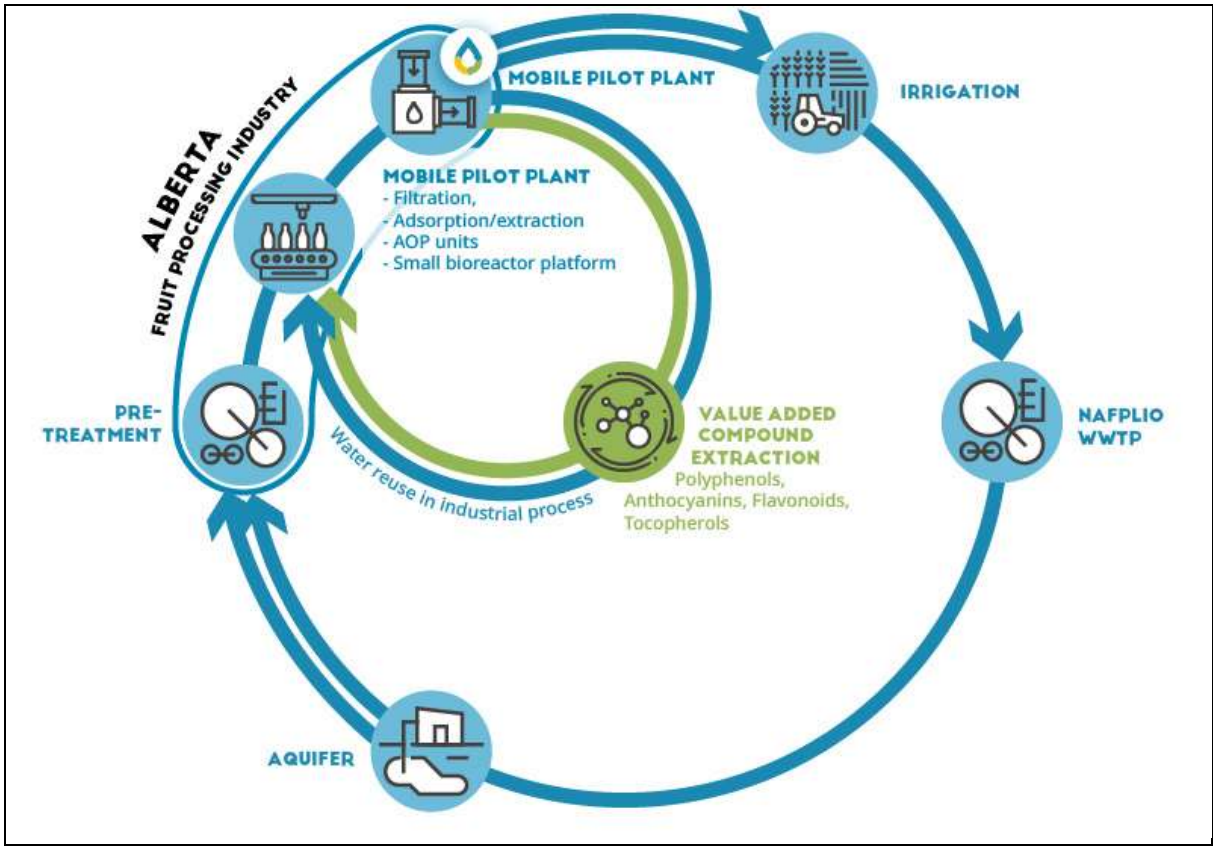

Figure 7 Overview industrial symbiosis demo case 4 in Greece.

Applied Technologies:

- Small Bioreactor Platform (SBP)

Key Innovations & Actions:

- Adsorption / Extraction
- Advanced Oxidation Process

Legislation & Policy Recommendations:

Clarifying responsibilities and developing consistent guidelines for water reuse licensing and service provision across the EU are essential to ensure effective practices.

The strategic agenda proposes comprehensive coverage of all water reuse types, emphasising safety, environmental impact assessment, and the integration of reclaimed water into local water balances based on regional circumstances.
Future regulations should establish minimum standards for non-agricultural uses, enhance risk assessment, and promote research on innovative water reuse technologies and practices.

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2.5. Demo Case 5, Lleida (Spain) - Water Recycling in the Beverage Industry

This demo case focuses on implementing water recycling technologies within the beverage industry. In Lleida, the water smart industrial symbiosis exists since 2009 and interlinks the Mahou San Miguel (MSM) brewery with a multinational utility Aqualia as well as the local municipal utility of Lleida and the Catalan Water Agency. Aqualia compares the performance of two bioreactor prototypes at the Mahou San Miguel brewery, an Anaerobic Membrane Bioreactor (AnMBR) and an ELectroStimulated Anaerobic Reactor (ELSAR®).

The brewery has its own wastewater treatment plant. However, up to now, there is no water reclaimed and no energy recovered. Mahou San Miguel desires to reduce its water consumption by 10% by 2025, which shall be facilitated by the Ultimate solution for water reclamation.

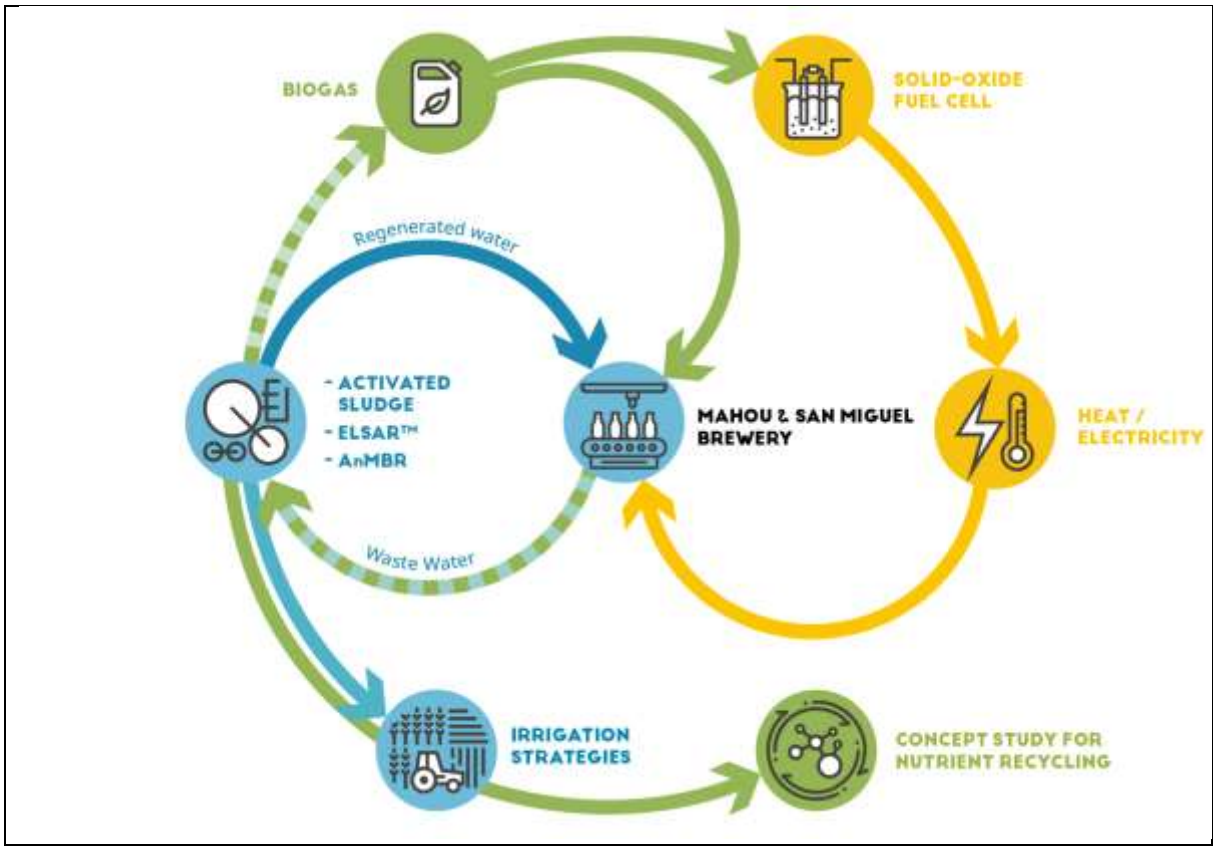

Figure 8 Overview industrial symbiosis demo case 5 in Spain.

Applied Technologies:

- Anaerobic Membrane Bioreactor (AnMBR) with degassing unit
- Early warning system for membrane fouling in anaerobic membrane bioreactors
- Electro-stimulated anaerobic reactor

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- Solid oxide fuel cell using biogas
- Ultrafiltration & nanofiltration membranes as pre-treatment for reverse osmosis

Key Innovations & Actions:
- Water reuse after secondary treatment
- Concept study for nutrient recovery
- Increased yield in biogas production

Legislation & policy recommendations:
Clarifying responsibilities and developing consistent guidelines for water reuse licensing and service provision across the EU are essential to ensure effective practices.

The strategic agenda proposes comprehensive coverage of all water reuse types, emphasizing safety, environmental impact assessment, and the integration of reclaimed water into local water balances based on regional circumstances.
Future regulations should establish minimum standards for non-agricultural uses, enhance risk assessment, and promote research on innovative water reuse technologies and practices.

To replicate biogas production and valorisation technologies in Europe, stable prices for upgraded biogas and electricity are needed at least for a period of five years to amortise the plant. Another five years would be beneficial, after an adaption on the energy market, to provide incentives to the investors.

To bridge a potential gap between the guaranteed price and the actual market price, subsidies might be needed. A minimum quota for upgraded bio-methane in the gas grid can further support the willingness of investors to implement biogas production technologies and upgrading units.

A simplification of administrative formalities and financial support related to the gas grid connection can highly accelerate the implementation of biomethane producing technologies.

2.6. Demo Case 6, Karmiel and Shafdan (Israel) - New Ways to Deal with Wastewater Shock Loads

Addressing the challenge of shock loads in wastewater treatment, this demo case focuses on developing adaptive solutions for managing unexpected surges in wastewater volume or pollutant concentration. It also addresses energy recovery via biogas production and the recovery of polyphenols within the food industry. The goal is to enhance treatment resilience.

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The agro-industrial sector includes agriculture, food industry, olive oil mills and water treatment. The symbiosis will enable to protect the current WWTP of Karmiel and Shafdan that are usually exposed to sudden shocks of strong and problematic agro-industrial wastewater (i.e., OMW, Slaughterhouse, winery).

Suitable pre-treatment of agro-industrial wastewater at the Shafdan site will enable the continuation of the current nature-based reuse system and supply water for agricultural activity in the Negev desert, even when receiving more agro-industrial wastewater in the future, in addition to partially reduce the energy demand, decrease the sludge production as well as increase the biogas production.

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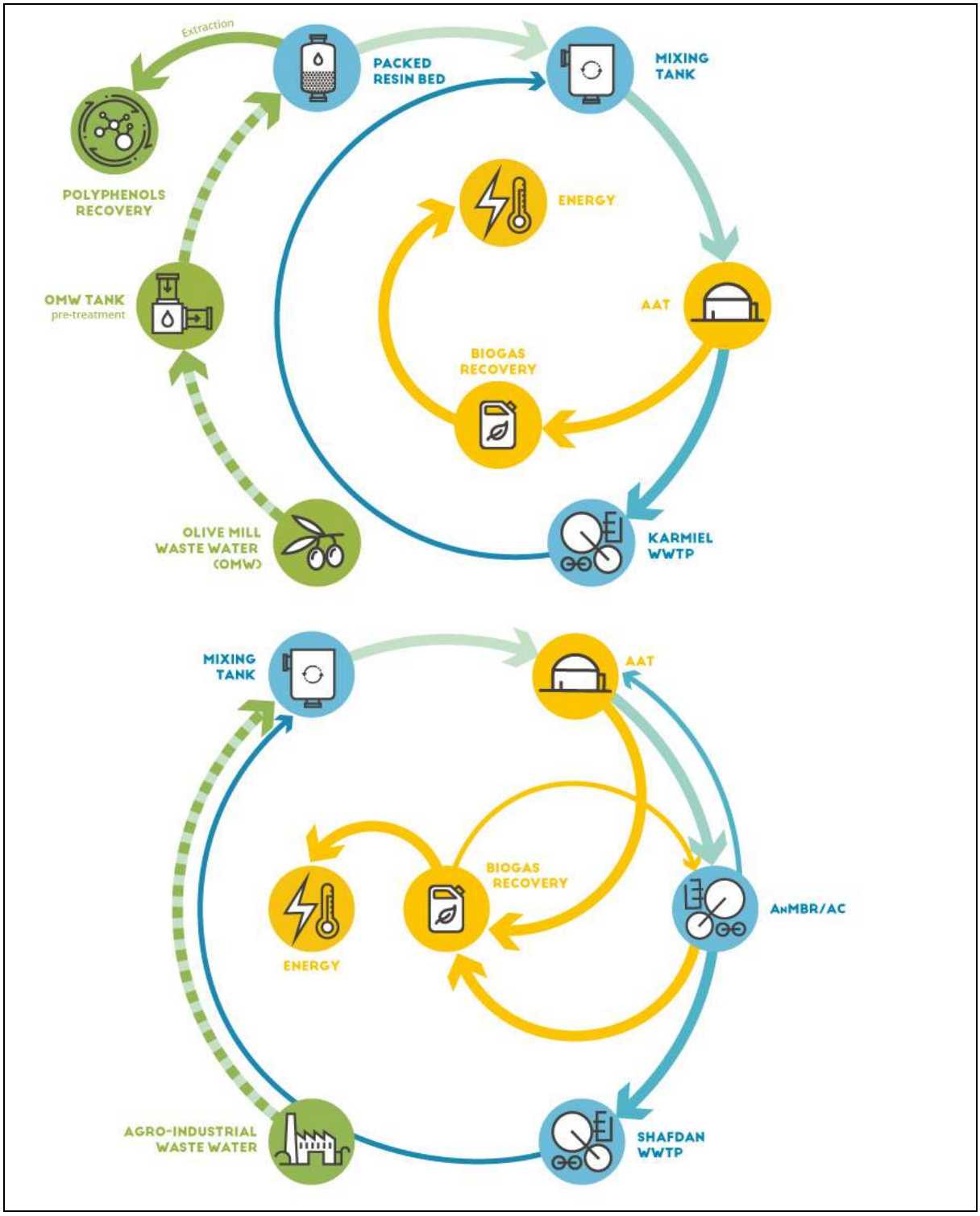

Figure 9 Overview industrial symbiosis in Karmiel (top) and Shafdan (bottom) in Israel.

Applied Technologies:

- Immobilised high-rate anaerobic reactor

Key Innovations & Actions:

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- Extraction of value-added compounds
- Biogas production
- Polyphenol removal

Legislation & Policy Recommendations:
To replicate biogas production and valorisation technologies, stable prices for upgraded biogas and electricity are needed at least for a period of five years to amortise the plant. Another five years would be beneficial, after an adaption on the energy market, to provide incentives to the investors.

To bridge a potential gap between the guaranteed price and the actual market price, subsidies might be needed. A minimum quota for upgraded bio-methane in the gas grid can further support the willingness of investors to implement biogas production technologies and upgrading units.

A simplification of administrative formalities and financial support related to the gas grid connection can highly accelerate the implementation of biomethane producing technologies.

2.7. Demo Case 7, Tain (United Kingdom) - Water Recycling, Energy Recovery, and Material Recovery in Distilleries

This demo case explores integrated approaches to water recycling, energy recovery, and material recovery within distilleries. The project aims to enhance resource efficiency and reduce the environmental impact from distillation processes.

This symbiosis interlinks the Glenmorangie whisky distillery and the company Aquabio which provides circular economy (CE) enabling treatment and reuse solutions. An anaerobic membrane bioreactor (AnMBR) was installed to treat the wastewater generated in the distillery during the whisky making processes and allows to discharge the treated effluent in the local estuary, the Dornoch Firth.
As part of ULTIMATE, Aquabio and Cranfield University collaborated with the Glenmorangie distillery and Alpheus, the current operator of the treatment site, (both stakeholders) evaluating options to expand the CE approach at the site. The AnMBR effluent provides opportunities for heat recovery, nutrient recovery and finally with further advanced treatment for water recycling within the distillery.

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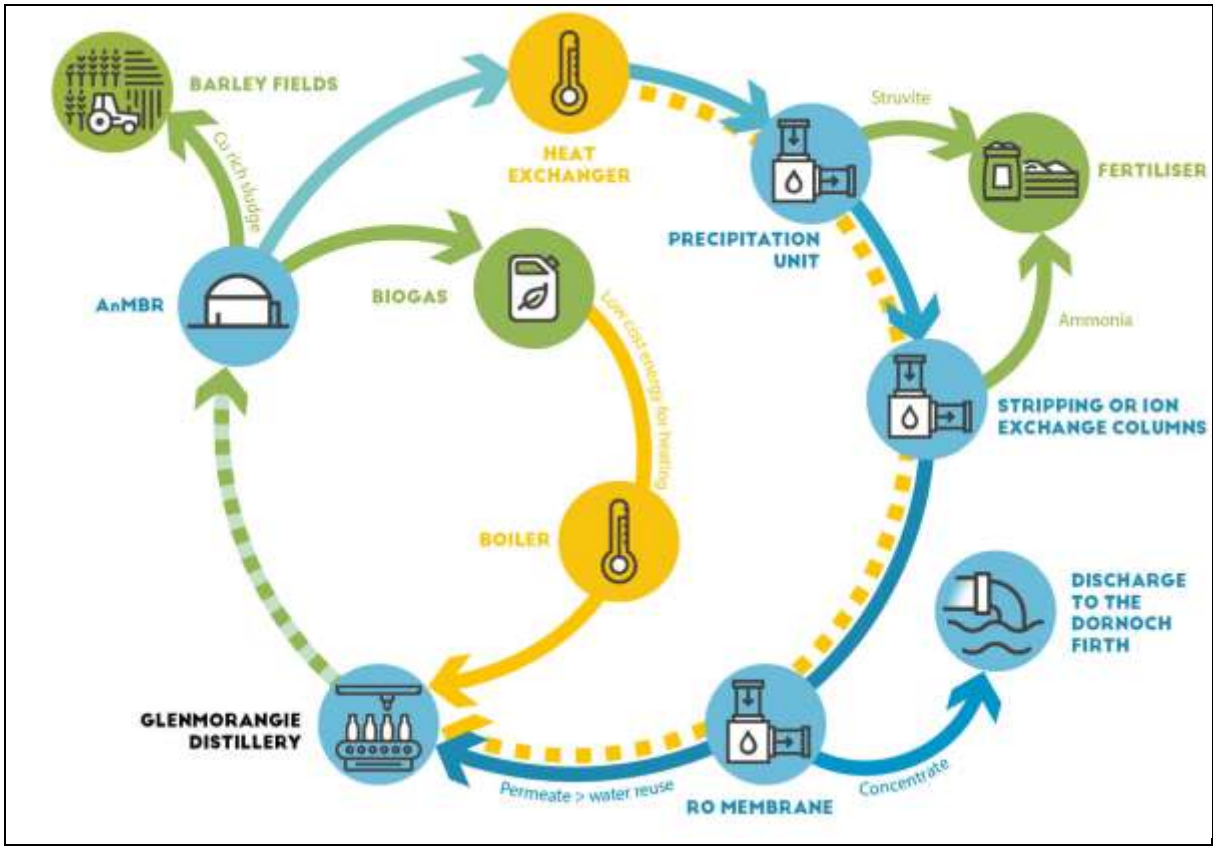

Figure 10 Overview industrial symbiosis at the demo case in United Kingdom.

Applied Technologies:

- Ammonium sulphate production (air stripping & scrubbing)
- Low grade heat recovery from wastewater
- Reverse Osmosis
- Struvite production

Key Innovations & Actions:

- Water reuse in cleaning processes in the distillery
- Ammonia & heat recovery from wastewater

Legislation & Policy Recommendations:

Clarifying responsibilities and developing consistent guidelines for water reuse licensing and service provision across the EU are essential to ensure effective practices.

The strategic agenda proposes comprehensive coverage of all water reuse types, emphasizing safety, environmental impact assessment, and the integration of reclaimed water into local water balances based on regional circumstances.

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Future regulations should establish minimum standards for non-agricultural uses, enhance risk assessment, and promote research on innovative water reuse technologies and practices.

Assess the opportunity of eco-labels and certification schemes for circular by-products. This may be an opportunity to foster material recovery purposes in Europe through the promotion of best practices to the consumers.

Additionally, a potential mandatory share of recovered fertilisers in conventional fertilisers can stimulate a market pull.

2.8. Demo Case 8, Roussillon (France) - Heat and Resource Recovery in Chemical Incineration Plant

Focusing on a chemical incineration plant, this demo case in France investigates methods for heat and resource recovery. SUEZ RR IWS Chemicals operates on this platform two hazardous waste incinerators that treat a significant proportion of the chemical platform waste and a biomass recovery unit that provides 15% of the chemical platform steam requirement. Aim is to reduce pollutant load in flue gas cleaning water of the incineration facility for hazardous and non-hazardous liquid waste. This leads to optimised energy use while minimising waste generation

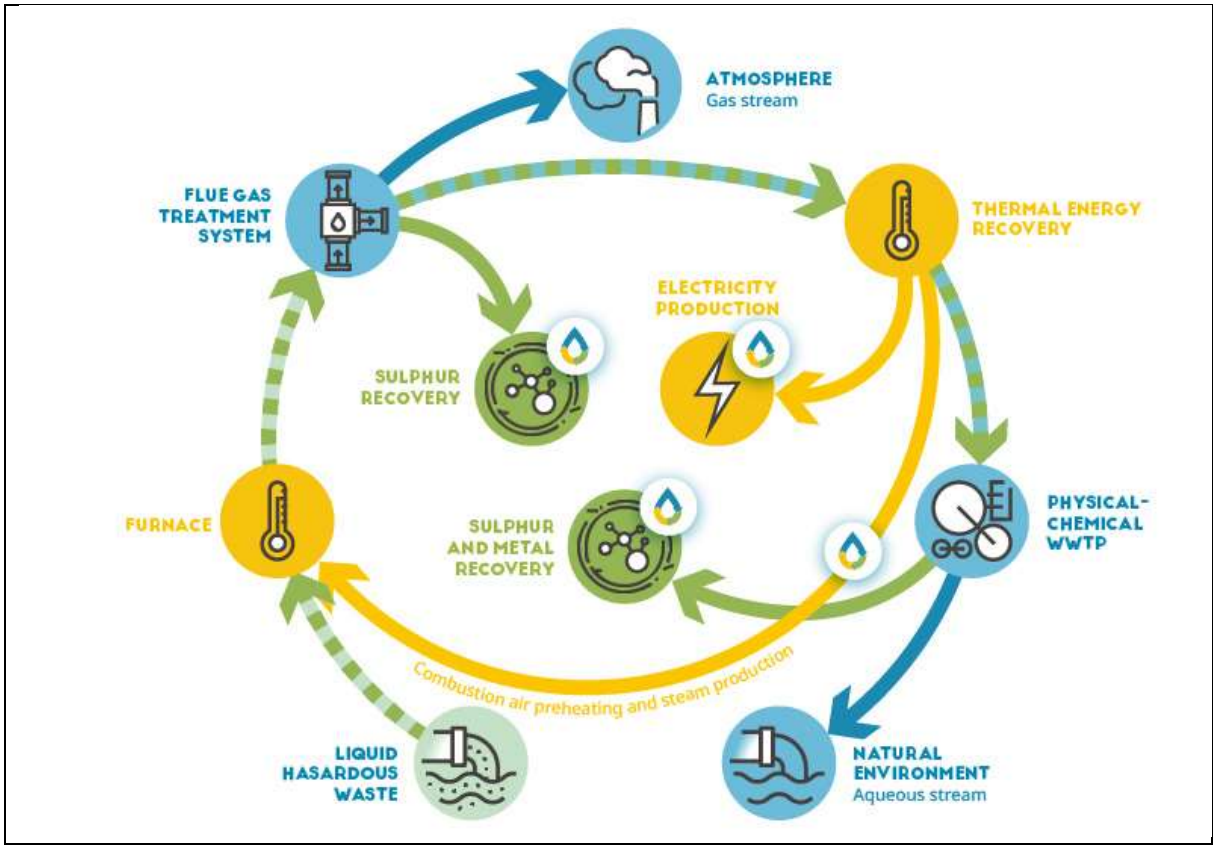

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Figure 11 Overview industrial symbiosis at the demo case in France.

Applied Technologies:
- Sulphur Recovery

Key Innovations & Actions:
- Manufacturing of a product from the sulphur dioxide
- Physical chemical wastewater treatment plant modification
- Energy production from hot scrubbing water

2.9. Demo Case 9, Kalundborg (Denmark) - Strengthening Water, Energy, and Material Reuse at the Kalundborg Industrial Symbiosis

This demo case exemplifies the principles of industrial symbiosis by strengthening the reuse of water, energy, and materials among industries in Kalundborg, Denmark. The focus is on enhancing collaborative efforts to create a closed-loop system.

The Kalundborg Industrial Symbiosis Association exists since 1972 and interlinks thirteen private and public companies. The local industrial sector includes petrochemical, light building construction material, food, pharma, biotech, energy and bioenergy as well as waste processing.

ULTIMATE focuses on the optimisation of two WWTPs aiming at developing and implementing a joint control system for both plants, the recovery of the WWTP effluent as fit-for-purpose water and to explore the potential for the recovery of valuable compounds from the industrial wastewater as well as on identifying options to reuse thermal energy recovered from wastewater. Therefore, the symbiotic relationship between Novozymes / Novonesis and Kalundborg Forsyning is extended in the frame of ULTIMATE to create a win-win situation for both.

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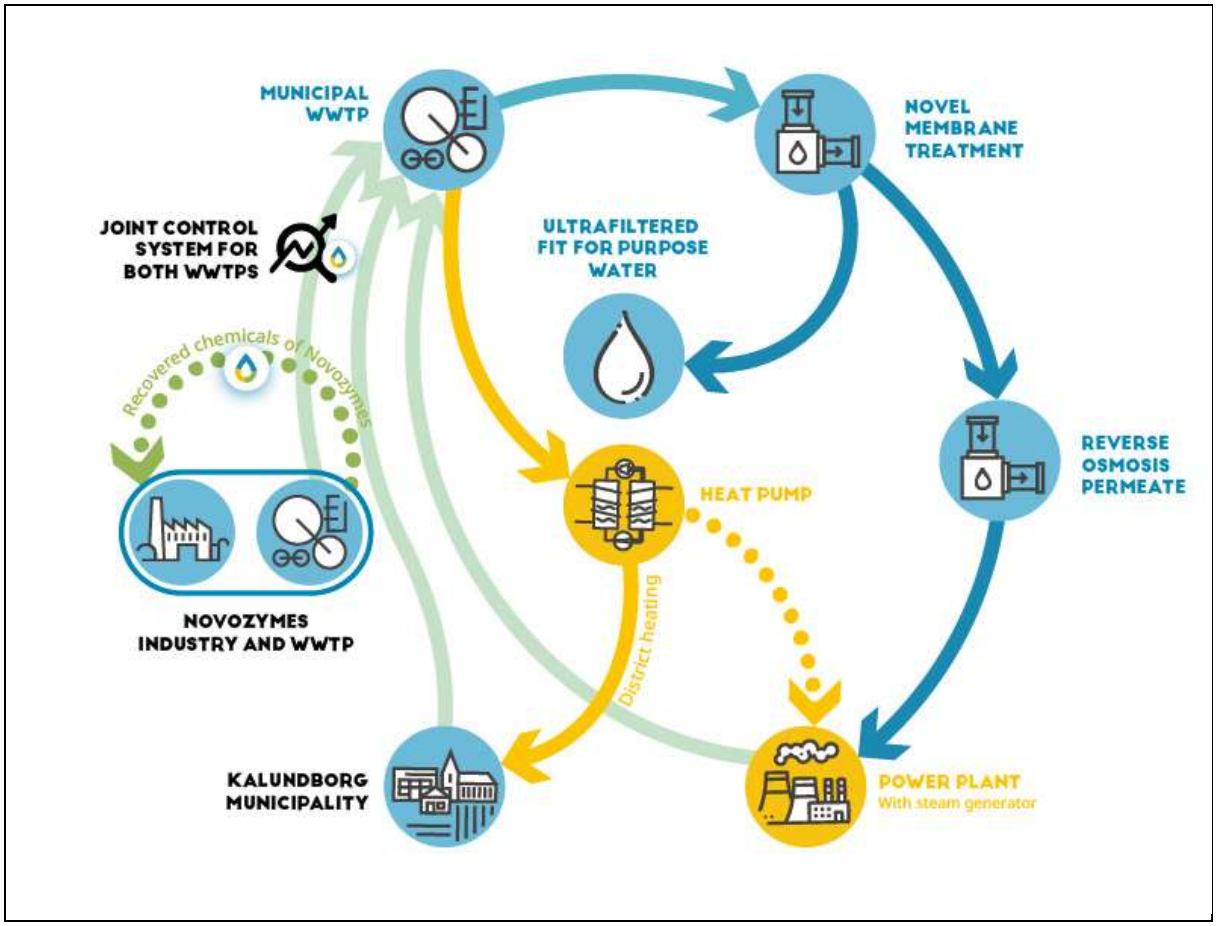

Figure 12 Overview industrial symbiosis at the demo case in Denmark.

Applied Technologies:

- Joint control system for two wastewater treatment plants
- Ultrafiltration & nanofiltration membranes as pre-treatment for reverse osmosis

Key Innovations & Actions:

- Exploitation of water reuse potential
- Identification of new purposes for recovered heat
- Concept study for the recovery of sulphur & acetic acid

Legislation & Policy Recommendations:

Clarifying responsibilities and developing consistent guidelines for water reuse licensing and service provision across the EU are essential to ensure effective practices.

The strategic agenda proposes comprehensive coverage of all water reuse types, emphasizing safety, environmental impact assessment, and the integration of reclaimed water into local water balances based on regional circumstances.

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Future regulations should establish minimum standards for non-agricultural uses, enhance risk assessment, and promote research on innovative water reuse technologies and practices.

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3. Conclusion

The ULTIMATE project serves as a pioneering initiative in demonstrating practical applications of circular economy principles through industrial symbiosis, particularly in water management. The diverse demo cases, located across Europe and beyond, showcase a comprehensive range of strategies that various industries can adopt to enhance sustainability and resource efficiency.

The key actions implemented in these demo cases underscore the importance of collaboration and stakeholder engagement in fostering a circular economy. For instance, the establishment of partnerships between water utilities, agricultural sectors, and industrial players exemplifies how shared resources can lead to significant improvements in water use efficiency. Additionally, the integration of innovative technologies in water treatment and recycling demonstrates the potential for advancements in efficiency and cost savings.

Moreover, the alignment of ULTIMATE's actions with the objectives of Hubs for Circularity (H4C) highlights a clear pathway for achieving circularity at regional and national levels. By engaging multiple stakeholders, these hubs facilitate the sharing of knowledge and resources, creating a network of support for industries seeking to implement circular practices. The lessons learned from ULTIMATE can serve as valuable insights for H4C initiatives, providing a roadmap for developing integrated strategies that prioritise sustainable water management.

For engaging with multiple stakeholders, various stakeholder tools had been implemented in the project at the individual demo cases. The key actions implemented in these demo cases underscore the importance of collaboration and stakeholder engagement in fostering a circular economy (as facilitated by the Community of Practice (CoPs) among other engagement practices). See also in Annex 1 an overview of the conducted CoPs meetings.

The ULTIMATE demo cases have proven that they could also embrace the concept of Water-Oriented Living Labs (WOLLs) in creating Water Smart Industrial Symbiosis Living Labs (WSIS-LLs)[1], which can provide a real-life environment where the different stakeholders of the Quadruple Helix come together to co-create, test, and scale innovative solutions for sustainable, secure, and resilient water industrial ecosystems.

[1] A WSIS LL is a collaborative, innovation-focused ecosystem that connects water service providers with industries to advance sustainable, circular water management. It leverages existing WOLLs to foster industrial symbiosis through shared knowledge and stakeholder engagement, promoting efficient resource use and reducing environmental impacts. WSIS LLs aim to enhance water-smart societies by integrating real-world testing, user feedback, and technology validation to address industry water needs effectively. For more information WSIS-LL, refer to ULTIMATE Deliverable D3.2 https://ultimatewater.eu/wp-content/uploads/file-manager/public-folder/Public%20Reports/D3.2ULTIMATE_WSIS%20Living%20Labs.pdf

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WSIS-LLs model emphasises the value of collaborative, on-the-ground experimentation as key approach for driving transformation in the water sector.

Moreover, ULTIMATE could also contribute to the discussion of the Water Resilience Strategy engaged by the European Commission. This institution aims to “ensure sources are properly managed, scarcity is addressed, and that we enhance the competitive innovative edge of our water industry and take a circular economy approach[2]. This objective is fully in line with the actions run by the project.

In summary, the ULTIMATE project not only showcases successful models of water reuse and efficiency but also reinforces the notion that collaboration and innovation are critical to transitioning towards a circular economy. The project’s findings advocate for a holistic approach that combines technological advancements with policy support and community engagement, paving the way for a smarter, more resilient water society.

[2] European Commission, *Political Guidelines 2024-2029 : Europe ’ s choice,* Brussels, 2024 link : https://commission.europa.eu/document/download/e6cd4328-673c-4e7a-8683-f63ffb2cf648_en?filename=Political%20Guidelines%202024-2029_EN.pdf

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Annex 1

Overview of Community of Practice meetings conducted in ULTIMATE

	CoP meeting	# of partici-pants	Type of organisations engaged	Meeting objective(s)	Gender diversity (%)	
					M	F
CS1	1	7	Research institutes, end-users (Tarragona Industrial Companies Association), water industry (AITASA) and external stakeholders	• Dissemination of ULTIMATE activities • Definition of the approach and objectives of the CoP	43	57
	2	16	Authorities, research institutes, end-users (Tarragona Industrial Companies Association), water industry (AITASA) and external stakeholders	• Dissemination of ULTIMATE activities to the Catalonia Administration • Definition of the legal approach in case AITASA scales up ULTIMATE solution in its facilities	56	44
CS2	1	13	Research institutes, end-users, representatives of Glastuinbouw Nederland and external stakeholders	• Get to know each other • Share experiences with organising cooperative water treatment in horticulture • Identify topics of interest for the CoP and topic for next CoP meeting. Identify additional parties to be invited to CoP	77	23
	2	9	End-users, representatives of Glastuinbouw Nederland and external stakeholders	• Present the results from ULTIMATE aimed at the requirements from De Vlot (water and nutrient recovery using ED) • Reflection and discussion on the results	100	0
CS3	1	35	Public authorities, engineering companies, representatives of other sectors, research institutes, end-users, water industry and external stakeholders	• Learn more about our Stakeholders and introduce the ULTIMATE CS3 Partners • Introduce the Stakeholders to the project, showing some details, explaining the importance of the “Work Package-WP” system	71	29

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	CoP meeting	# of partici-pants	Type of organisations engaged	Meeting objective(s)	Gender diversity (%)	
					M	F
				• Explain the meaning and the potential benefits to be part of a Community of Practice • Validate the composition of the Community and the Roadmap, even presenting the potential topics to face during the next meetings • Co-define with stakeholders their level of involvement and their kind of specific expertise as added value for the ULTIMATE Project • Co-define with stakeholders the mission and interests of the CoP, considering short- and long-term value and impact		
	2	40	Public authorities, engineering companies, representatives of other sectors, research institutes/universities, end-users/industry, water utilities and external stakeholders	• Analyse current legislations about quality requirements for treated wastewater reuse in irrigation and further purposes • Analyse regulation strategy and discuss on planning opportunities / alternatives to encourage water reuse • Deal with critical aspects through local-regional water reuse experiences and start with the exploration of governance scenarios locally available • Start analysing ARETUSA Governance from a multi-purpose point of view: consider integrating industrial reuse with other ones (basically agricultural reuse)	78	23
	3	50	Public authorities, engineering companies, representatives of other sectors, research institutes/universities, end-users/industry, water utilities and external stakeholders	• Analyse current legislations about the definition of a “by-product” and the requirements regarding the End-Of-Waste procedure, to	74	26

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CoP meeting	# of partici-pants	Type of organisations engaged	Meeting objective(s)	Gender diversity (%)	
				M	F
			enhance material reuse through circular systems • Analyse regulation strategy and discuss on planning opportunities / alternatives to encourage material reuse • Deal with critical aspects through local-regional material reuse experiences and start with the exploration of scenarios locally available • Inform the Community about the progress in ULTIMATE project and introduction about AquaSPICE project to show the importance of the relationship between local issues to solve, European research program H2020 and an engineering-based approach		
4	21	No data	• Living Lab meeting organised with Water Europe • Meeting to lay the foundations for a concrete comparison between the various administrations and potential users through the sharing and exchange of experiences/good practices with the objective of stabilising water quality and quantity and safeguarding the water resource in Cornia Valley	No data	No data
5	41	Public authorities, engineering companies, representatives of other sectors, research institutes, end-users, water industry and external stakeholders	• Analysis of the legislation on the wastewater reuse in agriculture, highlighting territorial opportunities through the application of the new EU regulation 741/2020 in Italy (new dpr) to enhance water reuse through circular systems • Deal with critical aspects through local water reuse for industrial purpose	63	37

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	CoP meeting	# of partici-pants	Type of organisations engaged	Meeting objective(s)	Gender diversity (%)	
					M	F
				experiences (Val di Cornia (Livorno)) and illustration of synergies with the Ultimate project; in particular, highlight the contribution that Consorzio Aretusa is promoting at environmental level in the European scenario thanks also to Solvay's concrete commitment to reduce water consumption for industrial use • Presentation of the predictive model of the quality of wastewater in the sewer network, in order to optimise the performance of the water reclamation plant and consequently the quality of the effluent • Inform the Community about the progress in ULTIMATE and AquaSPICE projects to show the importance of the relationship between local issues to solve, European research program H2020 and an engineering-based approach		
CS4	1	23	Authorities, engineering companies, research institutes, end-users, water industry, representatives of other sectors and external stakeholders	• Identify all the stakeholders and to co-set the scene regarding the number of meetings, the possibility of formatting focus groups	65	35
	2	25	Authorities, engineering companies, research institutes, end-users, water industry, representatives of other sectors and external stakeholders	• Present the water reuse regulation in Greece & EU and to identify barriers	60	40
	3	18	Authorities, research institutes, end-users, water industry, representatives of other sectors and external stakeholders	• Demonstrate the unit • Involve stakeholders from the local community • Present the progress of the project	67	33

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	CoP meeting	# of partici-pants	Type of organisations engaged	Meeting objective(s)	Gender diversity (%)	
					M	F
				• Motivate and inspire the stakeholders by showcasing examples of industrial symbiotic systems and water reuse installations in a larger scale and different sectors		
CS5	1	13	Engineering companies, research institutes, end-users and water industry	• Dissemination of ULTIMATE activities	77	23
	2	9	Authorities, engineering companies, research institutes, end-users and representatives of other sectors	• Interchange experiences and different views between water sector shareholders (belonging to different areas of the chain value) specialists or with experiences on water reclamation • Dynamize sectorial networking between attendees • Understand the view, the drivers, the particularities and the uncertainty to be dealt with of the shareholders around water reclamation	78	22
	3	18	Authorities, research institutes, end-users, water industry, biogas/biomethane industry and hydrogen industry	• Interchange experiences and different views between water sector stakeholders (belonging to different areas of the chain value), specialists or with experiences on water reclamation • Dynamize sectorial networking between attendees • Understand the view, the drivers, the particularities and the uncertainty to be dealt with of the stakeholders around energy in the water cycle	78	22
CS6	1	37	Authorities, engineering companies, research institutes, water industry	• Present the ULTIMATE project • Provide an overview of the problem of dumping	73	27

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	CoP meeting	# of partici-pants	Type of organisations engaged	Meeting objective(s)	Gender diversity (%)	
					M	F
				untreated agro-industrial waste into the central wastewater treatment system • Outline the ULTIMATE technologies by the technology providers • Review the existing regulations related to this issue • Provide a platform for end users, water corporations, generators of agro-industrial waste, regulators, engineers and others to exchange ideas and suggestions face to face • Share knowledge and discuss the steps for successful design and implementation of water-related technologies and innovations		
CS7	1	10	Engineering companies, research institutes, end-users and water industry	• Introduce the ULTIMATE project, the case study and some of the initial results • Discuss with the stakeholders the potential and limitations in the implementation of industrial symbiosis and circular economy in this context	70	30
CS8	1	14	Upstream customer, economic interest group, transport and trading of secondary raw material	• Presentation of the project (European context, ULTIMATE project, CS8 objectives, resources and planning) • Presentation of CoPs (definition, objectives, benefits, etc.) • Building our CoPs (members, objectives, organisation)	57	43
CS9	1	44	Food/biotech & pharmaceutical industries, authorities, water industry,	• Introduction to ULTIMATE and CoPs	66	34

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	CoP meeting	# of partici-pants	Type of organisations engaged	Meeting objective(s)	Gender diversity (%)	
					M	F
			and representatives of other sectors	• Water Reuse and the water smart industrial Symbiosis in Tarragona • Overview of the present situation in EU in relation to the results in the Kalundborg case • Results of the Pilot Installations in Kalundborg		
	2	32	Food/biotech & pharmaceutical industries, authorities, water industry, and representatives of other sectors	• The latest from the 9 cases of ULTIMATE • Next steps in the Kalundborg pilot plants • Supply of Petro-chemical Industry with the right water quality • Reused water as municipal drinking water (with perspectives from Sweden where this is already a reality)	59	41
	3	47	Food/biotech & pharmaceutical industries, authorities, water industry, and representatives of other sectors	• Kalundborg Utility and water supply and consumption in the coming years • Overview and present status of the ULTIMATE project • Latest results and update of the 9 cases In ULTIMATE (focusing on those specifically relevant to Kalundborg)	64	36
	4	28	Food/biotech & pharmaceutical industries, authorities, water industry, and representatives of other sectors	• ULTIMATE and status of its case studies • Production of fit-for-purpose water in Kalundborg • Experience on operating a full-scale water reclamation plant in Belgium	64	36
	5	49	Food/biotech & pharmaceutical industries, authorities, water industry, and representatives of other sectors	• Update on the ULTIMATE activities in Kalundborg • Perspectives from Koyambedu Water Reclamation Plant in India • Experience on Operating a full-scale water reclamation plant in Rosignano in Italy	57	43

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	CoP meeting	# of partici-pants	Type of organisations engaged	Meeting objective(s)	Gender diversity (%)	
					M	F
	6	54	Food/biotech & pharmaceutical industries, authorities, water industry, and representatives of other sectors	• Final results from pilot plant operation for water reclamation in Kalundborg • Microbial health risk assessment of water reuse scheme in Kalundborg • Tackling the development of regulatory frameworks for water reuse in Malta through the EU Water Reuse Regulation	67	33
	7	No data	No data	• Main outcomes of the 9 ULTIMATE case studies • Life cycle assessments of selected case studies • ULTIMATE''s added value for the Industrial Symbiosis Kalundborg and Kalundborg Utilities • Insight in the plans for the Horizon Europe project "Recreate" which is Kalundborg Utility's follow-up project on water reclamation, water reuse and new water technologies	No data	No data

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