



Advancing Sustainability of Process Industries through Digital and Circular Water Use Innovations

AquaSPICE: Capitalising the experience of other projects to achieve a successful (water) symbiosis

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AquaSPICE Innovation Pillars

CIRCULAR INNOVATION

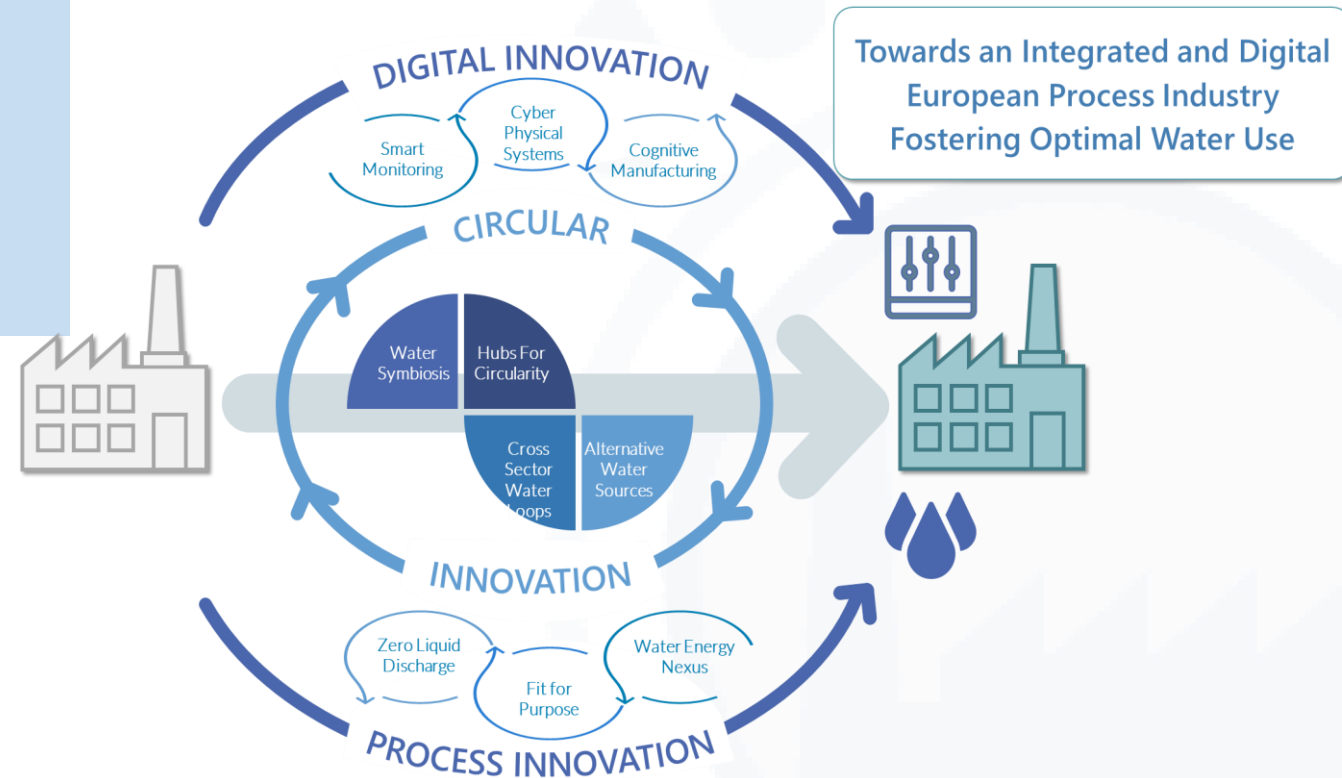
- Water re-use options at different levels
- Design, monitoring and evaluation of demonstration schemes using systemic methodologies and tools, based on holistic modelling concepts

PROCESS INNOVATION

- Installation,
- Operation, and
- Assessment of advanced technologies and practices with energy and substances recovery

DIGITAL INNOVATION

- Water-specific Cyber-Physical-System (WaterCPS) synthesises digital twins of industrial and value chain entities to provide advanced water-saving awareness and optimised water efficiency at different industrial levels
- Real-time monitoring and distributed data management system connects the physical and digital worlds through smart sensor networks, IIoT and cloud/edge technologies



Capitalising the experience of relevant EU funded projects

Name	Year	Waste	Type	Region	Led by
enCO ₂ re	2015-2016	Carbon Dioxide	Gas	Northern Europe	Industry
Bri4Food	2016	Brines	Liquid	Mediterranean	Industry
SWAN	2019-2020	Solid Waste	Solid	Balkan Region	Public Authority
AquaSPICE	2020-2024	Industrial Water	Liquid	EU	RO

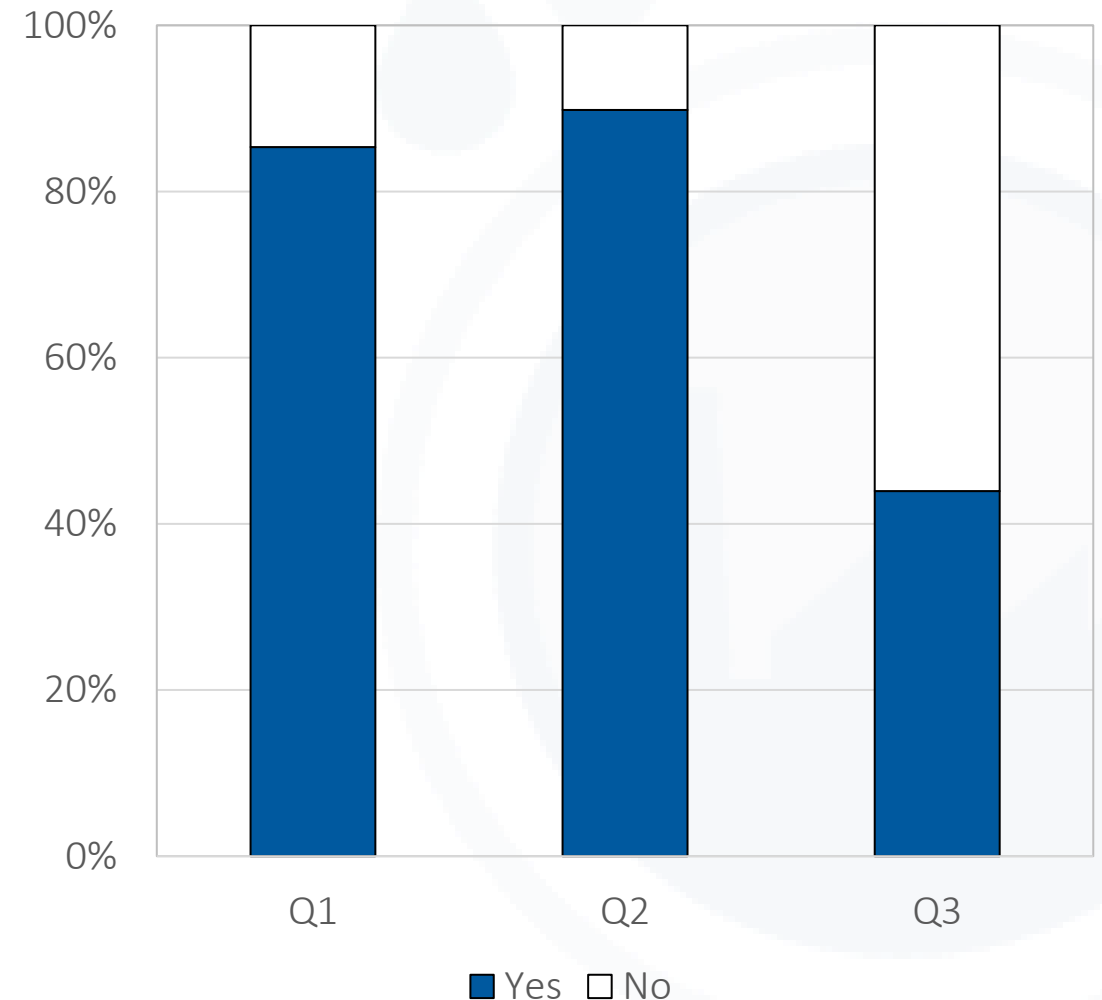
- Different Characteristics, Different Barriers and Different Problems
- Main factors examined
 - Technical Considerations
 - Industrial and Public Awareness
 - Common Sense

Technical Considerations

	Solid Waste	Gas Waste	Liquid Waste
Waste Source	Manual or mechanical sorting and separation	Capture and Purification	Purification/Treatment
Storage	Most probably required	Only if liquified (as intermediate step)	Rarely Considered
Matching Sources with Receivers	Challenging since the streams are not uniform/homogenous	Based on purity of main component / presence of hazardous compounds	Based on stream composition / presence of hazardous compounds
Transportation	Trucks only	Trucks, pipes, ships	Mostly using pipes
Environmental Impact	Carbon Footprint	Carbon Footprint	Carbon & Water Footprint
Safe Reuse	Hazardous waste excluded from the matching process	Need for end-of-waste criteria	EU/National Directives for reuse based on sector
Aspects for IS success	Industrial Awareness	Distance, Product Acceptability	??

- 315 industrial plants in the Balkan Region
 - Q1 Are you familiar with the concept of industrial symbiosis?
 - Q2 Would the plant be interested in participating in symbiotic value chains?
 - Q3 Are there any existing symbiotic links in the company?

Industrial awareness exists but the instruments are missing. AquaSPICE will (hopefully) contribute closing the gap by facilitating stakeholder engagement at Case Study level



- In order of the new business models to be economic viable, there needs to be a market for the new products.
- Would you buy a fizzy drink with captured CO₂ from a nearby chimney?
- Would you buy an exfoliant from used coffee grains?

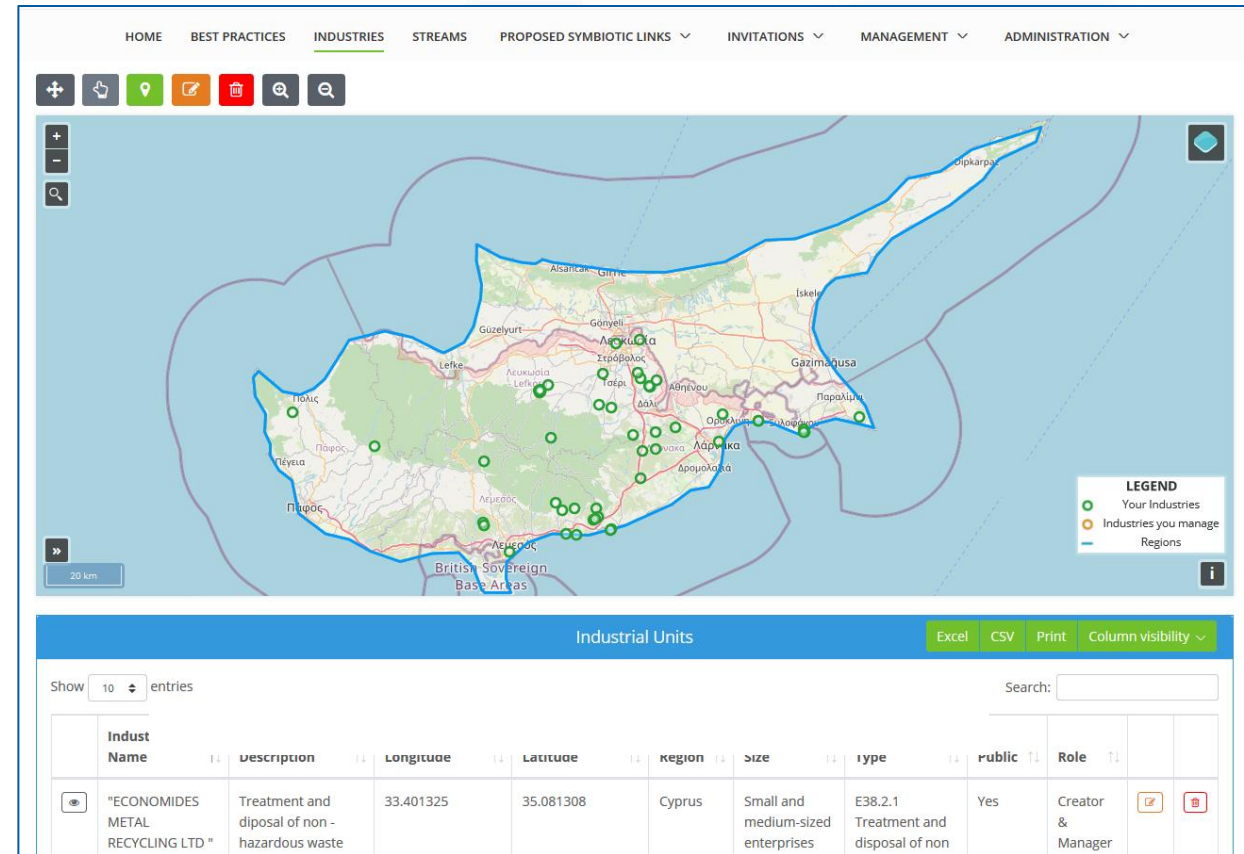
Would you buy:	1: Strongly Disagree 5: Strongly Agree
Petrol for your car	4.31 (SD 0.91)
Mattress for your bed	4.06 (SD 0.96)
Concrete for your house	4.20 (SD 0.91)
1 kg tomatoes	3.79 (SD 1.11)
1 bottle of fizzy drink	3.88 (SD 1.06)
Dietary supplements	3.75 (SD 1.07)

Public knowledge affects acceptability and thus success of symbiotic schemes. Public showed willingness to support such schemes. AquaSPICE will (hopefully) contribute to increase awareness via its Communication, Dissemination, Training and Social Awareness strategy.



- Usually, the waste stream in a symbiotic scheme is incorporated in the final product.
- What might go wrong if the waste stream is not incorporated but used as a supplementary resource in a different production line?
- A desalination unit provides drinking water to the local community, and has the right to discharge water to the water body quid pro quo...
- What if they want to redirect the wastewater stream to another local industry?

Should we / can we address everything?

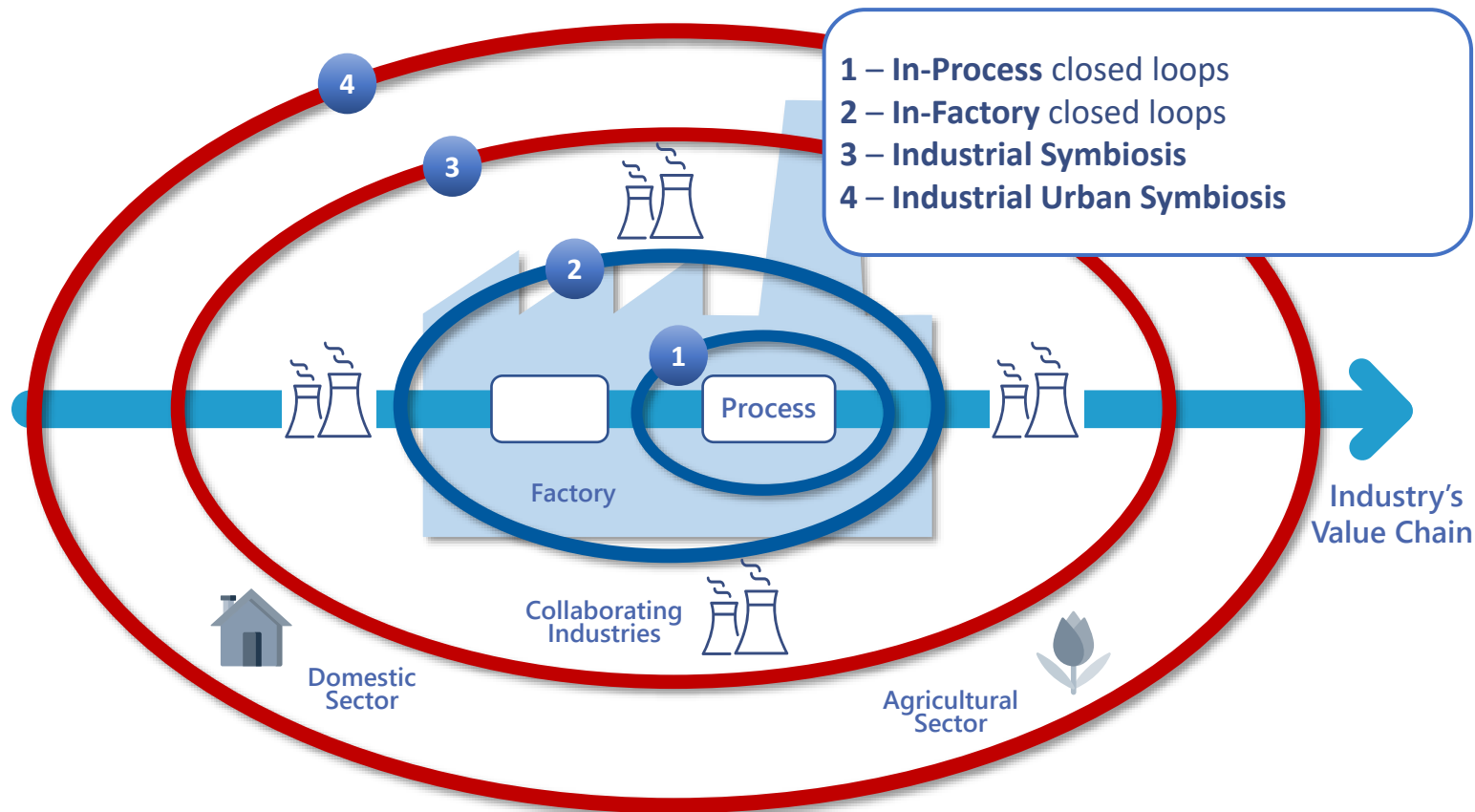
- Design and develop an online platform that will facilitate the formulation of novel symbiotic business models focusing on water/wastewater reuse.
- Propose alternative solutions and assess their technical feasibility using a semantic approach based on the qualitative and quantitative characteristics of the water/wastewater streams
- Assess the economic viability of all the technically feasible symbiotic schemes.



The screenshot displays the AquaSPICE web application interface. At the top, there is a navigation menu with options: HOME, BEST PRACTICES, INDUSTRIES, STREAMS, PROPOSED SYMBIOTIC LINKS, INVITATIONS, MANAGEMENT, and ADMINISTRATION. Below the menu is a toolbar with icons for home, location, edit, delete, search, and zoom. The main area features a map of Cyprus with various locations marked by green and orange dots. A legend in the bottom right corner of the map area identifies the markers: green dots for 'Your Industries', orange dots for 'Industries you manage', and blue lines for 'Regions'. Below the map is a table titled 'Industrial Units' with a search bar and a 'Show 10 entries' dropdown. The table has columns for Indust Name, Description, Longitude, Latitude, region, size, type, public, Role, and a column with edit and delete icons. The first row of data is as follows:

Indust Name	Description	Longitude	Latitude	region	size	type	public	Role	
"ECONOMIDES METAL RECYCLING LTD "	Treatment and disposal of non-hazardous waste	33.401325	35.081308	Cyprus	Small and medium-sized enterprises	E38.2.1 Treatment and disposal of non	Yes	Creator & Manager	 

Applying Industrial Symbiosis in AquaSPICE



Waste to fuel transformation in a Biorefinery at JEMS
 Location: Ljubljana (SL)
Symbiotic potential between biorefinery, agricultural stakeholders, local municipality and industrial plants



Water treatment and re-use with peroxide production units at SOLVAY
 Location: Tuscany and Marche (IT)
Symbiotic potential between Solvay, ARETUSA and local municipality



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Thank You!

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