Deliverable 11.7

Layman's report

Date: 30 August 2023

Revised: 31 January 2024

Second revision: 31 December 2024

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement 869474.

Deliverable 11.7	Briefing Document
Related Work Package	WP 11 – Communication
Deliverable lead	TU DELFT
Author(s)	Philipp Wilfert (TU DELFT) Mark van Loosdrecht (TU DELFT) Patricia Osseweijer (TU DELFT)
Contact	p.osseweijer@tudelft.nl
Reviewers	Philipp Wilfert (TU DELFT) Nicole Heine (DECHEMA)
Grant Agreement Number	869474
Instrument	Horizon 2020 Framework Programme
Start date	01-09-2020
Duration	31-12-2024
Type of Delivery (R, DEM, DEC, Other)[1]	OTHER
Dissemination Level (PU, CO, Cl)[2]	PU
Date last update	31-12-2024
Website	www.watermining.eu

[1] **R**=Document, report; **DEM**=Demonstrator, pilot, prototype; **DEC**=website, patent fillings, videos, etc.; **OTHER**=other

[2] **PU**=Public, **CO**=Confidential, only for members of the consortium (including the Commission Services), **CI**=Classified

Revision no	Date	Description	Author(s)
0.1	15/08/2023	First draft	Philipp Wilfert (TU DELFT)
0.2	30/08/2023	Comments and suggestions from co-authors	Mark van Loosdrecht (TU DELFT) Patricia Osseweijer (TU DELFT)
0.3	31/08/2023	Comments and suggestions from external reviewers	Yuemei Lin (TU DELFT) Josep Crous-Duran (REVOLVE)
0.4	06/09/2023	Final edits	Patricia Osseweijer (TU DELFT)
0.5	05/01/2024	First draft revision	Patricia Osseweijer, Athanasios Polyportis, Dimitris Xevgenos, Lotte Asveld (TU DELFT)
0.6	23/01/2024	Second draft revision	Patricia Osseweijer (TU Delft)
0.7	25-31/01/2024	Comments and suggestions from external reviewers	Josep Crous-Duran (REVOLVE) Gonzalo Gamboa (UAB) Dimitris Xevgenos (TU Delft) Andrea Cipollina (UNIPA) Guillermo Zaragoza (PSA) Ellen Tuinman (Westlake) Michiel Beer (Nobion) Philipp Wilfert (TU Delft) Jordi Llimos Turet (Eurecat)
0.8	31-01-2024	Final edits	Patricia Osseweijer (TU Delft)
1.0	1-12-2024	Revision	Patricia Osseweijer (TU Delft)
1.1	31-12-2024	Review	Philipp Wilfert (TU Delft) Nicole Heine (Dechema)
1.2	31-12-2024	Final version	Patricia Osseweijer (TU Delft)

This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No 869474.

The opinions expressed in this document reflect only the author's view and in no way reflect the European Commission's opinions. The European Commission is not responsible for any use that may be made of the information it contains.

Table of Contents

1. Executive summary

The document presented here describes the Water Mining layman's report which aims to inform non-specialists on the final results of the EU project Water Mining and in particular on its Case Studies and the lessons learned in the approach with stakeholder interactions. Water Mining uniquely combines social engagement with technological innovation in the assumption that this will improve social and market implementation and smooth the process for policy adaptations. The objective of the layman's report is not only to inform layman on the innovations in water management but also to provide recommendations on future research in social engagement, and how this relates to gender issues and public acceptance for innovation in water management. The layman's report describes the 6 case studies and their quantitative results and how identified stakeholders were involved in a process of social engagement and how this affected the designs and identification of important policy measures. We conclude that it is meaningful to involve stakeholders in the design and implementation of innovation as suggested changes prove to create better solutions for present and future local needs. We also observe that the process increases attention for differences in public opinions including between genders and it contributes to creating trust. However, it is important to involve stakeholders in the case studies from an early stage onward so that the relationships could be established and maintained for a longer duration. This requires time from both social process facilitators and from technologists involved in the innovative design and operations and consequently adequate funding and time allocation.

2. Introduction

The Water Mining project aims to demonstrate innovative and sustainable water management solutions in practice for seawater desalination, urban wastewater treatment and industrial wastewater treatment. In addition to innovative technology, the project analyses the overall sustainability of the novel solutions, the policy measure implications and uniquely implements stakeholder interactions on design and applications to improve social and market uptake of the innovation. The Water Mining team wishes to inform non-technological audiences on the results of both the case studies and the process of social engagement, so that we can all learn from these findings for the future. To do this we designed a concise document avoiding jargon language in a lay-out that we hope is inviting to read.

This layman's report describes the technological innovation applied in the Water Mining project and the social engagement activities, including its relation to gender issues and public perceptions. This report includes the results on impact analysis, perceptions, market exploitation and policy measures required to smoothly implement and benefit from the innovation. This is an updated version from the report delivered in January 2024. The final Layman's report is presented in chapter 3.

The Layman's report will be posted on the WATER-MINING website and announced through the WATER-MINING project´s social media channels. It will also be presented to the audiences of the IWA (International Water Association; https://iwa-network.org/) and CIRSEAU[3] supported Conference on Water Smart Economy and Society (https://wses2025.dryfta.com/), organized by TU Delft to be held in Rotterdam in May 2025; in the CIRSEAU project activities and it will be provided to the audeinces of the United Nations action plan which was presented in March 2023.[4]

[3] CIRSEAU : The CIRSEAU cluster consists of five sister projects (granted within the H2020 call topic CE-SC5-04-2019 "Building a water-smart economy and society") demonstrating the feasibility of a **water-smart economy and society (https://b-watersmart.eu/cirseau-cluster/)**

[4] https://sdgs.un.org/partnerships/circular-wastewater-treatment-extracting-biopolymers-wastewater-sludge-campinas-brazil

3. Water Mining Layman's report

Why do we need to improve our water management systems?

We depend on water. For our agriculture - to provide food and drinks -, for our health, for our industrial production, for our environment. The average European uses around 140 liters of water per day. Such amounts vary greatly over the world, due to climate, availability, spillage, infrastructure and human behavior. A shower of 10 minutes uses easily 160 liters of water! With more people and higher temperatures foreseen for the future, it is important that we are careful with our water consumption and that we design smart water systems to treat our wastewater. Due to changing climates, especially islands in warmer regions increasingly depend on making fresh water from seawater through desalination processes. But up till now these processes cost much energy while the left over salts (called brines), are a threat for the environment. The European Commission therefore decided to invite experts to develop smart and circular solutions for water management, addressing societal issues. The Water Mining project was funded to develop better solutions for desalination, for treating urban wastewater and for smart industrial water usage and treatment. The focus is not only on fresh water recovery and energy savings but also on nutrient and product recovery and less burden to the environment! Novel equipment such as filters, reactors with smart microorganisms, evaporators and solar energy collectors are tested to make integrated treatment systems that can desalinate seawater to fresh water or treat wastewater from households or industry to win back clean water and nutrients. Smart monitor software and augmented reality software is developed to easily show the installations and check how they perform. To enable decision making on best solutions the project also includes evaluation of environmental, economic and social impacts of the new technology, but also whether and how recovered products can be sold on the market and which policies either hinder or stimulate this process. Together with local people who are involved in water management, such as local councils, citizens, farmers, politicians and wastewater treatment owners, we evaluated the different solutions and agreed on the best options. To test this integral approach Water Mining developed 2 pilots for the desalination systems, 3 on saving and reusing in urban wastewater and 1 in an industrial setting.

Sea Mining: Case study Lampedusa and Almeria: what can we improve?

Cala Pisana, Lampedusa, Italy

As Lampedusa is a rather small island (located in the south of the Mediterranean Sea), its inhabitants and tourists are dependent on desalination for their fresh water needs. Unfortunately the process to make fresh water from sea water requires a lot of energy and the salty rest products, or brine, is polluting the Mediterranean. The Water Mining pilot system, installed in 2022, showed that up to 92% of the energy needed for a 'Multiple Effect Distillation' can come from the waste heat from the local energy plant. This facilitates the production of high valuable salts with a purity of 90-99%, such as magnesium and calcium hydroxides, sodium sulphate and table-salt which all can be used in the market for different applications. Also the chemicals hydrochloric acid and sodium hydroxide (or caustic soda) are produced, which can be used as process reactants or for cleaning purposes but also for the desalination plant maintenance. We showed that all incoming desalination brine/seawater can fully be used for product recovery, so a circular process is realized with zero pollution to the sea! Importantly, the new system provides 80% recovery of high quality potable water compared to approximately 40% of the existing desalination facility and reduces the energy consumption with 10% (see figure 1).

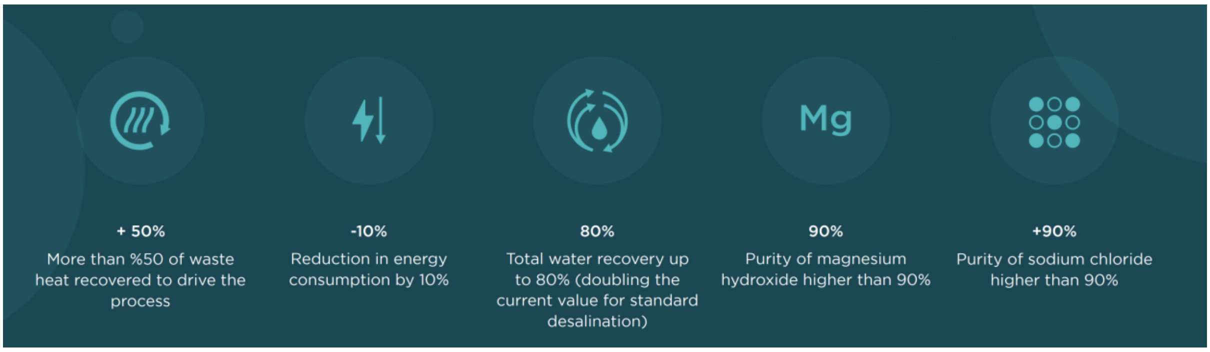


Figure 1: Results of the Water Mining Case Study in Lampedusa (see https://watermining.eu/wp-content/uploads/2024/12/WM_Factsheet_Lampedusa_CS1.pdf). Source: REVOLVE

Implementing these novel systems at full scale provides not only less pollution but also less expensive water and opportunities for jobs, as both magnesium salts and sodium chloride (NaCl or 'kitchen salt') can attract business to the island. The economic evaluation shows that the novel system can achieve a payback time of 2-3 years, however the off take of the significant amounts of hydrogen chloride (HCL) and caustic soda (NaOH) cannot be done by the island itself and transport costs very high.

Site visit at Lampedusa Pilot system. Source: REVOLVE

Almeria, Spain

In Plataforma Solar de Almeria in Spain we explored whether we can make fresh water from seawater and recover the salts by using solar energy and nanofiltration. We demonstrated that the nanofiltration removes the ions and then improves the 'Multiple Effect Distillation', powered by 100% renewable energy from the Concentrating Solar Power plant, so we could recover high quality fresh water. With the reject from the nanofiltration, we could mineralize the water for irrigation, since the ions rejected are valued as fertilizers.

A view of the site of WATER-MINING's Case Study 2 in Almería, Spain. Source: REVOLVE

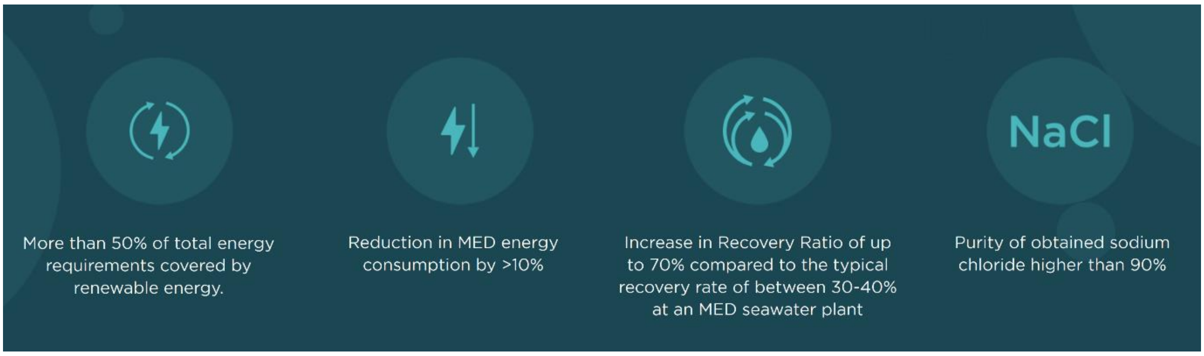


Figure 2: Results of the Water Mining Case Study in Almeria (see https://watermining.eu/wp-content/uploads/2023/11/WM_Factsheet_CS2-1.pdf). Source: REVOLVE

The results (figure 2) of this case study showed a very profitable business opportunity which would pay itself back in 2 years time. The issue however is the high production of salts (NaCl) which easily reach 40% of the overall domestic needs. Unguided marketing may ruin the business plan so this requires a distributed marketing introduction plan with may include longer term storage and/or slower production in addition to exploring global markets.

Overall the Case Studies in Sea Mining were perceived as highly sustainable, including social benefits. A replication of the desalination designs for the Greek island Chios shows similar promising results. The cases highlight the importance of incorporating local opportunities and challenges in the business plans. Agreements are now made to develop the implementation at full scale for more (Greek) islands in the Mediterranean Sea.

Comparing pilots on treating urban wastewater in Faro, Portugal; Larnaca, Cyprus; and La Llagosta, Spain: what can we improve?

Faro, Portugal vs Utrecht, The Netherlands

Over 30 years ago experts at TU Delft discovered that wastewater treatment can be dramatically improved in terms of land-use needs and process time by making sludge granular. The improvements are related to (A) the simultaneous occurrence of several microbial process required for successful wastewater treatment within one granule, (B) very quick settling of granules and (C) the mass transfer area for granular sludge which results in high turnover rates. Our partner RHDHV commercialised the process under the name NEREDA® in 2011 in a public private partnership together with Dutch Water Authorities and TU Delft. Now over 100 plants are in operation or construction all over the world. Recently it was discovered that the bacteria in the granules produce polymeric substances with interesting properties such as a remarkable water retention capacity and flame retarding properties. The biopolymer exploitation has consequently been commercialized under the name Kaumera. It is extracted from granular sludge. With the first production units in The Netherlands, i.a. in Utrecht it proved possible to produce circa 70 kg of Kaumera per person per year from wastewater. Kaumera has the valuable capability to replace petroleum derived polymers in composite materials, it can be used in agriculture for stimulating seed growth, as soil conditioner and as a flame retarding material in the construction sector. The Water Mining pilot in Faro proved that Kaumera can also be produced with high efficiency in warmer climates with different wastewater compositions using the same technology as in the Netherlands. It showed that integrating phosphorus recovery with Kaumera extraction recovers roughly 50% of the total phosphorus in the sludge as well. During Kaumera extraction an organic rich waste sludge with high pH and salt content is produced. Fermentation at these conditions is challenging but with specially adapted microorganisms from soda lakes we got a very high methane yield and almost pure methane stream (>95%). This way the volume of waste is reduced and at the same time a substitute for natural gas is produced in a sustainable way. Another step towards higher circularity. We have also tested the quality of Kaumera and demonstrated its use as combined water absorber and biostimulant in agriculture to drastically reduce irrigation needs for farmers in the water stressed Algarve. The market for Kaumera is still in its infancy so it is difficult to exactly establish the economic value of these novel technologies. However, calculations showed that aiming for higher valued products could result in a payback time for the investments of less than 2 years. "Kaumera Sales & Services" was established to bridge innovation with the market and a cooperation agreement was made between relevant partners to further develop the implementation in wastewater treatment plants. To develop the use of Kaumera as flame retardant a spin-off company "Bioflame" was established.

Above: pilot at Faro and left: Possible applications of Kaumera. Source: RoyalHaskoningDHV

Larnaca, Cyprus

Cyprus also suffers from water scarcity as an island in the south of the Mediterranean Sea. In addition, their underground water reservoirs are salinized while farmers need water and nutrients for irrigation, and citizens, tourists and (food) industry depend on adequate supply of potable water. Although the present system already has a high level of circularity with treated wastewaters for irrigation, issues are increasing on the salinity of these waters and hence the fertility of the agricultural soils. So in Water Mining we looked at improving water and nutrient recovery from urban wastewater testing adapted desalination technology. With filtration, adsorption and evaporation water is produced for irrigation and industry, while salts and phosphorus are recovered and sold. Phosphorus removal was added because it could have benefits to prevent biofouling in the salination steps and to help the sewage treatment plant to comply with the future effluent limits for the revised Urban Wastewater Directive. The current sewage treatment plant has an effluent limit for total P of 10 mg/l and achieves an effluent quality of 2-3 mg/l. The revised Urban Wastewater Directive would require an effluent value of 0,7 mg P/l by 2045.

Left: Visitors are explained the pilot system in Larnaca. Source: REVOLVE

While the pilot showed that the integrated technology could work well, the economic evaluation results showed that full nutrient recovery comes at a cost. Desalination of urban wastewater emerged as a viable solution to address salinity challenges in treated effluent, enhancing its suitability for agricultural reuse. Among three evaluated scenarios, the economically viable option involved producing mixed salts while prioritizing desalinated water for irrigation or blending into potable water systems. Stakeholder engagement highlighted both support for improved water quality and concerns over cost implications, emphasizing the need for clear cost-sharing mechanisms and regulatory alignment to foster broader acceptance and adoption.

Figure 3: Results for Case Study 4, Larnaca. Source: REVOLVE (see https://watermining.eu/wp-content/uploads/2022/11/WM_Factsheet-CS3-v2.pdf).

The local inhabitants of Cyprus comment in the movie on the need for water at the island (https://www.youtube.com/watch?v=11_QlcILdiQ).

La Llagosta, Spain

In La Llagosta, near Barcelona in Spain, Water Mining demonstrated that wastewater treatment of a city can be more circular and even be converted to *resource recovery facilities* producing energy, reducing energy consumption and generating by-products for industrial or agricultural purposes. The use of a Granular Anaerobic Membrane Bioreactor proves better that the conventional use of aerobic activated sludge, as it reduces energy costs with 60% by converting organic matter to biogas. To remove the nitrogen, we replaced the energy demanding nitrification-denitrification process by a biological nitrogen removal process in two-stages. We show that in those two-stages we can remove ammonium without the need for organic matter. With two innovative processes: ViviCryst followed by BioPhree, the phosphorus is recovered here cost-effectively as well (at 100 €/kg removed), so it can be sold as fertilizer. Finally, a reverse osmosis membrane system was used to obtain a high-quality water using regenerated membranes, that decrease the operational cost of the process. The system can recover over 90% of the water.

Left: Researcher at Pilot Case Study Lla Lagosta. Source: REVOLVE

To calculate the economic viability 4 (full scale) scenarios were compared to the present wastewater treatment system which dumps its treated water into the Besos river. The scenario's show higher levels of environmental and social sustainability, but also that energy and phosphorous recovery alone deliver not enough income to pay for the investments. However, including (circular) water reuse can make the system profitable, and certainly more profitable that the existing system. Fertigation, which is treated water with remaining nutrients for irrigation, is most profitable, but further purifying the water for industrial processes may prove even more valuable at the long term, although it will require higher investments.

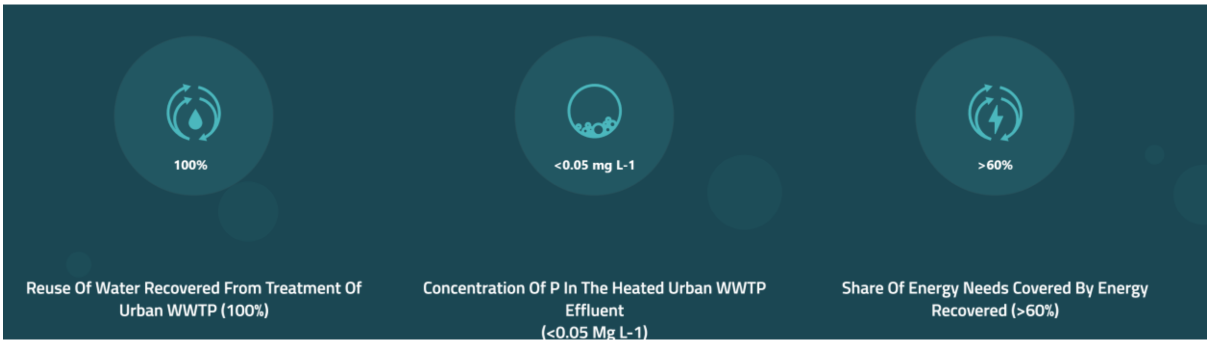


Figure 4: Results from the Case Study at La Llagosta. Source: REVOLVE (see https://watermining.eu/case-studies/cs5-la-llagosta-spain/)

Industrial collaboration: can closed-loops and leasing improve our water management? Rotterdam, The Netherlands

In the Port of Rotterdam with its intense chemical industry a lot of industrial activity depends on water: for cooling; buffers; chemical processes etc. A closed-loop water recovery could dramatically improve the water footprint and recover and reuse valuable compounds. This was demonstrated in the chlorine cluster by NOBIAN and Westlake Epoxy in Pernis and technology developer KVT in Graz, Austria.
In this case study a demonstration was designed to receive the effluent discharged from the production of Epoxy-Resin to recover the brine (NaCl, a salt stream), water and heat. This design illustrates an industrial symbiosis, where the waste from one of the partners (Westlake) is the raw material for the other partner (Nobian). The water and heat recovered was for Westlake itself and the recovered NaCl brine was meant for the local chlorine producer (Nobian).
In turn, Nobian recycles its brine to produce chloride and caustic soda which is provided back to Westlake for Epoxy-Resin production. The whole set-up reduces freshwater consumption, and energy requirements and consequently reduces environmental impacts.

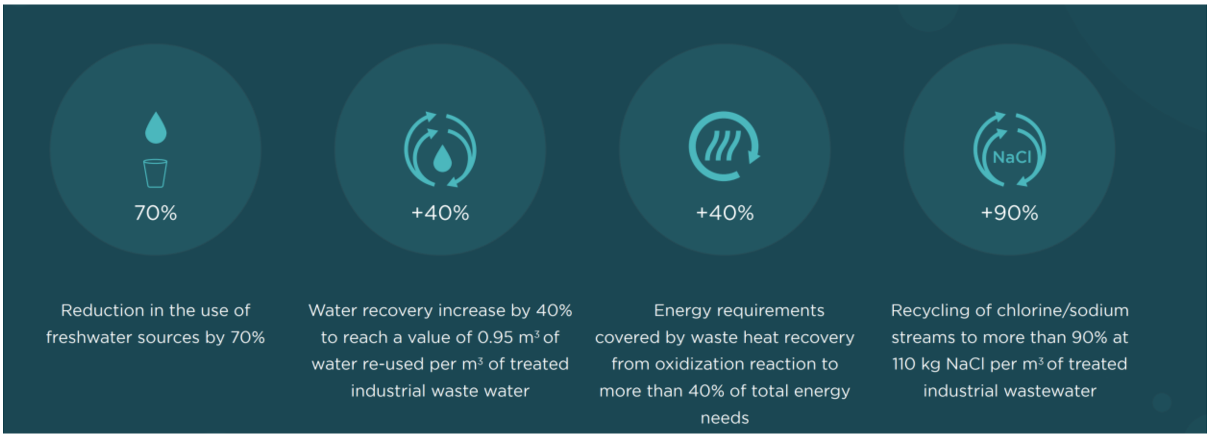
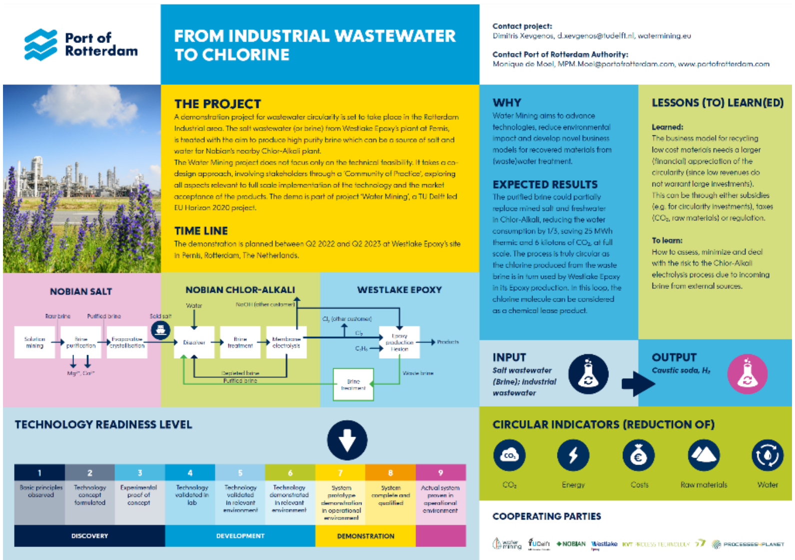


Figure 5: The results of the Industrial Case Study at Rotterdam. Source: REVOLVE

A full scale implementation of the tested technology within the chlor-alkali and epoxy resin industries cluster was calculated. While the technology demonstrated substantial environmental benefits and potential applicability in diverse contexts, economically it turned out to be difficult at the Rotterdam site. This was not just because of high capital and operational costs, but also because of the existing infrastructure and lack of regulations to avoid discharge of brines. As mentioned the outcome shows a high sustainability improvement and the economic viability might change when a higher price is allocated to its gains in environmental performance (lower CO2 emissions and lower brine pollution) and when a substantial subsidy is given for the equipment costs. When also the required caustic soda is provided in a collaboration at cost price instead of commercial value the installation becomes profitable within a reasonable period of less than 10 years.

The design with high levels of recirculation show the ability to improve the environmental footprint. With expected stricter environmental regulations in the future, the recirculation of water and salts may alleviate the challenges to producers in maintaining the industrial activity, the jobs and the added value they create. Recirculating water and salts also reduces the amount of effluent treated by biological wastewater treatment and requires thus less energy for sludge incineration and release of water to the environment. But the demonstration shows also that intense collaboration is necessary to create such win-win situations.



Left: overview Case Study Rotterdam. Source: PoR

Can the studies also provide value elsewhere?

Water Mining also carried out some replication studies in different locations. The value of the Sea Mining cases was confirmed in the setting of Chios, a Greek Island. Also here the business cases proved viable and environmentally advantageous and a roadmap was made to further introduce the technology in the Greek Mediterranean islands. For Urban Mining a new entity: "Kaumera Sales and Services" was set up to bridge the innovative approach and demand for the resulting recovered products, while also a new company was launched to develop bio flame-retardants called "Bioflame". End of waste status for Kaumera is expected in early 2025 as well as CE Certification for Kaumera usage as fertiliser. The novel resource recovery technology is also now tested in other European settings. Calculations for another location for the industrial mining innovations, further from the sea and with specific local needs, showed indeed that the innovation could be economically viable for different settings, which is promising for recycling aims requiring industrial collaboration.

Getting it right: Why involving stakeholders in developing the best local solutions?

WATER-MINING partners involved in a WS1 workshop on research in Palermo, Italy. Source: REVOLVE

In a world where water is becoming more precious than ever, finding more sustainable ways to use it wisely within a circular economy is crucial. In Water Mining we developed pilot designs to test the best technologies, but we also coupled this process to stakeholder engagement to *co-create innovation through social engagement for societal embedding*. We connected knowledge and minds, local communities, and technology pioneers and gained insights, understanding people's needs, and ensuring the water innovations we create are practical, desired, real-world investments. Co-creation can also de-risk the transition, as decisions on choices can be made together and responsibility for the consequences can be carried together. In the process we used details on the technological designs, not only on costs and benefits, but also on environmental and social impacts, on existing and required regulations and on market opportunities.

Decision making proved a complicated process. Which effects are more important? With what security can a certain outcome be anticipated? What times do we consider for economic viability? Fluctuations in resource prices and operational costs may introduce financial uncertainties into the equation. What is best regulation? Regulatory compliance adds another layer of complexity. Circularity means that we re-use what was waste, and novel practices may be prevented by existing policy measures. All these uncertainties were incorporated in the process of negotiation. In that we also coped with public perception, opposition, or resistance, together with ethical considerations and the need for transparency and inclusivity. These factors tend to significantly influence project outcomes, constituting a societal risk factor. These multifaceted risks and uncertainties underscore the need for a systematic approach to de-risk investments in water mining technologies.

De-risking this requires diving deep into the values and needs of all stakeholders of the innovation ecosystem, engaging communities in meaningful ways, and ensuring that the innovations developed resonate with societal needs. By understanding what truly matters to stakeholders, whether they are policymakers, local communities, or industries, we can together tailor our innovations to meet their expectations. We can build trust, gain essential insights, and create solutions that are not just technologically advanced but also socially and environmentally responsible. Thus, de-risking is the safety net that allows us to invest wisely, not just for immediate gains but for the long-term sustainability of our water resources and the well-being of the people who rely on them.

How do we involve stakeholders?

We first identified the stakeholders for each case study location. These were invited to participate in a dedicated Community of Practices (CoP). In each CoP we ensure a balance in gender representation and inclusion of all stakeholders. The 6 CoPs were introduced to the pilot designs and objectives through movies and fact sheets developed for each pilot. To further identify needs and (local) issues and translate this into best solutions we used the Value-Sensitive Design approach in three phases. The data on the pilot performances and on impact, market opportunities and policies are coming together in this approach:

- Setting the Scene: Understanding Moral Values and Social Perceptions: In this initial phase we discussed ethical considerations surrounding water technologies. Through in-depth interviews, questionnaires, and workshops, we explored the moral values, value tensions and design indicators that underpin the Water-Mining ecosystem. Results of this phase were:
  - Different views in ownership and distribution of benefits and costs
  - Different sustainability concerns; costs and land-use increase versus use of renewable energy
  - Uncertainty on safety of recovered water and products and acceptability of risks
- Value-Sensitive Optimization: The explored values and concerns were translated into different scenario's per case study related to the issues brought forward. Up to 5 scenario's per location provided information on costs (Opex and Capex), benefits, environmental footprints, etc. With the calculations provided in a next round of CoP meetings, people could better develop their visions and justify their choices. For the pilot in Faro this did not make sense as all tensions and issues related to the end-use of Kaumera, beyond the scope of the Water Mining pilot. In Rotterdam sustainability issues were raised on use of fossil resources which also go beyond the scope of the pilot to establish circular loops. The scenarios were discussed with stakeholders, generating interesting and relevant outcomes: In Lampedusa stakeholders advised to prioritise on water recovery due to the lack of a local market for recovered products such as magnesium. In Almeria the potential increase in water recovery raised questions in view of the avoidance of brines, the required increase in land and the costs associated. Also the marketability of the amount of NaCl was questioned. It was stressed that policies needed to focus on avoidance of expansion of water usage. In Larnaca stakeholders would like to see a priority to zero liquid discharge of brine, and there were concerns on price increases for water. Stakeholders in La Llagosta liked the flexibility of the system but saw regulatory barriers on using cleaned industrial wastewater for irrigation.

❖ Full-Scale Implementation: Here we focussed on the integrated cases, and discussed all data considering the trade-offs and opportunities of the best design for the location.

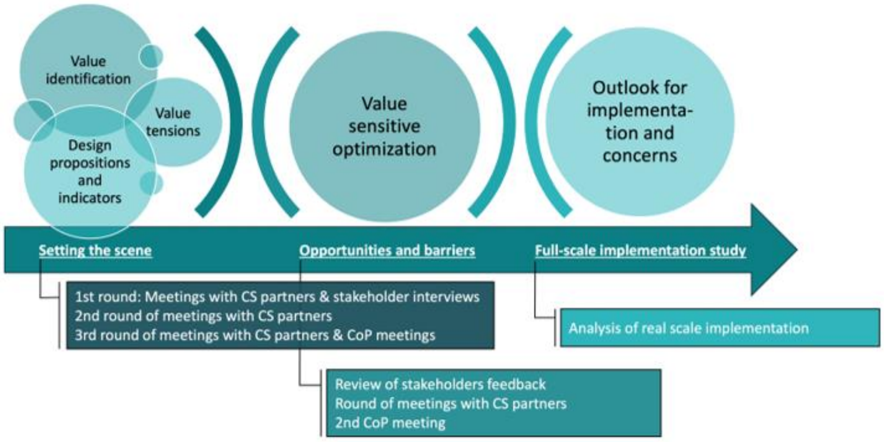


Figure 6: Value-sensitive design process. Source: Water Mining Deliverable 2.2

In parallel with the Value-Sensitive Design process, we also conducted *behavioral studies* to better understand how consumers and other water users interact with these innovations. This identified factors influencing acceptance and ease of use. Here we found that during the repeating CoP meetings people became more positive about the novel technology. Factors influencing their opinions and acceptance were whether the new system is affordable and environmentally friendly. Especially women brought this forward. The behavioral studies also investigated sociocultural factors and gender issues so we can take these into account and develop inclusive solutions.

Does it work?

While we have built CoPs, which remained active over the duration of the project, we established important relationships and created ongoing feedback so we stayed in tune with changing circumstances and evolving stakeholder needs. We did see that the process of stakeholder engagement often runs behind the innovation process. The development of the CoP group takes time and should start as early as possible in the process. We often also see that CoP facilitators are engineers, not trained in social engagement processes. By making a model 'best practice' for CoPs and evaluating our process we contributed to developing the approach of co-creation and its value for innovation. The 'best-practice' model is presented at https://watermining.eu/wp-content/uploads/2024/09/d2.3-Best-practices-of-stakeholder-engagement.pdf. Results show that end-users articulated apprehensions regarding the complexity of the technologies, underscoring the necessity of streamlining processes to facilitate wider adoption. Stakeholders were more inclined to accept WATER-MINING technology when they recognised concrete advantages, such as cost reductions or environmental benefits. We also addressed gender issues in the process, and we saw differences in female and male values and hence weights given on important factors for decision making. We dived deeper into these differences and how to best design for inclusion. We developed a dedicated check list to see if there were difference in acceptance and concerns between man and women. The findings showed that addressing this specifically enhances inclusivity but also improves the overall effectiveness and sustainability of water management solutions.

A full-scale implementation study to integrate the approach and findings focused on the practical deployment of WATER-MINING technologies in Cyprus, examining how circular water systems could be embedded within the islands existing socio-technical frameworks to address water scarcity and related issues. We identified key barriers and opportunities for upscaling the WATER-MINING technologies, covering desalination, urban and industrial wastewater treatment and material recovery. Co-creation with local stakeholders including government agencies, water utilities, and industrial actors—was considered essential for aligning technological solutions with regional priorities and resource constraints. Additionally, the study emphasized the need for long-term government incentives, regulatory support, and investment in infrastructure to facilitate the transition from linear to circular water models in Cyprus.

The report also provides targeted recommendations to address the identified challenges, especially in technology adoption to improve the scalability of WATER-MINING solutions. These include the need to strengthen public-private partnerships to drive innovation, develop regulatory frameworks and incentives that promote circular practices, and prioritize renewable energy integration to mitigate environmental impacts. The report also highlights the importance of capacity building and training to ensure local expertise in managing advanced water technologies, while urging the incorporation of gender-inclusive design to address systemic disparities and ensure equitable access to water resources.

WATER-MINING Project members: final Consortium Meeting in Delft, The Netherlands October 2024. Source: REVOLVE

Further reading:
https://watermining.eu/wp-content/uploads/2021/12/WM_D2.6_InfoSheetQuickScan_VSD_2021-11-30.pdf
https://watermining.eu/news/community-of-practice-meetings-kicked-off/
https://watermining.eu/newsletter/
https://watermining.eu/project-videos/
https://watermining.eu/water-mining-project-leaves-successful-legacy-to-build-on-as-project-wraps-up/