

WATER PROJECTS EUROPE WATER-MINING

14 June 2022

How Innovation Projects can Support a
Water-Smart Industrial Emissions Directive

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Introduction

The Water Mining workshop on “How Innovation Projects can Support a Water-Smart Industrial Emissions Directive” was a joint event of Water Europe (WE) and Water Mining organised in the frame of Water Project Europe 2022 (WPE2022).

This was a hybrid event that took place on June 14, 2022 and was lead by Andrea Rubini (WE) in collaboration with Dimitris Xevgenos (CIRSEAU Cluster).

In total 5 projects were presented during this event. In addition to presentations a keynote speech was given by Ms Evdokia Achilleos, Head of Sector at REA and a panel discussion which was conducted by Andrea Rubini, the director of operations at Water Europe. The event itself gave an overview of five different projects and their relationship with current legislation and their contribution to achieving a Water-Smart Society. Each project also got the opportunity to provide discussion statements they would like to talk about.

The participating projects were:

1. B-Water Smart- David Schwesig
2. Ultimate- Gerard van den Berg, KWR
3. Water Mining- Dimitris Xevgenos, TU Delft
4. Zero Brine- Dimitris Xevgenos, TU Delft
5. Brine Mining (LIFE)- Kallirroi Panteleaki, NTUA

Organisers: Water Europe, Water Mining

The panellists:

- ∠ Evdokia Achilleos (EC REA),
- ∠ Solon Mias (EC CINEA LIFE Programme)
- ∠ Gergana Chapanova (DOW),
- ∠ Gerard van den berg (KWR),
- ∠ Dimitris Xevgenos (TU Delft),
- ∠ Kallirroi Panteleaki (NTUA).

Moderators: Andrea Rubini (Water Europe) and Dimitris Xevgenos (TU Delft)

All presentations are available: [WPE2022-ALL Presentations](#)

AGENDA



- ∠ Welcome and introduction- Durk Krol, Water Europe and Dimitris Xevgenos, TU Delft
- ∠ Keynote- Evdokia Achilleos, REA
- ∠ Industry perspective (regulatory aspects and expectation)- Gergana Chapanova, DOW & Water Europe representative
- ∠ Project presentation 1- B-Water Smart- David Schwesig, IWW
- ∠ Project presentation 2 – Ultimate- Gerard van den berg, KWR
- ∠ Project presentation 3 – Water Mining- Dimitris Xevgenos, TU Delft
- ∠ Q&A
- ∠ Project presentation 4- Zero Brine- Dimitris Xevgenos, TU Delft
- ∠ Project presentation 5 – Brine Mining (LIFE+)- Kallirroi Panteleaki, NTUA
- ∠ Q&A
- ∠ Technical take away- Dimitris, Xevgenos, TU Delft
- ∠ Practical take away- Evdokia Achilleos, REA
- ∠ Conclusions- Andrea Rubini, Water Europe



Keynote Speech on Water-Industry Projects supporting Policy

The Keynote speech was presented by Evdokia Achilleos, EC REA, Head of Sector, who gave an introduction to how innovation projects can support a Water-Smart Industrial Emissions directive and the work that has been done so far towards this objective.

The presenter began with a brief explanation of the EU policy & Water & Industry Projects and highlighted the important role that Water Europe plays in boosting and fostering collaborations between projects as well as institutions, stakeholders, and industries. Additionally, she suggested that some projects might consider communicating their results through Water Europe as their best option as well as joining forces with a group of projects to make suggestions.

Next, Ms Achilleos gave a list of projects that the EC has funded under Horizon 2020 and that relate to the water industry. The list contained 4 different groups of projects and included:

- 1) Projects from Water Focus Area (EIP priorities) & Waste focus Area
- 2) Projects relating to Circular Economy and Water Smart Economy & Society
- 3) Projects related to Mining /Raw Materials
- 4) Projects from CE-SPIRE-07-2020 topic.

During the event one specific cluster of projects, the CIRSEAU Cluster, that brings five different projects together, was discussed in more detail. All projects combined have a budget of 84.0 Million Euro. These projects came in 2019 with a mutual topic of **Building a Water-Smart Economy and Society** and two subtopics:

- 1) Symbiosis between industry and water utilities (ULTIMATE & WIDER UPTAKE)
- 2) Large scale applications with multiple water users at various relevant (REWAISE, WATER MINING & B-WATER SMART).

The main objectives of these projects were to:

- Make available **alternative water resources**
- Significantly **reduced use of water** from freshwater sources
- **Improve recovery and use of resources** (materials and water), including energy
- Creation of new **business opportunities** and increased competitiveness of EU industries
- Water security and **enhanced water use efficiency**
- Achievement of the relevant **UN Sustainable Development Goals**.

These five projects have 35 case studies that are being analysed in order to collect information to create one report/ document to be communicated. Additionally, these projects have collaborated in creating a set of working groups that focus on eight topics, that include:

- a) Stakeholder engagement (Led by ULTIMATE/KWR)
- b) Communication & Dissemination (Led by B.WATERSMART/IWW)
- c) Assessment Methodologies (LCA/Water-smartness etc) (Led by REWAISE/AQUALIA)
- d) Young professionals (Led by WIDER-UPTAKE/SINTEF)
- e) Policy & long-term impact (Led by WATER-MINING/TUDELFT).

Policy implications from demo cases

Project: B-WaterSmart

Title: B-WaterSmart-Accelerating Water Smartness in Coastal Europe

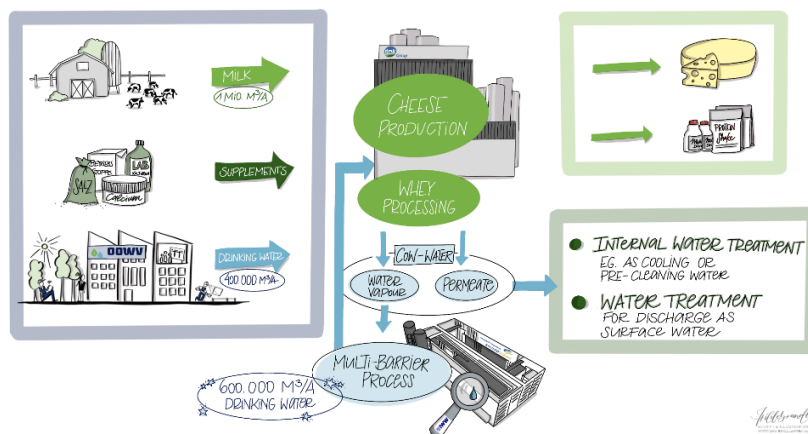
Presenter: David Schwesig, IWW



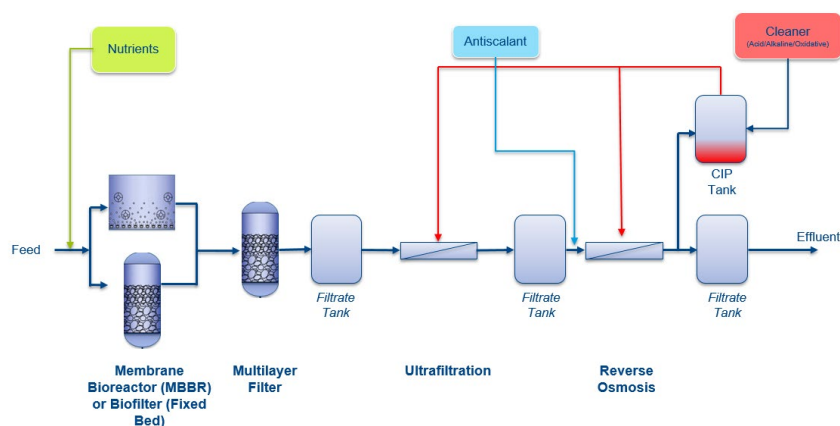
The presentation started with an introduction of basic information about the project. The full name of the project is: "B-WaterSmart-Accelerating Water Smartness in Coastal Europe" and it is led by IWW Water Center in Germany. It was funded within the CE-SC5-04-2019 Call for Building a Water-Smart Economy and Society, has a budget 17.3 M euro from which 15.0 M euro was contributed by the EU, and the duration of the project is expected to last from September 2020 till August 2024. The project is responsible for six case studies within the cluster.

Next, the presenter introduced one case study that is being analysed within this project and focusses on the industrial solution as well as the planned large-scale implementation of a Living Lab located in the northern part of Germany in East Frisia. The aim is to use "cow water" as a substitute to drinking water in one of the largest European dairies. The main challenges faced include: increasing water demand by growing industrial sectors and untapped efficiency potential of water resources' availability.

Pilate plan of the process



The ruth conceptional scheme indicating the various steps that are needed



Additionally, three different types of challenges relating to this process have been identified: Technical, Legislative/approval and mental. These mostly concern:

- The optimization of process with regard to process stability, energy and resource requirements
- Optimization about the strong fluctuating inlet quality
- Proof of hygienic stability of the process water; Adjustment of the reuse water to the different purposes at the site
- Coordination with authorities on the use of process water like drinking water in the dairy process
- Acceptance of reuse water as a permanent solution for maintenance of drinking water resources.

The presenter then moved on to explain the lessons learned so far. The first being that the process needs to be energy efficient and self-sustainable. Sustainability assessment is also a part of the work and they have written it out as a clear exploitation plan on how this can be commercialised in the end. The presenter underlined the importance of the communities of practice for the success of the process as well as the diversity of stakeholders involved.

Future plans of the project regarding the case study include a Short-Term Demand Forecasting Tool as well as a Regional demand-supply matching GIS Tool. This also happens to be how the project aims to contribute to fostering a Water-Smart Society with a systemic solution approach.

The project has identified 4 key drivers and barriers relating to their work, these are:

- gap in policy and regulation for reuse of municipal wastewater in the industrial sector
- topic is new at national level and most technical solutions remain on pilot-scale
- so far, only drinking water can be used in the food processing industry (TrinkwV, LmhV)
- Digitalisation is a major but still emerging topic, and a diverse set of regulations apply for digital solutions in the water sector, e.g. data protection, data security.

The presentation ended with an introduction to two discussion statements:

- If there is higher transparency about wastewater flows from industry (with regards to its quantity and quality), reuse of such (alternative) resources can be better organized.
- Reuse processes introduce new residual streams that are not always compatible with existing recovery routes. Simplified frameworks for permitting concentrate discharge can promote reuse innovation.

Project: ULTIMATE

Title: ULTIMATE

Presenter: Gerard van den Berg (KWR)

The presentation started with an introduction of basic information about the project. The full name of the project is: “ULTIMATE indUstry water-utiLiTy symbiosis for a sMarter wATer society” and it is led by KWR. It was funded within the CE-SC5-04-2019 Call for Building a Water-Smart Economy and Society, has a budget 16.6 M euro, and the duration of the project is expected to last from May 2020 - April 2024. The aim of this project is to create economic value and increased sustainability by introducing circular symbiotic arrangements between industry and water service providers. The project has 9 case studies in Europe.

Rosignano was the case study that the presentation was focused on. Rosignano is located in Italy, where a circular system is already in place but there are still areas that can be and should be improved. Regarding this the ULTIMATE project aims to improve industrial processes and water management Rosignano Case Study by:

- Decrease in the groundwater withdrawal for industrial purposes
- Increase in the availability of water for drinking water uses and lower aquifer exploitation
- Decrease in effluents discharged into the sea from the WWTPs
- Improvement of the quality of drinking water resources
- Reducing the impact to surface water and seawater.

According to the presenter the Rosignano Case Study contributes to achieve a *Water-Smart Society* and the *Ultimate solution to foster a circular economy* by:

- Targeted qualitative-quantitative monitoring to dynamically map relevant saline water intrusion
- Digital Twin and Early Warning System (model-based)
- Smart equalization system to achieve fit-for-purpose reuse
- Analysis of potential alternative re-use options (agriculture, industry) and data-driven matchmaking platform

TRL: 5 to 7

Quantifiable targets: > 35% Reduction of fresh water through re-use of treated wastewater

- Adsorption pilot with alternative GAC, (coupled with a coagulation flocculation unit and/or AOP?)

TRL: 4 to 7

Quantifiable targets: > 10% material recovery

So far, the lessons learned in this project are that the success of the circular transitions depend on systematically addressing problems. The project investigates enabling different technologies, digital support tools, the opportunity to exploit/valorises various schemes, as well as recognizes the crucial role of stakeholder engagement and making the socio-political and governance context actually happen.

The presenter continued to highlight the different stakeholders that they work with and to explain the different types of Exploitation/Valorisation schemes that they are looking into regarding the ULTIMATE project. These included:

- Partnerships between industries and municipal water utilities looking for symbiotic gains
- Co-ownership of water service providers by co-located industries to catalyse symbiosis

- WSIS service provision to industries by commercial companies of various scales: from niche SMEs (potentially spin offs) to multinational corporations
- Business transformation to WSIS is accelerated through active stakeholder engagement and supported by good Governance

Next the presenter talked about their connection to the Industrial Emissions directive and the activities they have already completed that include an ULTIMATE workshop on legal risks assessment, the production of a white paper - *Ethical Drivers & Societal Expectations for the Circular Economy* – and the participation of projects partners in a policy-oriented workshop for the MEP Water Group at the European Parliament. In the recently published Policy Brief the project recommend:

- To encourage reclaimed water use through the industrial Emissions Directive.
- To support financial incentive for circular economy systems.
- To familiarize citizens with circular economy systems.
- That companies may provide a more transparent overview also of their non-circular activities.
- not to support more restrictive water quality requirements for reclaimed water reuse.

The presentation ended with an introduction to one discussion statements:

Quantitative goals regarding circular economy (reuse of water, exploitation of energy and recovery of materials) should be adopted by the Industrial Emissions Directive to stimulate the development and uptake of new circular technologies and processes leading to a faster transition from linear to circular water-smart industries (and water utilities) in Europe.

Project: Water Mining
Title: Water-Mining project
Presenter: Dimitris Xevgenos (TU Delft)



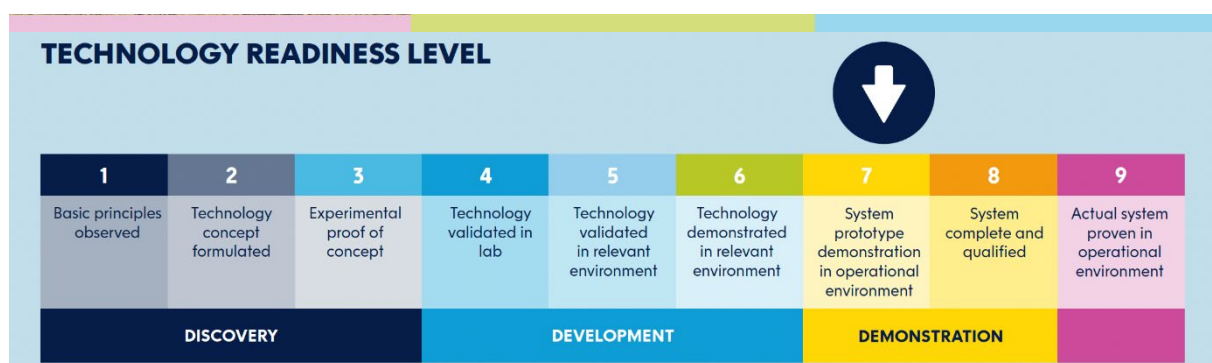
The presentation started with an introduction of basic information about the project. The full name of the project is: *"WATER-MINING: Next generation water-smart management systems: large scale demonstrations for a circular economy and society"* and it is led by TU Delft. It was funded within the CE-SC5-04-2019 Call for Building a Water-Smart Economy and Society and has a budget 19 M euro. The aim of this project is to provide for real-world implementations of Water Framework Directive, as well as the Circular Economy and EU Green Deal packages by showcasing and validating innovative next generation water resource solutions at pre-commercial demonstration scale. These solutions combine WATER management services with the recovery of value added renewable resources extracted/MINED from alternative water resources ("WATER-MINING"). The project focusses on 8 case studies that are split into three categories of demo-case types: desalination Sea-mining, Urban wastewater Urban-mining, and Industrial Used streams Industrial mining.

The presenter decided to focus on the case study located in Rotterdam. He stated that the industries are looking for ways to close the loop and move to a circular & carbon neutral economy but they are facing a challenge in finding a solution to the question of how to reuse 3,000,000 m³ of wastewater, containing salts and organics? Currently, they are disposing the 3,000,000 m³ of wastewater per year into the Mass River, meaning that the 50 kt NaCl salt and 100 kt CaCl₂ salt the water contains is lost.

Next, the presenter continued to answer the question of how the project can contribute to sustainability or what would be needed to support beyond the project to ensure the long-term sustainability – and scalability - of the project's solutions from the environmental, social and financial perspective.

He explained that until now the Rotterdam case uses to operate linear approach to collaborate but thanks to Water Mining they are now using a circular one that allows the implementation for the reduction of water consumption by 30%, thermal energy consumption by 25 MWh and CO₂ emissions by 6 Ktons. These results enable full circularity, and no discharge that is in line with the zero-pollution action plan.

He proceeded to explain both the linear and circular economy solutions that they are going to implement.



The project is impacted by both national and European regulations and directives. The presented forms of impact included:



- Past regulation on chlorine transportation ban: in 2002 the Dutch government and chlorine manufacturer signed an agreement to bring large-scale chlorine transportation to an end by 2006.
- National Programme for circular economy & Circular Economy Implementation Programme 2021 - 2023 (The Dutch government has set targets of halving raw materials use by 2030 and achieving a fully circular economy by 2050)
- Further to that Circular Economy agenda is being drafted by the province (in close collaboration with the Rotterdam Port industries) – this is a voluntarily drafted agenda, not part of an (legislation-related) obligation for the province.
- CO₂ and energy related à National Climate Agreement (Climate Act on May 28, 2019)
- Cluster Energy Strategy (Cluster Energie Strategien - CES) à Here for Rotterdam Port & Moerdijk

The presentation ended with the introduction of two discussion statements:

In the Netherlands we have already some early CE implementations (“marbles”), leading the way towards market creation and deployment. Aquaminerals (shareholders: drinking water companies) have managed to market struvite. How can we take lessons from that? End-of-waste status discussions with competent authorities took 5 years...

In the Netherlands today we have Ministerial Regulations (Ministeriële Regelingen) , Guidelines (Handreikingen) & Legal Opinion (Rechtsoordeel). Innovators claim that regulators are unsure on how to answer questions about end-of-waste status. Where does Circular Economy fit in? What is the competent Authority (Ministry? Inspectorate? Regional Authority?) Policy Measure: Can there be an EU-wide platform providing guidance on this structure/governance per country (or even region if needed)?

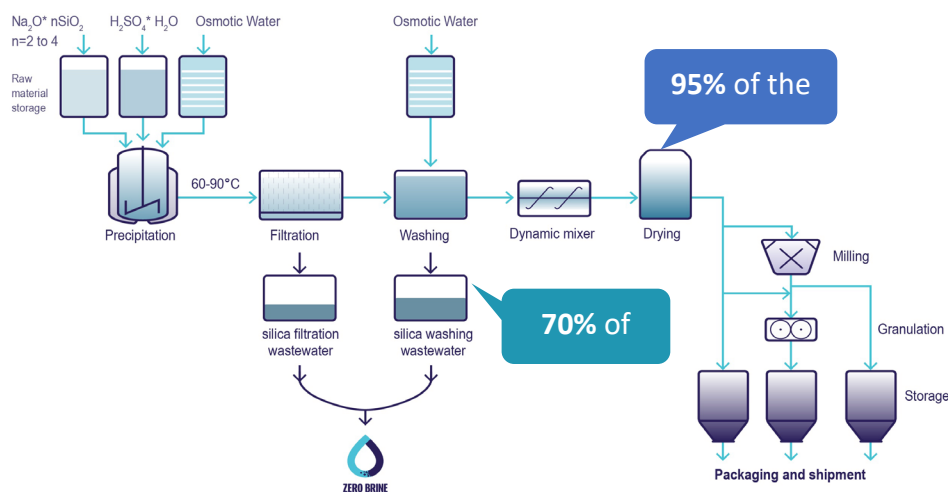
Project: Zero Brine
Title: Zero Brine project
Presenter: Dimitris Xevgenos (TU Delft)



The presentation started with an introduction of basic information about the project. The full name of the project is: “Re-designing the value and supply chain of water and minerals: a circular economy approach for the recovery of resources from saline impaired effluent (brine) generated by process industries — ZERO BRINE” and it was coordinated by TU Delft. had a budget around 11 M euro, and the duration of the project was from June 2017 - April 2021. The project has 4 case studies. The case studies are:

- Case study 1: Evides industry water (Rotterdam Port, the Netherlands)
- Case Study 2: Coal mines effluent (Poland)
- **Case Study 3: Precipitated silica (Spain)**
- Case Study 4: Textiles effluent (Turkey).

The presenter decided to focus on case study number 3. He explained that the main challenge the case study is facing is connected to the filtration step- they cannot expand because they are already producing the maximum amount according to regulations. Within the production site they have two different production lines: the Sodium silicate and the Prec. Silica. He then proceeded to show a graph of the production process.



The presentation ended with an introduction to two discussion statements:

- *Within ZERO BRINE we were able to retrieve critical data from the European Pollutant Release & Transfer Registry (E-PRTR). Expanding the scope of data collection from industrial plants to include e.g., sulphates would be important for identifying key market opportunities e.g. for sodium sulphate products.*
- *How to align the needs for evidence-based policy through data supply from research projects to enable impact generation through policy change?*

Project: Brine Mining

Title: LIFE BRINE-MINING – Demonstration of an advanced technique for eliminating coal mine wastewater (brines) combined with resource recovery

Presenter: Kallirroï Panteleaki (NTUA)



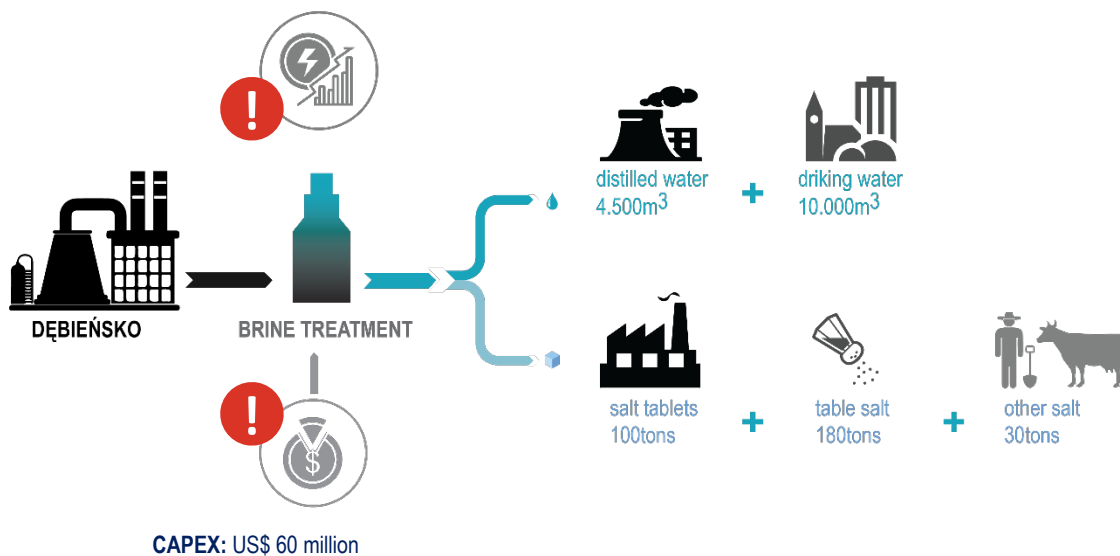
The presentation started with an introduction of basic information about the project. The full name of the project is: “LIFE BRINE-MINING – Demonstration of an advanced technique for eliminating coal mine wastewater (brines) combined with resource recovery” and it is led by NTUA. It has a budget around 6.4 M euro, and the duration of the project is expected to last from September 2019 – June 2024.

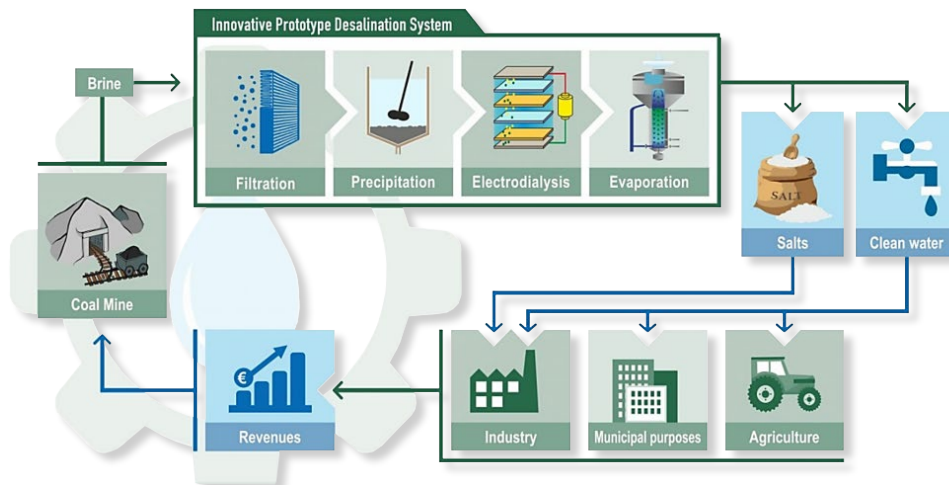
The presenter then moved on to talk about coal production in Poland focussing mainly on the Silesia region (Śląskie). She underlined that the production comes at a high environmental cost for the country as well as for the agriculture and water transport sectors. This is because per year around 182M m³/year of brine discharge is released into the Vistula and Odra rivers, the two largest rivers in Poland. The economic losses for the country amount to approximately €250 M per year.

Dębieńsko Coal Mines were chosen as the case study example for the presentation. This is because it was the **1st plant globally** to apply Zero Liquid Discharge system to treat coal mine brine and to recover salts of high quality. The presenter showed one graph of the original procedure and one showing the changes proposed by the project.

High Energy Consumption

(~713 kWh/t of salt recovered)





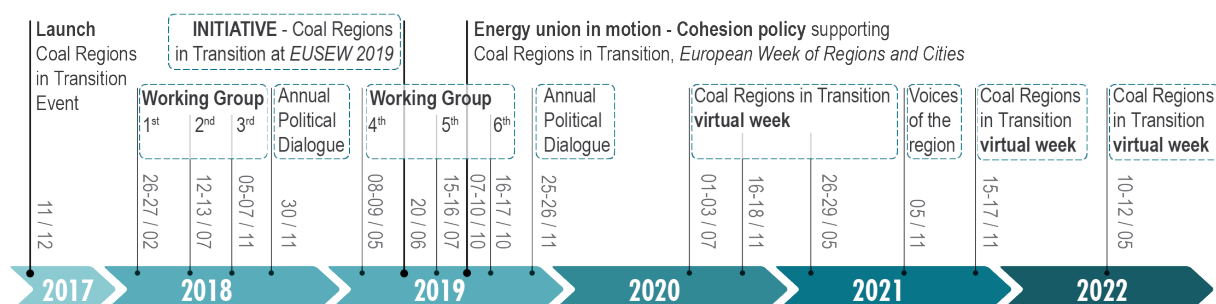
Next the presenter introduced the Circular economy business model tool based on the concept of Wastewater Circular Value.

This tool contributes to the environment by elimination of the coal mine water discharges to surface waters & reduced energy requirements, the society by through the creation of new job opportunities in the coal mine regions, and the economy, through creating additional revenue streams.

The project contributes to the concept of a Water-Smart Society by doing 5 things:

- 1) Elimination of brine and full recovery of resources included in the brine
- 2) Production of end products, which satisfy market specifications
- 3) Implementation of the WFD, IED and CE package
- 4) Creating new jobs, Reskilling & capacity building
- 5) Minimization of solid by-product and subsequent needs of landfilling (target: waste residual <10% of total salt stream recovered).

The presenter mentioned that the 3 main regulations/directives that have an impact on this project include the WATER FRAMEWORK DIRECTIVE, the INDUSTRIAL EMISSIONS DIRECTIVE and the EU GREEN DEAL. She also talked about the role of the Just Transition Fund and gave a role of its implications in Poland.



The presentation ended with an introduction of one discussion statement:

What is the role of Reskilling and Capacity Building within the transition towards the Circular Economy (e.g. coal mine sector)?

Discussion

Andrea Rubini: What is the main challenge with the legislation especially the Industrial Emissions Directive. What should we do to make this directive more water- smart?

Evdokia Achilleos: We need to see what is in the directive and what is in the BREF separately. Now in the revised version of the directive the aspects of water quantity are mentioned. Which is very important. The question is what will go in the BREF.

Dimitris Xevgenos : I think that this has already been identified. We do not have the circularity part within the BREF, climate objectives we also don't have and water objectives we don't have. And now I think it's the time because we have a lot of projects it is significant to get the insights from all these projects to support the BREF development. So, circularity, climate and water should be in the BREF documents. And let's see how the different projects by the way of the different case studies can tackle specific BREF. There are two horizontal BREF and we can learn from, but we do not have BREF for circularity, climate and water objectives.

Gerard van den Berg: what I would like to mention is what I learned from this (Ultimate) and other projects that having clear legislation helps things being developed and implemented from the industry side. So, we need to attract industries and other partners to participate in these projects to make them feel the challenges we want to address, have their contribution to facilitate the business to adopt and invest in the solutions of the projects.

Andrea Rubini: What should we do more to engage the stakeholders but not only at the level of engagement? Should we go well beyond the simple engagement and support the co-creation that can support also new more effective legislation for the water sector?

Dimitris Xevgenos: The CoPs (Communities of Practice) is a tool that we use since some years now, in Zero Prime and now in Water Mining and the others CIRSEAU cluster projects. And I think this is super important because within the CoPs we don't have only the project partners, but we have external parties that bring different expertise but also have clear interest to see the uptake for the commercialisation of the solutions, it is like seeding something and support its growth. CoPs are an opportunity that we are now trying to establish putting different parties with a clear interest to uptake the project results.

Gerard van den Berg: I fully agree that the big challenge with many projects over the years has been to keep the interest alive and to make sure that the knowledge that has been developed stays in place. I fully agree that for example CoP and Living Labs are ways to assure this continuation of projects and scalability of project results.

Solon Mias: the LIFE Programme has been implementing the Green Deal since 1992! On IED we addressed many challenges particularly on air and water sectors, and on the governance. We see that policy makers want to know how an innovation will work before pushing on policy changes, while innovators wishes that policy would changes. Also, investors must come into this picture for the sustainability of innovation. Hence, we need to create a win-win situation where high TRL solutions can be demonstrate for enough time to attract investment to upscale and replicate the result in the real market. It is important to close the loop between innovation policy development and investments.

Concluding observations and takes away

- It is important to creating the bridge between policy development, replication of innovation coming from high TRL projects and investors
- High TRL projects should host in the partnership technology providers to facilitate the market uptake of the solutions.
- It is necessary to strengthen the collaboration and the dialogue between the researchers and the business to mutually understand the different challenges, needs, and expectations to optimise the efforts and foster the market uptake of solutions
- Innovations from R&I projects can highly contribute to the BREF development.
- Community of Practice (CoP) and Water-Oriented Living Labs (WOLs) are excellent tools to support the full cycle from research to innovation to market uptake. Particularly WOLs engage the relevant stakeholders of the quadruple helix and can mobilise the necessary financial resources, foster policy development, and attract investors to scale up solutions for larger deployment. CoPs and WOLs should be extensively used in high TRL R&I projects

RELEVANT EU POLICY, STRATEGIES AND REGULATIONS

CSS Chemicals Strategy for Sustainability COM/2020/667

<https://ec.europa.eu/environment/pdf/chemicals/2020/10/Strategy.pdf>

CEAP Circular Economy Action Plan

<https://op.europa.eu/en/publication-detail/-/publication/6e6be661-6414-11ea-b735-01aa75ed71a1/language-en/format-PDF/source-search>

DWD Drinking Water Directive (EU) 2020/2184

<https://eur-lex.europa.eu/eli/dir/2020/2184/oj>

EQSD Environmental Quality Standards Directive 2013/39/EU

<https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32013L0039>

European Green Deal

<https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1596443911913&uri=CELEX:52019DC0640#document2>

EU Strategy for Adaptation to Climate Change COM/2021/82

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2021:82:FIN>

Flood Risk Management Directive 2007/60/EC

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32007L0060>

GWD Groundwater Directive 2006/118/EC

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02006L0118-20140711>

RWRA Water Reuse Regulation (EU) 2020/741

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020R0741>

IED Industrial Emissions Directive 2010/75/EU

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32010L0075>

Nitrate Directive 91/676/EEC

<https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1561542776070&uri=CELEX:01991L0676-20081211>

RepowerEU

https://eur-lex.europa.eu/resource.html?uri=cellar:fc930f14-d7ae-11ec-a95f-01aa75ed71a1.0001.02/DOC_1&format=PDF

UWWTD Urban Waste Water Treatment Directive 91/271/EEC

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31991L0271>

WFD Water Framework Directive 2000/60/EC

<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060>

ZPAP Zero Pollution Action Plan

https://ec.europa.eu/environment/strategy/zero-pollution-action-plan_en

