Policy Brief

The Benefits of a Digital and Holistic Approach based on a Water-Smart Industrial Symbiosis for a Competitive Industry

December 2024

The AquaSPICE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 958396.

AquaSPICE is an EU-funded project (Horizon 2020) that brings together 27 partners from 12 countries and aims at materialising circular water use in European process industries, fostering awareness in resource-efficiency and delivering compact solutions for industrial application. The project aims to reach this objective through the development and validation of water efficiency management and optimization methodologies, technologies and tools; the creation of a water-specific cyber-physical system; and the definition of effective methodological, regulatory and business frameworks.

KEY OBJECTIVES

- Decrease water intake by 20% (goal);
- Significant steps towards closed-loop systems in industrial processes.
- Break the existent silos to empower cross-domain decision-making and enabling industries to share data;
- Support data spreading to enable circular economy and process symbiosis strategies;
- Provide metadata and context-based information to interlink water-management information with industrial process, material and energy industrial fluxes;
- Generating open linked data related to industrial process and process symbiosis information;
- Support the construction of data models that allow to harmonise the information exchange and the production of Open APIs to explore such information;
- Support the data understanding about circular economy and industrial symbiosis practices.

In its five case studies, AquaSPICE project increases awareness in resource efficiency, including water treatment, technologies for reuse, and closed-loop recycling practices. The project will also develop a cyber-physical-system controller including a system for real-time monitoring, assessment and optimisation of water use and reuse at different interconnected levels.

MAIN RECOMMENDATIONS

- Provide a holistic approach by breaking the existent silos to empower cross-domain decision-making and enabling industries to share data;
- Provide incentives to facilitate the integration of digital monitoring systems in water-smart symbiosis practices
- Foster the interoperability and accessibility of the data in order symbiosis to enable circular economy and process symbiosis strategies

DISCLAIMER: *The project consortium can be contacted via AquaSPICE's contact platform to get the information in the respect of this confidentiality framework.*

Tackling water crisis through water-smart and digital solutions

Each corner of Europe is increasingly affected by either too much, too little, too polluted water, or a combination thereof. These water challenges constitute a water crisis and put at risk the availability of a resource that is essential to our industry.

Around 20% of global fresh water consumption is used by industry. This proportion is increased to 50% in industrialised countries. While treatment is not always needed (e.g. cooling water), the industrial sector is also a major water polluter, as only up to 60% of industrial wastewater receives treatment before being disposed of into the environment.[1]

Indeed, water-related risks could significantly affect businesses and were noted by almost 70% of the firms reporting to a CDP survey.[2] By adopting new water-efficient technologies to reduce water consumption and exploit the value of and in water, businesses can lower their environmental impact and free up water for others. The CDP values these "water-related opportunities" at approximately €640 billion,[3] reflecting savings, market growth in water-smart technologies, and improved community relations.

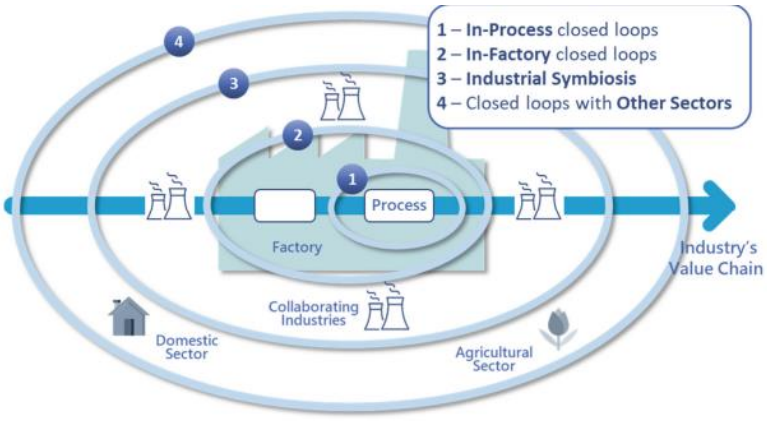

Figure 1: Systemic approach in water management where water efficiency can be achieved in different levels.

AquaSPICE aims at materialising water-smart industrial symbiosis[4] by following three objectives:

- Develop and validate water efficiency management and optimise methodologies, technologies and tools;
- Create a water-specific cyber-physical system;
- Define effective methodological, regulatory and business frameworks.

[1] AquaSpice, *AquaSpice website*, https://aquaspice.eu/ (consulted on 14.08.2024)
[2] Miriam Denis Le Sève, *CDP Global Water Report 2022*, 2023, https://cdn.cdp.net/cdp-production/cms/reports/documents/000/006/925/original/CDP_Water_Global_Report_2022_Web.pdf?1679328280
[3] Ambroise Fayolle and Henk Ovink, *Water crisis: a vital investment opportunity*, European Investment Bank, 22nd of March 2023. U.R.L.: https://www.eib.org/en/stories/water-crisis-investment (consulted on 14.08.2024)
[4] Water Smart Industrial Symbiosis (WSIS) aims to create economic value and increased sustainability by introducing circular symbiotic arrangements between industry and water service providers.

AquaSPICE promotes a Water Efficiency Framework[5] based on 4 phases comprising a total of 10 steps to enhance water circularity in the European Process Industry. It aims to suggest a tailored plan to industries in order to refine their way to manage water; encompassing all the steps from the exploitation of the freshwater to the treatment and potential reuse of their wastewater.

Supporting EU Legislation by Water-Smart Industrial Symbiosis

AquaSPICE builds upon the Green Deal[6] and Digitalisation of Europe[7] agendas. It will contribute to the main strategic plans such as the Zero Pollution Action Plan[8], the Circular Economy action plan,[9] which extends water reuse for industrial uses[10], and the EU Climate Target Plan[11] by helping to mature and develop innovative, reproducible technologies for water-efficient processes and digital monitoring.

In 2020, AquaSPICE [12] in cooperation with ULTIMATE[13] and NextGen[14] stressed:

- **Digital transformation of the water sector can support water-smart management in cities and greater regions via circular processes**, and be key for risk management, smart water use, and early warning systems.
- **Circular transition of water in small and decentralised communities**, which is supported by innovative solutions that combine green, grey, and digital infrastructure can support climate change adaption and reduction of water scarcity.
- **Circular transition in industrialised regions and symbiosis between industry and wastewater treatment plants could support resource efficiency.**

AquaSPICE particularly contributes to the Industrial Strategy[15] by providing new tools to reduce and prevent strategic dependencies on water. It will also support the implementation of the new Industrial Emissions regulatory framework[16] and facilitate synergies with other legislation objectives such as the new Urban Wastewater Treatment Directive,[17] contributing to a fair and sustainable industry whilst improving its global competitiveness.

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[5] AquaSpice, *D1.4 – The AquaSPICE Conceptual Water efficiency Framework*, 30 May 2023.

[6] European Commission, European Commission website, *Delivering the European Green Deal*, U.R.L: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en (consulted 14.08.2024)

[7] European Parliament, *A Europe fit for the digital age,* U.R.L.: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age_en (consulted 14.08.2024)

[8] European Commission, Communication COM/2021/400, « Pathway to a Healthy Planet for All EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil'», 2021. Link: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021DC0400&qid=1623311742827

[9] European Commission, Communication COM/2020/98, *A New Circular Economy Action Plan For a Cleaner and More Competitive Europe*, 11th of March 2020. U.R.L.: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN

[10] European Commission, Communication COM/2020/98, "*A new Circular Economy Action Plan* ». Link: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN

[11] European Commission, Communication, COM/2020/562, *EU Action, Stepping up Europe's 2030 climate ambition*, 2020. U.R.L.: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0562

[12] European Commission, European Research Executive Agency, Borja Barberà, C., González Camejo, J., Fatone, F. et al., *European Horizon 2020 systemic actions for water-smart circular cities, regions and industries – Post-conference H2020 report ECOMONDO 2021*, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2848/972029

[13] EU-Funded ULTIMATE Water project. see https://ultimatewater.eu/

[14] EU-Funded NextGen Water project. See https://nextgenwater.eu/

[15] European Commission, European Industrial Strategy, *op.cit*.

[16] European Commission, Directive 2010/75/EU, *Directive on Industrial Emissions (integrated pollution prevention and control)*. U.R.L.: https://data.consilium.europa.eu/doc/document/ST-16939-2023-INIT/en/pdf

[17] European Commission, 2022/0345/ COD, *Directive concerning Urban Wastewater Treatment Directive (recast)*, 2022. U.R.L.: https://environment.ec.europa.eu/publications/proposal-revised-urban-wastewater-treatment-directive_en

Generating and sharing key data between process industries lie in the core of the AquaSPICE project, which strongly support the INSPIRE Directive (2007/2/EC)[18] aiming to create an European spatial data infrastructure for environmental policies. The EU needs to enhance Digital Water[19] through sensors deployment to effectively monitor industrial water quality and quantity[20].

The AquaSPICE semantic model adds significant value by enabling data representation for circular economy strategies, providing context-based information, generating open linked data, and supporting the creation of open APIs for data exploration. This kind of model is regularly encouraged by the Council of the European Union, such as in its conclusion on "A Competitive European Industry Driving our Green, Digital and Resilient Future".[21] As encouraged by Thierry Breton[22] or Enrico Letta in his latest report,[23] it is essential to "anticipate the transition" and thus reinforce the "European leadership in circularity".

Therefore, a water-smart industry in Europe should be at the core of the foreseen Water Resilience Strategy, based particularly on the realisation of digital water[24]. The call for an EU Blue Deal[25] and an action plan by the EU Economic and Social Committee, which has resonated widely across Europe, as well as the requests of the Local and Regional Authorities in their two recent opinions[26] of the Committee of Regions, have culminated in the announcement of a Water Resilience Strategy by President von der Leyen in the Political Guidelines 2024-2029.[27] Synergies between water-related and industrial policies must be strongly considered to strengthen our strategic autonomy.

[18] European Commission, Directive 2007/2/EC, *Directive establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)*, 2007 U.R.L.: https://eur-lex.europa.eu/eli/dir/2007/2/2019-06-26

[19] Water Europe, *Water Smart Industry*, White Paper, U.R.L.: https://watereurope.eu/wp-content/uploads/2024/06/Water-Smart-Industry_online-1.pdf

[20] See for example the recital 19 of the Urban Wastewater Treatment Directive, *op.cit*.

[21] The Council of the European Union, *A Competitive European Industry Driving our Green, Digital and Resilient Future*, 24th of May 2024. U.R.L.: https://data.consilium.europa.eu/doc/document/ST-10127-2024-INIT/en/pdf

[22]Thierry Breton, *Energy Crisis and Dependencies: We Must Anticipate the Transition*, European Commission, Directorate-General for Communication, News Blog, 13th of October 2021. U.R.L.: https://commissioners.ec.europa.eu/news/energy-crisis-and-dependencies-we-must-anticipate-transition-2021-10-13_en

[23]Enrico Letta, *Much More than a Market*, April 2024, U.R.L.: https://www.consilium.europa.eu/media/ny3j24sm/much-more-than-a-market-report-by-enrico-letta.pdf

[24] Digital Water: exploit the benefits of the extreme interconnectivity of people, devices and processes, and create capillary networks capable of monitoring the water system, starting at its multiple sources through to the individual end-user, thus generating continuous flows of valuable data for innovative decision-support systems at different governance levels. Water Europe, *the value of water*, 2023.

[25] European Economic and Social Committee, *EU Blue Deal*, 2023. U.R.L.: https://www.eesc.europa.eu/sites/default/files/files/qe-04-23-852-en-n.pdf

[26] Vanlouwe K. *Creating an EU Blue deal from an agriculture and rural development perspective across EU Regions*, Opinion Factsheet, CoR, 20th of June 2024. URL; https://cor.europa.eu/en/our-work/Pages/OpinionTimeline.aspx?opId=CDR-5513-2023

Viola A. *Towards a resilient water management to fight climate crisis within an EU Blue Deal*, Opinion Factsheet, CoR, 19th of June 2024. U.R.L.: https://cor.europa.eu/EN/our-work/Pages/OpinionTimeline.aspx?opId=CDR-5587-2023

[27] European Commission, *Political Guidelines 2024-2029, op.cit*.

Annex of the Policy Brief: List of the case Study

The project includes 5 cases studies in Belgium, Romania, Turkey, Italy, Germany and The Netherlands.

Case study 1: Technology focus for freshwater intake reduction, Boehlen and Terneuzen

The Dow Chemical Company connects chemistry and innovation to the principles of sustainability. Dow's businesses include specialty chemicals, advanced materials, and plastics. Due to the tight water balance in the region south of Leipzig, the Boehlen location of Dow is classified as a water scarce. I-Parc Dow Terneuzen is under severe water stress as it is located in a coastal area with very limited availability of fresh water. Therefore, sustainable solutions for the responsible use of water resources are sought for long-term development at the two locations. Both Boehlen and Terneuzen strive to reduce their freshwater intake intensity by:

- enhancing the internal recycle of various process water streams – these comprise but are not limited to cooling tower blowdown and dilution steam blowdown streams.
- creating a next level of site water management by using smart monitoring, algorithms and control on raw water, discharge and recycle streams.

Case study 2: Water treatment and re-use within peroxide production units, Rosignano Solvay

The Rosignano Solvay industrial site is one of the oldest and largest in Italy. It produces sodium carbonate, sodium bicarbonate (also for pharmaceutical use), calcium chloride, chlorine, hydrochloric acid, chloromethane, plastic materials, peracetic acid and hydrogen peroxide. In order to deliver more sustainable water management, Consorzio ARETUSA was established in 2001 as PPP among water utility (ASA Livorno), industry (Solvay Chimica Italia) and tech provider (Termomeccanica). Thanks to ARETUSA, since more than 15 years the Solvay chemical plant is implementing a utility-industry (public-private) symbiosis system for optimising the regional water cycle, by reusing about 3 million cubic meters per year of urban wastewater treated in the ARETUSA reclamation plant. The existing Waste Water Reuse Plant (WWRP) contains flocculation, sedimentation, filtration, activated carbon filter (GAC), and UV disinfection. The goal of the Case Study 2 is to treat the wastewater coming from the hydrogen peroxide production department inside the Solvay facility in order to reuse it. Digital solutions will support process control, internal water re-use and the treatment and direct reuse of slightly polluted process water and dilution steam blowdown streams.

Case Study 3: Sustainable and robust water system for an industrial zone, Antwerp

The Port of Antwerp is the leading European oil and chemical cluster in Europe and home to key industrial players in chemicals production. Several of these chemical companies are large water users that require water for processing products, for cooling and for steam production. The freshwater source that connects to the Antwerp harbour is the

Albert Canal. Drinking water company Water-link abstracts water from the Albert Canal for drinking water production. Due to climate change, there is increasing salinization of the dock waters in the port, as well as of the River Scheldt and the Albert Canal. The available amount of freshwater is declining. Therefore, large water users in this region are obliged to investigate alternative water sources.

The largest water user in the port of Antwerp is the BASF site, which abstracts water from the docks for cooling purposes, water that contains a substantial concentration of salts. In case of climate change, the water quality of the harbour dock will change, and this will undoubtedly affect the management of cooling water in the system. BASF is also shifting towards a new demineralized water treatment using fresh surface water from the Biesbosch area based upon reverse osmosis (RO) technology. The concentrate from the RO will be highly loaded in terms of NaCl, very promising for possible reuse options. Additionally, BASF currently has a number of organically and salt loaded wastewaters which are currently not reused.

The stakeholders in the area need to develop strategies that ensure that water quality and scarcity are factored into decisions that protect current operations and support business growth. This requires the development of integrated water-smart strategies for industrial processes demonstrating water recycling technologies and real-time smart monitoring and management systems.

Case Study 5: Sustainable water use in meat production in the circular economy, Bacau

Water is a critical resource for the poultry, meat and agricultural industry. The meat industry needs to implement smarter solutions, reduce the environmental footprint and contribute to the circular economy. AGRICOLA is a private meat company in Bacău County, Romania, using their poultry husbandry-specialised farms, 15 chicken raising farms and a state-of-the-art slaughterhouse. The pilot case study implemented at AGRICOLA and employed smart solutions for sustainable wastewater treatment, with the objective of improving water efficiency monitoring and achieving process optimisation, options for water reuse in the region were assessed (cf. Main findings).

Case Study 6: Water treatment and re-use within refinery, Izmit

Oil & gas refining industry is highly water intensive, requiring vast amounts of water, used as cooling water, service water, firefighting water, demineralization water and for steam production. A refinery also has closed loop water reuse opportunities embedded in the production line (e.g. drum wash water, stripped sour water, desalter, make/up water, coke-cutting water). Tüpraş is the first producer in Turkey's refining sector and largest industrial enterprise of the country, operating four oil refineries with a total annual processing capacity of 30 million tons crude oil. The Tupras Izmit Refinery is consuming both fresh water from the lake and treated wastewater from its own wastewater recovery plants. During maintenance operations or in case of capacity problems, the refinery relies heavily on a lake. In order to increase the water reuse opportunities and decrease freshwater intake from a lake, any attempt approaching more water reuse is considered seriously.